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# No relationship between late HIV diagnosis and social deprivation in newly diagnosed patients in France

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## Objectives

The aim of the study was to determine whether there is a relationship between social deprivation and time of HIV diagnosis in France.

## Methods

Prospectively collected data from a multicentre database were used in the study. Patients with a first HIV diagnosis between 1 January 2014 and 31 December 2015 were selected from the database. Deprivation was measured using the European Deprivation Index (EDI), which is an ecological index constructed from the address of residence and based on the smallest geographical census unit, in which individuals are classified so as to be comparable with national quintiles.

Time of diagnosis was classified as being at an early, intermediate, late, or advanced stage of disease. Age, gender, distance from home to HIV centre, most probable route of infection, and hepatitis B or C coinfection were considered in the analysis. Because of a strong interaction between gender and most probable route of infection, we constructed a 'population' variable: men who have sex with men (MSM), heterosexual men and women.

## Results

Of 1421 newly diagnosed patients, 44% were diagnosed either late or at an advanced stage of disease, and 46.3% were in the highest deprivation quintile. Using multivariate logistic regression, 'population' [odds ratio (OR) 0.62 (95% confidence interval (CI) 0.48–0.78) for MSM compared with women] and age [OR 1.39 (95% CI 1.07–1.80), 1.72 (1.32–2.23) and 1.86 (1.40–2.47) for the second, third and fourth quartiles, respectively, compared with the first quartile] were found to be related to late diagnosis. EDI level was not related to late HIV diagnosis.

## Conclusions

'Population' seems to be more relevant than EDI to define evidence-based interventions to limit late diagnosis.

Keywords: age, deprivation, HIV, key population, late diagnosis

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\*See Appendix.

## Introduction

Late diagnosis of HIV infection [1] has consequences both for the individual and for society. The rate of late diagnosis has been estimated in Europe to be around 50%,

depending on the country and exposure group [2]. Educational level has been found to be associated in France with test-seeking behaviours [3], while in Switzerland late presentation for HIV care (which includes late diagnosis and delayed entry to care after testing positive) has been found to be more common in individuals living in neighbourhoods of lower socioeconomic status [4]. Deprivation (defined as the damaging lack of material benefits considered to be basic necessities in a society) can be approached via individual characteristics, but such characteristics are usually not collected routinely in medical records. Based on the patients' residence address, ecological level of deprivation has been used as a proxy for individual social characteristics [5]. Regarding HIV, gaining knowledge of HIV diagnosis conditions in the deprived population could lead to evidence-based policymaking to reduce social disparities.

The objective of our study was to search for a potential association between social deprivation and the time of HIV diagnosis, across a large population of patients newly diagnosed as HIV-positive in 10 HIV reference centres in France.

## Patients and methods

Information was collected from 10 large HIV reference centres in France. These hospitals maintain prospective databases of all HIV-1-infected patients who seek care at the centres and provide written consent. The data collection has been approved by the French National Commission on Informatics and Liberty (CNIL). The databases are implemented via an electronic medical record (EMR) [6]. The EMR collects demographic details and data on clinical events, antiretroviral history, viral load and CD4 T-cell count for patients at regular 3- to 6-month intervals during routine clinical assessment.

For the purposes of this study, we selected all patients with a first HIV-positive diagnosis between 1 January 2014 and 31 December 2015. Individual postal addresses, entered by the physician into the patient's medical file, were used to construct the French European Deprivation Index (EDI) [5]. The geographical units used were consoli-

dated islets for statistical information (CISI), as defined by the National Institute for Statistics and Economic Studies (INSEE), an CISI representing the smallest geographical census unit available in France, including approximately 2000 individuals with relatively homogeneous social characteristics. Patients with no valid address in their medical files were thus excluded. An EDI level was attributed to each patient according to national

approach spatial disparities, the distance (in km) between the patient's home and the closest reference centre for HIV infection was calculated. Time of diagnosis was initially classified as being at an early, intermediate, late or advanced stage of disease [1]. Thus, patients for whom neither a CD4 cell count nor a clinical AIDS-defining event was available within 3 months of diagnosis were also excluded. For the purpose of the analysis, we then classified patients with late and advanced stages of disease as having a late diagnosis, while those with early and intermediate stages of disease were grouped and considered to have a non-late diagnosis; furthermore, as a sensitivity analysis, we considered only patients diagnosed at an advanced stage versus all other categories. The other variables considered in the analysis as potential confounders were age, gender, most probable route of infection, and hepatitis B or C virus coinfection. Because of a strong interaction between gender and the most probable route of infection, we constructed a 'population' variable: men who have sex with men (MSM), heterosexual men and women. Because it was found that some centres serve more deprived populations than others, and may have specific practices or resources dedicated to these populations, centres were classified in three deprivation levels (described in the footnote to Table 2).

Table 1 Patients' characteristics, conditions of HIV diagnosis, and deprivation index

Characteristic		
Gender (male/female) [n (%)]	1098/323	(76.7/22.7)
Age (years) [median (25% IQR)]	37	(29-47)
Distance from home to HIV centre (km) [median (25% IQR)]	6.06	(2.86-20.9)
CD4 count at diagnosis (cells/LL) [median (25% IQR)]	399	(225-598)
'Population' [n (%)]		
MSM (54.6)		776
Heterosexual man	322	(22.8)
Women	323	(22.7)
Hepatitis B or C virus coinfection	91	(6.4)
Diagnosis		
Early*		464
(33) Intermediate†		327
(23) Late‡		267
(19)		
Advanced disease§	363	(25)

EDI (national quintiles) quintiles used to partition the country, 0 corresponding to the least deprived and 4 to the most deprived areas. To

0 (least deprived)	118	(8.3)
1	157	(11.1)
2	179	(12.6)
3	309	(21.7)
4 (most deprived)	658	(46.3)

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\*CD4 count at diagnosis > 500 cells/IL.

†CD4 count at diagnosis 350–500 cells/IL.

‡CD4 count at diagnosis 200–349 cells/IL.

§CD4 count < 200 cells/IL or clinical AIDS at diagnosis.

EDI, European Deprivation Index; IQR, interquartile range; MSM, men who have sex with men.

Categorical variables are described as proportions and compared using  $\chi^2$  tests. Continuous variables are described as medians and the 25% interquartile. Continuous variables were transformed into categorical variables according to quartiles. Univariate analysis compared the patients' characteristics across each class of diagnosis. All variables with  $P < 0.10$  were then included in two multivariate logistic regression models, the first considering late diagnosis, and the second considering only diagnosis at an advanced stage. EDI was forced in both models.

The study was approved by the French Commission on Informatics and Rights (CNIL nDR-2015-559).

## Results

Between January 2014 and December 2015, 1822 patients were newly diagnosed as HIV positive in the participating

centres. Of those, 227 (12.4%) were excluded because either they did not have a valid address in their medical file or the provided address was not recognized by the encoding system. These excluded patients did not differ from the studied population regarding their age, gender, most probable route of infection, CD4 cell count at diagnosis, or timing of diagnosis. Furthermore, we excluded 174 patients (9.5%) because of a missing CD4 cell count at the time of diagnosis. They did not differ from the studied population regarding their characteristics, except for deprivation, with 62% of them in the highest deprivation quintile. Finally, 1421 patients (78.1%) were included in the analysis. Table 1 shows the main characteristics of the population. Deprivation was frequent by comparison with the national quintiles, 46.3% of the patients being in the highest deprivation quintile, while  $< 10\%$  were in the lowest deprivation quintile. Deprivation was more

Table 2 Associations of individual characteristics with the timing of HIV diagnosis

Univariate analysis						Multivariate 1*		Multivariate 2*	
	Early <sup>‡</sup>	Intermediate <sup>§</sup>	Late <sup>¶</sup>	Advanced <sup>††</sup>	P	OR	95% CI	OR	95% CI
"Population"									
MSM	300 (38.7)	213 (27.4)	129 (16.6)	134 (17.3)	<0.0001	0.62	0.48-0.78	0.48	0.38-0.63
Heterosexual men	75 (23.1)	52 (16.1)	69 (21.3)	128 (39.5)		1.17	0.86-1.58	1.29	0.97-1.72
Women	89 (27.6)	63 (19.5)	70 (21.7)	101 (39.8)		Ref.			
Ref. Hepatitis B/C									
No	443 (33.3)	313 (23.5)	249 (18.8)	325 (24.4)	0.001	Ref.		Ref.	
Yes	21 (23.1)	14 (15.4)	18 (19.8)	38 (41.7)		1.29	0.85-2.03	1.59	1.08-2.33
Age <sup>†</sup>									
≤29 years	152 (42.5)	96 (26.8)	62 (17.3)	48 (13.4)	<0.0001	Ref.		Ref.	
30-37 years	123 (34)	83 (22.9)	68 (18.8)	88 (24.3)		1.39	1.07-1.80	2.01	1.45-2.82
38-47 years	106 (28.4)	81 (21.7)	79 (21.2)	107 (28.7)		1.72	1.32-2.23	2.35	1.70-3.27
>47 years	83 (25.3)	67 (20.4)	58 (17.7)	120 (36.6)		1.86	1.40-2.47	2.94	2.12-4.11
EDI quintile									
0	35 (29.7)	28 (23.7)	21 (17.8)	34 (28.8)	0.69	Ref.		Ref.	
1	55 (35)	34 (21.7)	38 (24.2)	30 (19.1)		0.84	0.54-1.31	0.66	0.40-1.08
2	60 (33.5)	43 (24)	33 (18.5)	43 (24)		0.94	0.61-1.45	0.96	0.60-1.52
3	91 (29.5)	74 (23.9)	57 (18.5)	87 (28.1)		1.09	0.73-1.62	1.11	0.74-1.68
4	223 (33.9)	148 (22.5)	118 (17.9)	169 (25.7)		0.82	0.56-1.18	0.85	0.58-1.25
Distance to centre <sup>†</sup>									
<2.86 km	115 (32.7)	85 (24.1)	65 (18.5)	87 (24.7)	0.12				
2.86-6.06 km	114 (32.4)	74 (21.0)	60 (17.1)	104 (29.5)					
6.07-20.9 km	111 (31.6)	98 (27.8)	70 (19.9)	73 (20.7)					
>20.9 km	118 (33.5)	67 (19.0)	70 (19.9)	97 (27.6)					
Deprivation at the centre level <sup>**</sup>									
1	99 (31.2)	73 (23.0)	56 (17.7)	89 (28.1)	0.50				
2	213 (32.8)	139 (21.4)	134 (20.6)	163 (25.2)					
3	152 (33.4)	115 (25.3)	77 (16.9)	111 (24.4)					

Values are n (%).

CI, confidence interval; EDI, European Deprivation Index; MSM, men who have sex with men; OR, odds ratio.

\*Those with late and advanced disease were considered to have a late HIV diagnosis, and those with early and intermediate disease were considered to have a non-late HIV diagnosis for model 1, and categories were advanced versus other for model 2.

<sup>†</sup>In classes according to quartiles.

<sup>‡</sup>CD4 count at diagnosis  $> 500$  cells/IL.

<sup>§</sup>CD4 count at diagnosis 350–500 cells/IL.

<sup>¶</sup>CD4 count at diagnosis 200–349 cells/IL.

<sup>††</sup>CD4 count  $< 200$  cells/IL or clinical AIDS at diagnosis.

<sup>\*\*</sup>1, providing care for the least deprived population (Toulouse and Nantes); 2, providing care for the population with intermediate deprivation (Montpellier, Reims, Nice, Marseille, Lyon and St Etienne); 3, providing care for the most deprived population (north Paris and Tourcoing).

frequent in two study centres: 65.8% of patients from the north Paris area were extremely deprived, as were 58.8% of patients from the north of France (Table S1).

In the univariate analysis, individual characteristics related to late diagnosis were ‘population’, most probable route of infection, hepatitis coinfections and age. Deprivation quintile was not related to the time of diagnosis, nor was deprivation at the centre level. Using multivariate logistic regression, ‘population’ and age were the only variables related to late diagnosis, while having hepatitis B or C virus coinfection was also associated with diagnosis at an advanced stage (Table 2). As deprivation was found to be less frequent in MSM than in women or heterosexual men, we stratified the analysis by ‘population’ class, but we did not find any relationship between deprivation and late diagnosis (Table S2). We did find a relationship between the distance from the patient’s home to the closest reference centre for HIV infection and deprivation category, with patients who were more deprived living nearer to the centre than those who were less deprived. We thus tested the interaction between distance and deprivation as a characteristic related to time of diagnosis, but it was not significant.

## Discussion

In a large prospective French study, it was shown that being on welfare benefits before diagnosis was associated with a lower risk of late diagnosis [7]. The EDI provides a more detailed representation of social disparities. Our study population was found to be significantly deprived, 46.3% being in the worst category. We did not find any association between deprivation and HIV diagnosis timing. We hypothesized that social deprivation could be related to late HIV diagnosis in either of two ways. On the one hand, people living in very deprived areas are more likely to benefit from social welfare and to be supported in health-seeking initiatives. Furthermore, in France, having a severe disease is associated with some social benefits, such as full coverage of medical expenses and the provision of legal status for migrants, and so having a complete health check-up is important for some patients. On the other hand, being deprived can lead to basic needs being prioritized, and medical needs may be neglected. However, our results do not support this latter hypothesis. This emphasizes the effectiveness of national social support.

Although our study population had the advantage of being large and representative of patients newly diagnosed in France [8], the study had some limitations. First, the EDI could not be attributed to homeless people. Many French homeless people can use a postal address, usually that of a nongovernmental organization. These addresses

were used for the EDI. As they are usually located in deprived parts of cities, this may not have biased our results. As already stated, we excluded patients we could not classify as having a late or non-late diagnosis because of missing values. This excluded population was found to be even more deprived than the studied population. Mainly they were patients who were seen only once at the medical centre, and then were lost to follow-up. Although an HIV diagnosis is necessary for access to HIV care, it is of little use if it does not lead to actual engagement in care. This excluded population may have led to a differential bias, which could have lessened the impact of deprivation on time of diagnosis. Furthermore, we studied only patients with proven HIV infection, and thus we cannot draw any conclusions about HIV test seeking. In the Paris metropolitan area, it has been shown that poor socioeconomic status is related to no lifetime HIV test, with huge disparities between neighbourhoods of residence [3]. Finally, place of birth and migration history were not collected in the databases for legal reasons, so we could not take into account the geographical origin of the patients as a confounding factor in the relationship between late diagnosis and deprivation.

In conclusion, we could not find any relationship between deprivation, assessed by the EDI, and late HIV diagnosis in France in recent years. This may be a consequence of the efficiency of the French welfare system or the limitations of deprivation indexes in capturing the most underprivileged and/or underserved areas. Thus, “population” seems to be more relevant than the EDI to define evidence-based interventions.

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## Author contributions

L. Cuzin and CD designed the study. L. Cuzin performed the analysis and wrote the first version of the manuscript. PP performed the data management. YY, TH, L. Cotte, CA, JR, IPM and FBS were responsible for data collection and quality in their centre. All authors reviewed and approved the final version of the manuscript.

## Appendix: The Dat’AIDS Study Group

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