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Low income and outcome in idiopathic pulmonary fibrosis: an association to uncover

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Abstract:

Background: Low income, a known prognostic indicator of various chronic respiratory diseases, has not been properly studied in idiopathic pulmonary fibrosis (IPF). We hypothesize that a low income has an adverse prognostic impact on IPF.

Methods: Patients were selected from the French national prospective cohort COFI. Patients' income was assessed through the median city-level income provided by the French National Institute of Statistics and Economic Studies according to their residential address. Patients were classified in two groups as "low income" vs. "higher income" depending on whether their annual income was estimated to be < or ≥ 18 170 €/year (the first quartile of the income distribution in the study population). The survival and progression-free survival (PFS) of the groups were compared by a log-rank test and a Cox model in multivariate analysis.

Results: 200 patients were included. The average follow-up was 33.8±22.7 months. Patients in the low income group were significantly more likely to be of non-European origin (p<0.006), and to have at least one occupational exposure (p<0.0001), and they tended to have a higher cumulative exposure to fine particles $PM_{2.5}$ (p=0.057). After adjusting for age, gender, forced vital capacity at inclusion, geographical origin, and occupational exposure having a low-income level was a factor associated with a worse PFS (HR: 1.81; $CI_{95\%}$: 1.24 - 2.62, p=0.001) and overall survival (HR: 1.49; $CI_{95\%}$: 1.0006 - 2.23, p=0.049).

Conclusions: Low income appears to be a prognostic factor in IPF. IPF patients with low incomes may also be exposed more frequently to occupational exposures.

Abstract word count: 250 words

Background:

Socioeconomic status (SES) is an important health determinant. SES is an individual economic and sociological standing indicator that combines income, education and occupation. Health disparities, defined as a significant difference in health between populations, are common for diseases of the

respiratory system, and socioeconomic background is considered one of the major causes of these disparities[1]. While many epidemiological studies have demonstrated a substantial impact of SES on the severity of chronic lung diseases such as chronic obstructive pulmonary disease (COPD), asthma and lung cancer[2],[3],[4], little data is available for interstitial lung diseases (ILDs) except for sarcoidosis [5]. Idiopathic pulmonary fibrosis (IPF) is one of the most frequent and severe ILDs, with a gradual deterioration of respiratory function, a median survival of 3 to 5 years, and few therapeutic options. Its natural history and physiopathology are yet to be elucidated[6]. Although of unknown cause, IPF is believed to be due to repeated alveolar injury on a senescent lung, in response to aero-contaminants, followed by an aberrant repair. Genetic factors are associated to sporadic and family IPF[6]. Moreover, several exposures are associated with an increased risk of IPF: tobacco smoke, occupational exposures (wood or metal dust, crystalline silica, agricultural environment/farming activities, asbestos) and air pollution[7].

Available data on the role of socioeconomic factors are exceedingly rare in IPF. A study conducted in the United States (US) on lung transplant IPF candidates showed an increased mortality in “Black” and “Hispanic” compared to “White” and “Asian” patients, whether or not they were listed, probably because of more disadvantaged SES[8]. From a US database of hospitalized patients, Gaffney et al. suggested that IPF patients with lower income or poorer insurance coverage had reduced access to transplantation, rehabilitation and lung biopsy, but no difference in hospital mortality[9]. However, data from registries have significant limitations, including measurement biases and risk of diagnosis misclassification. Moreover, no such study has been carried out so far in Europe.

We hypothesize that a low SES may have an impact on IPF prognosis. For that purpose, we conducted an ancillary study including patients from a national prospective cohort of incident patients with well-characterized IPF, named COFI (“COhorte FIbrose”), and we used median city incomes from the French National Institute of Statistics and Economic Studies (INSEE). The main objective of the study was to determine the role of income on IPF survival. The secondary objective

148 was to evaluate the relationship between income and IPF severity, occupational exposure and air
149 pollution.
150

151 **Patients and methods:**

152 For our study we selected patients from COFI, a multicentre prospective cohort involving the 24
153 respiratory departments from all University Hospitals in France. The enrolment period extended
154 from 2007 to 2010, with a 5-year follow-up. The study was approved by the ethics committee
155 (Comité de Protection des Personnes Ile-de-France) and by the French data protection authority
156 (CNIL: 908198).

157 ***COFI study design***

158 Patients were included provided they fulfilled the 2000 ATS/ERS consensus criteria for IPF, which
159 were slightly amended. First, basal and subpleural honeycombing on high resolution computed
160 tomography (HRCT) was required for patients not submitted to surgical lung biopsy (SLB), in keeping
161 with the definition of usual interstitial pneumonia (UIP) pattern of the 2011[10] and 2018[11]
162 updated consensus for IPF diagnosis. Second, SLB was mandatory for patients under 50 years of age.
163 Only incident cases with a diagnosis ≤ 9 months were eligible. IPF diagnosis was prospectively
164 adjudicated for each case by a centralized expert board involving several pulmonologists, a
165 radiologist and a pathologist during monthly multidisciplinary meetings. Data were collected in an
166 electronic Case Report Form (eCRF). At inclusion, demographics, smoking status, clinical information,
167 including history of comorbidities, pulmonary function tests (PFTs), and six-minute walk test (6MWT)
168 were detailed. After inclusion, patients were monitored every 3 months with spirometry, and
169 diffusing capacity for carbon monoxide (DLCO). At each visit, investigators reported every health
170 problem, including hospitalization or acute exacerbation (AE), as defined by Akira et al.[12]. Vital
171 status at 5-year follow-up and the causes of death, when applicable, were recorded. Gender Age
172 Physiology (GAP) staging was based on Ley et al.[13] and the *composite physiologic index* (CPI) was
173 calculated according to Wells et al.[14].

174 Three hundred and nine patients were recruited in COFI, 64 of whom were excluded (not
175 UIP pattern on HRCT: n=39, not UIP on SLB: n=2, recognized cause of ILD: n=13, bronchoalveolar
176 lavage (BAL) not available: n=3, BAL lymphocytes > 30%: n=5, and disease duration > 9 months: n=2).

177 ***Study population***

178 All patients enlisted in COFI were eligible, provided that their residential address was informed and
179 median city level income was available from the INSEE database. Of the 245 patients included in
180 COFI, 25 patients had no residential address in the database, 11 patients lived in small towns with no
181 available income data for such areas, and 9 patients who withdrew their consent were excluded. In
182 total, 200 patients were selected for the current study (Figure 1).

183 ***Socioeconomic status***

184 Since there was no specific socioeconomic data collected in COFI, the income of each patient was
185 estimated using the median city-level income per consumption unit (CU) provided by the INSEE[15].
186 For the biggest cities the median income per borough was available. INSEE estimates a city-based
187 median annual income per CU throughout the national territory on the basis of individual tax
188 declaration. Income per CU is a weighting system assigning a coefficient to each member of the
189 household using an equivalence scale (1 CU for the first adult in the household, 0.5 CU for each other
190 person aged 14 years or more, 0.3 CU for each child under 14 years). In France, data are not provided
191 for municipalities with less than 100 inhabitants for reasons of personal data protection and
192 statistical secrecy. In our study, incomes were imputed to patients according to their residential
193 address. We used the latest (2014) available data from INSEE [15]. The population was divided into
194 two groups depending on city-level incomes: "low income", when values were within the first
195 quartile of the study population, under 18 170€ euros per year *versus* the remainder in the "higher
196 income" group. Along with INSEE data, we obtained the price per square meter of the patients'
197 residential address from notarial registries (i.e. official sale property prices as registered by the
198 state)[16]. Prices from 2018 sales were taken into account as they were the only available.

199 ***Environmental exposures***

200 Assuming that SES could have a prognostic impact *via* higher level of exposures, we looked at
201 occupational exposures and air pollution. Some patients included in COFI cohort had a job exposure
202 assessment by an occupational health physician. The COFI investigators were asked to fill a box in the
203 eCRF regarding patients' exposures to asbestos, crystalline silica, wood, organic, livestock, and metal
204 dust. However, hypersensitivity pneumonitis or pneumoconiosis were excluded by the COFI expert
205 board. As previously described, air pollutant levels obtained from the air quality monitoring station
206 closest to the patient's residential address were assigned to each patient[17]. Cumulative exposure
207 to each pollutant was expressed as the average concentration of the pollutant during the exposure
208 period, which was defined as the entire period from inclusion to the date of disease progression or
209 the end of the study.

210 **Statistical analysis:**

211 Results are expressed as percentages or mean ± SD. Percentages and means in the "low income" and
212 "higher income" groups were compared using a Chi-squared test and ANOVA, as appropriate. We
213 evaluated the association of income with both overall survival and progression free survival (PFS).
214 Overall survival was defined as the time from the date of inclusion to death or transplantation. PFS
215 was defined as the time from the date of inclusion to the first occurrence of one of the following
216 events: (i) absolute decrease in forced vital capacity (FVC) > 10% of predicted value (pred) or
217 absolute decrease in DLCO > 15%pred compared to baseline values, after exclusion of other causes
218 of worsening, (ii) AE, (iii) transplantation, or (iv) death. The survival probability of "low income" and
219 "higher income" groups was estimated using the Kaplan-Meier method and compared by a log-rank
220 test. A Cox proportional hazards model was used for studying the survival after adjustment for
221 potential confounders. Key IPF outcome variables known to be strongly associated with IPF mortality
222 in the literature, including age, sex and FVC at inclusion were chosen as adjustment parameters for
223 the Cox model. In order to precise the relative contribution of low income compared to geographical
224 origin and occupational exposure, these parameters were also integrated in the model. Results of the
225 Cox model are reported as hazard ratio (HR) and 95% confidence interval. Data were analysed in R

software V3.0.1 and $p<0.05$ was considered significant.

Results:

Socioeconomic characteristics of IPF patients

Among the 200 IPF patients included, 154 (77%) were men, aged 68±11 years. The SES of IPF patients compared with the general population is presented in Table 1. The distribution of income in our IPF cohort was generally comparable to that in the French population. Conversely, the distribution of IPF patients' geographical ancestry was significantly different, with a low proportion of patients having European origin (77% *vs* 95%, $p<0.001$) (Table 1). As expected, the IPF patients' city-level income was strongly correlated to the property square meter price ($r=0.7$, $p<0.001$).

Comparison of characteristics at inclusion between "low income" and "higher income" groups

The findings are summarized in Table 2. "Low income" patients were more likely to be from a non-European origin (42% *vs* 17%, $p<0.006$), and to live in a cheaper residential area (2 337± 837€.m^2 *vs* 4 255 ± 3107€/m^2, $p<0.001$), whereas no differences were found between groups in terms of age, sex, cigarette smoking, or comorbidities (Table 2). With respect to disease severity, "low income" patients were more dyspnoeic ($p=0.049$), with a shorter distance on 6MWT at inclusion (74.1 % ± 18.3% *vs* 81.5% ± 21.8% $p= 0.021$), whereas functional impairment, GAP stages and CPI were similar between the two groups.

Comparison of outcomes between "low income" and "higher income" groups

The mean duration of follow-up was 33.8 ± 22.7 months. At the end of the study, 6 (3%) patients had been lost to follow-up, 32 (16%) had experienced an AE, 17 (9%) had been transplanted, and 120 (60%) had died. The large majority of deaths resulted from respiratory cause (n=94, 78%), including fibrosis progression (n=33), AE (n=26), pulmonary hypertension (n=5), lung cancer (n=7), pulmonary embolism (n=2), respiratory infection (n=16), and acute respiratory distress syndrome (n=5). The proportion of AE, hospitalization, lung transplantation and deaths were equivalent in both income groups. The median PFS was 15.6 months ($CI_{95\%}$: 13.0-20.4) for the entire cohort. In the "low income" group, the median PFS was significantly worse (11.6 months ($CI_{95\%}$: 6.9-21.1) *vs* 16.0 months ($CI_{95\%}$:

13.1-23.8), p=0.038). Low incomes remained an independent risk factor of poor PFS after a multivariate analysis adjusted for age, sex and FVC (% predicted) at inclusion, geographical origin and occupational exposure with an HR of 1.81 ($CI_{95\%}$: 1.24-2.62, p=0.001) (Figure 2) (Table 3). Considering survival, the median survival in the "low income" group was lower than "higher income" group, but the difference did not reach the level of significance (22.4 months ($CI_{95\%}$: 19.7- 40.2) *vs* 36.7 months ($CI_{95\%}$: 31.5-42.5, p=0.3). Nevertheless, on multivariate analysis adjusted for age, sex and FVC (% predicted) at inclusion, geographical origin and occupational exposure, low incomes were associated with an increased overall mortality (HR: 1.49; $CI_{95\%}$: 1.0006 - 2.23, p=0.049) (Table 3).

Comparison of exposures between "low income" and "higher income" groups

Nineteen patients had a job exposure assessment by an occupational health physician confirming at least one exposure among: asbestos (n=15), crystalline silica (n=1), wood dust (n=5), organic dust (n=1), and metal dust (n=8). In 34 additional patients, one or more exposures were reported by the investigator, yet without being based on a specialized evaluation (asbestos (n=15), silica (n=3), wood dust (n=1), organic dust (n=11), metal dust (n=13), and livestock exposure (n=6)) (Figure 3). Because of the small number of patients, the analyses combined all exposures. Patients in the "low income" group were more likely than those with higher income to have been exposed at least to one occupational pollutant (46% *vs* 20%, p<0.0001). With regard to the cumulative exposure to air pollution during follow-up, the "low income" group was more frequently exposed to fine particles matter ($(PM)_{2.5}$), the difference being almost significant (20.4 ± 3.62 *vs* 19.0±2.26 µg/m^3, p=0.057).

Discussion:

As far as we know, for the first time in IPF patients our study highlights that low income (i.e. estimated < 18 170€ per year) is related to poorer PFS and overall survival, even after adjusting for ~~other prognostic factors, including~~ age, sex and FVC, geographical origin, and occupational exposure. In addition, patients having low income are more frequently exposed to toxic inorganic particles in occupational settings and tend to have higher long-term $PM_{2.5}$ exposure.

Our results in IPF are consistent with the literature. In a recent American epidemiological study, the difference in life expectancy between the richest and poorest people was 14.6 years for men and 10.1 years for women[18]. Such inequalities are also present across Europe [19],[20]. COPD patients of the lowest socioeconomic stratum are at least twice as likely to have poor outcomes as those of the highest one[2]. In addition, beyond the effects of current smoking, income disparity is a strong predictor of disease progression in COPD[21]. Similarly, a worse survival is observed for patients with lung cancer and low income[22]. So far, only few studies have assessed the role of SES in ILDs. Gaffney et al. analysed a database consisting of all hospitalizations from a 20% sample of US hospitals and failed to find any association between insurance status or low income and death. However, the studied sample only represented hospitalizations, which could bias the results, since disadvantaged patients may be less likely to be admitted to hospitals that offer better quality of care. Moreover, IPF diagnosis was based on ICD-9 coding, with potential misclassification. Last, the model used in-hospital mortality. In our study, ~~we may hypothesize that~~ the effect of low income on overall survival, the most meaningful endpoint in IPF[23], was ~~not significant probably because of lack of statistical power~~ observed only in multivariate analysis. The impact of income was more pronounced in PFS, which for some authors is a relevant surrogate that takes into account several events related to the IPF natural history [24].

There are several possible explanations for our findings on the impact of SES on IPF PFS. First, having low income may inhibit the access to medical care, contributing to disease severity and mortality. There is a large body of evidence in the literature supporting the existence of a negative correlation between SES and lung function in the general population[25],[26]. In IPF, Lamas et al. suggested that delayed access to a tertiary care center was associated with a higher mortality, but surprisingly, this was independent from lung function, education attainment, or insurance coverage[27]. In the study by Gaffney et al., there was no information on lung function, but hospitalized IPF patients with low SES, Medicaid coverage and without insurance were less likely to receive several clinical interventions, including transplantation. A prospective cohort of sarcoidosis,

305 another fibrotic ILD, showed that low income and other barriers to healthcare access, including the
306 absence of private or Medicare health insurance, were associated with respiratory severity at
307 presentation[28]. In our study, IPF patients with low income tended to have a more severely
308 impaired lung function, worse dyspnoea and reduced 6MWT distance at inclusion, which may reflect
309 a potential delay in their diagnosis. Conversely, the proportion of transplanted patients was not
310 different according to income.

311 Second, the levels and types of exposure to air and occupational pollutants are strongly
312 linked to the SES[1]. In a previous publication, our group has raised the possibility of an association
313 between mortality and cumulative exposure to PM_{10} and $PM_{2.5}$ in IPF[17]. Similarly, IPF patients
314 exposed at the workplace have a worse prognosis than non-exposed[29]. Accordingly, our patients
315 with low income were more frequently exposed to occupational pollutants. They could could also be
316 submitted to higher air pollution levels, with a nearly significant over-exposure to $PM_{2.5}$.

317 Third, SES and education are intertwined, and inadequate education about preventive
318 measures regarding health habits, comorbidities or IPF itself (e.g. vaccinations, smoking cessation,
319 control of cardiovascular risk factors) may have promoted disease progression. Yet, even though
320 these indicators were not explored in our study, the causes of death were similar between patients
321 with low or higher income, which does not fully support this hypothesis.

322 The evaluation of SES is complex because it is multidimensional and changes over time, but
323 income has been established to be the best socioeconomic marker of health disparities[1]. Given the
324 absence of individual income in COFI, we applied the method of area-based *income estimates*[8]. We
325 decided to define the first quartile of income as our group of interest, because 18 170€/year (1
326 514€/month) corresponds approximately to the gross minimum wage in France, which makes our
327 results expressive. As expected, city-level incomes were strongly correlated with real estate sale
328 prices in IPF patients. Moreover, the associations highlighted in our study between level of income,
329 geographical origin and occupational exposure are in line with previous reports on respiratory health
330 status[1].

This study has several strengths. It is the first to deal with SES in a well-characterized IPF population of incident cases. COFI is indeed a well-designed prospective cohort, with a long follow-up. Its multicentre nature throughout France ensures a representative sample of IPF population in terms of SES and environmental contexts. The study also has several limitations. First of all, city-based imputations of income are less precise than individual measurements. However, this method has been used and validated in the literature [30][31][32]. Patient's health insurance status is an important socioeconomic factor that could not be evaluated in our study. On the other hand, given that the low-income group had worse NYHA and 6MWT at baseline, a lead-time bias in IPF diagnosis between groups may exist. Unfortunately, the time lag between the first symptoms and the diagnosis was not recorded in the cohort database. There was no systematic comprehensive evaluation of patients' occupational exposure, which was left to the investigator's judgement. Some potentially relevant exposures may therefore have been missed. Last, the level of education, another important socioeconomic factor, was not collected in COFI. Patients included in cohorts have often achieved sufficient education to understand an informed consent and accept its terms, leading to potential selection biases.

Conclusion:

As for other chronic respiratory diseases, the income appears to be a prognostic factor of PFS in IPF. Further studies using individual data on income and a holistic approach including SES, environmental and occupational exposures are required. In order to improve comparability between nations and across different levels of aggregation, a common definition for SES measurement would also be highly fruitful.

Data sharing: The data are available on request

Guarantor statement: LS takes responsibility for the content of the manuscript, including the data and analysis.

356 **Author contributions:** DV was the scientific leader of the COFI cohort. All authors and COFI
357 collaborators contributed to the data collection. HN conceived and planned the study. LS performed
358 the statistical analyses. LS, HN, DV, CC, IAM wrote the manuscript. All authors read the manuscript,

359

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Legend of figures

Figure 1: Study flow chart

Figure 2: Progression-free survival of IPF patients with low income *versus* higher income levels *

* Survival was calculated from the time of inclusion to physiologic progression, occurrence of acute exacerbation, lung transplantation, or death. Survival was adjusted for age, sex and forced vital capacity at inclusion (% of predicted value)

Figure 3: Occupational and environmental exposure assessment in IPF patients from the COFI cohort

* Prior to inclusion in COFI cohort some patients had an occupational health physician consultation.
¶ The diagnosis of IPF was adjudicated during an expert multidisciplinary discussion in all patients included in COFI cohort. For those patients with an exposure, the diagnosis of hypersensitivity pneumonitis or pneumoconiosis was excluded by the expert panel based on clinical grounds, the results of precipitins, bronchoalveolar lavage and/or surgical lung biopsy.

Table 1: Socioeconomic characteristics of the French population and the study population of IPF patients

Abbreviations: IPF: idiopathic pulmonary fibrosis; NA : not available.
*: provided by the French national institute for statistics and economic studies; †: provided by notarial registries; § : each patient could be exposed to several types of exposure.

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Socioeconomic variables	Study population n=200	Mainland France * n= 67,0 M	p value
Geographic origin: n (%)			
Europe	154 (77%)	95.0%	**<0.001**
Africa	38 (19%)	4.3%	**<0.001**
Asia	8(4%)	1.4%	**<0.004**
America, oceania	0(0%)	0.6	
Real estate sale price (€/m²) †		NA	
Minimal	830		
First quartile	1790		
Median	2760		
Third quartile	4850		
Maximal	10 870		
City-level annual income (€/year)			0.0615
Minimal	13 060	9 960	
First quartile	18 170	18 400	
Median	20 520	20 050	
Third quartile	23 800	22 270	
Maximal	42 770	45 900	
Exposures: n (%)	n=200	NA	
At least one exposure	53 (27%)		
Types of exposure	n=78 exposures in 53 patients§		
Crystalline silica	4 (5%)		
Asbestos	30 (38%)		
Wood dust	6 (8%)		
Organic exposure	11(14%)		
Metal dust	21 (27%)		
Livestock	6 (8%)		

	Higher income (>18170€/year)	Low income (< 18170€/year)	p value
	n=150	n=50	
Age (years): mean ± SD	68.2 ± 11.30	67.4 ± 8.48	0.592
Males: n (%)	115 (77%)	39 (78%)	1.000
BMI mean ± SD	27.6 ± 4.2	27.9±5.1	0.678
Smokers: n (%)			0.730
Current	10 (7%)	5 (10%)	
Former	94 (63%)	30 (60%)	
Never	46 (31%)	15 (30%)	
Geographical origin: n (%)			0.001
Non-European	25 (17%)	21 (42%)	
European	125 (83%)	29 (58%)	
At least one occupational exposure: n (%)	30 (20.0%)	23 (46.0%)	0.001
Cumulative air pollution exposure (µg/m³) : mean ± SD			
PM_{10}	25.9 ± 3.58	26.2 ± 3.11	0.619
$PM_{2,5}$	19.0 ± 2.96	20.4 ± 3.62	0.057
O_3	42.0 ± 7.72	40.8 ± 9.48	0.403
NO_2	30.7 ± 9.60	31.5 ± 8.11	0.592
Real estate sale price (€/m²): mean ± SD	4 255 ± 310	2 337 ± 837	<0.001
Comorbidities: n (%) †			
GER	40 (27%)	16 (32%)	0.585
Cardiovascular comorbidities	53 (35%)	19(44%)	0.863
Arterial hypertension	69 (46%)	22 (44%)	0.935
Diabetes	35 (23%)	8 (16%)	0.371
Neoplastic history	22 (15%)	7 (14%)	1.000
Sleep apnoea	22 (15%)	7 (14%)	1.000
NYHA functional class at inclusion: n (%)			0.049
I	24 (16%)	2 (4%)	
II	88 (59%)	35 (70%)	
III	35 (23%)	10 (20%)	
IV	3 (2%)	3 (6%)	
6MWT at inclusion			
Distance (% predicted): mean ± SD	81.5 ± 21.8	74.1 ± 18.3	0.021
Desaturation < 88%: n (%)	73(53%)	21(51%)	0.991
PFTs at inclusion			
TLC (ml): mean ± SD	4219 ± 1173	4153 ± 1141	0.725
TLC (% predicted): mean ± SD	68.3 (15 %)	69.2 (17%)	0.735
FVC (ml): mean ± SD	2591 ± 838	2444 ± 765	0.254
FVC (% predicted): mean ± SD	76.4 ± 19.6	74.1 ± 19.6	0.467
FVC < 50 % predicted: n (%)	13 (9%)	4 (8%)	1.000
FEV1 (ml): mean ± SD	2138 ± 671	2074 ± 621	0.548
FEV1 (% predicted): mean ± SD	81.1 (22%)	80.3 (20%)	0.813
DLCO (% predicted): mean ± SD	46.8 ± 16.3	46.6 ± 16.5	0.966
DLCO < 30 % predicted: n (%)	21 (14%)	7 (14%)	1.000
CPI: mean ± SD	48.3 ± 13.7	50.5 ± 15.6	0.372
GAP stage at inclusion: n (%)			0.561
I	61 (41%)	19 (38%)	
II	71 (47%)	22 (44%)	

III	18 (12%)	9 (18%)	
Treatment at inclusion: n (%)			
Immunosuppressive treatment	29 (19%)	9 (18%)	1.000
Corticosteroids treatment	48 (32%)	18 (36%)	0.728
Antifibrotic treatment	0 (0%)	0 (0%)	1.000
Follow-up			
Duration of follow-up (in months): mean ± SD	34.8 ±21.6	31.0 ± 25.9	0.309
Hospitalizations (nb of days?): mean ± SD	1.28 ± 1.80	1.36 ± 2.00	0.802
AE (nb of events?): n (%)	24 (16%)	8 (16%)	1.000
Death: n (%)			
Any cause	88 (59%)	32 (64%)	0.617
Respiratory cause	68 (45%)	26 (52%)	0.513
Transplantation: n (%)	13 (9%)	9(8%)	1.000

Table 2: Characteristics of IPF patients according to city-based annual income

Abbreviations: IPF: idiopathic pulmonary fibrosis; BMI: body mass index; GER: gastro-oesophageal reflux; 6MWT: six-minute walk test; PFTs: pulmonary function tests; TLC: total lung capacity; FVC: forced vital capacity; FEV1: forced expiratory volume in one second; DLCO: diffusing capacity of the lung for carbon monoxide; CPI: composite physiologic index; GAP: gender, age, and physiologic; AE: acute exacerbation.

* Provided by the French national institute for statistics and economic studies; † Cardiovascular comorbidities include coronary artery disease, myocardial infarction, atrioventricular block, heart failure, arteritis of the lower limbs or aortic aneurysm, cerebrovascular accident, atrial fibrillation or flutter.

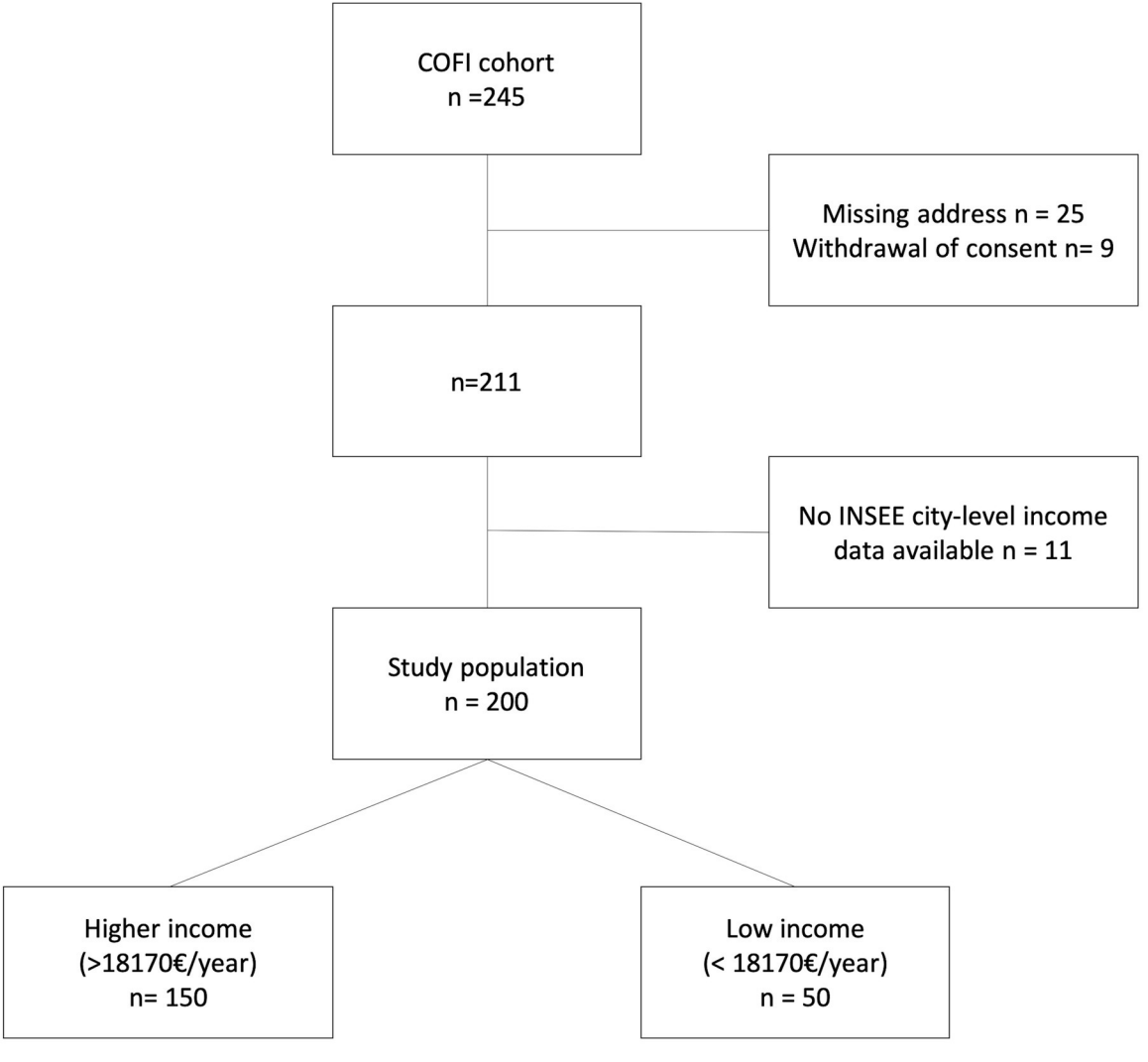
Table 3: Multivariate Cox model analyzing the relative contribution of income on survival of IPF patients

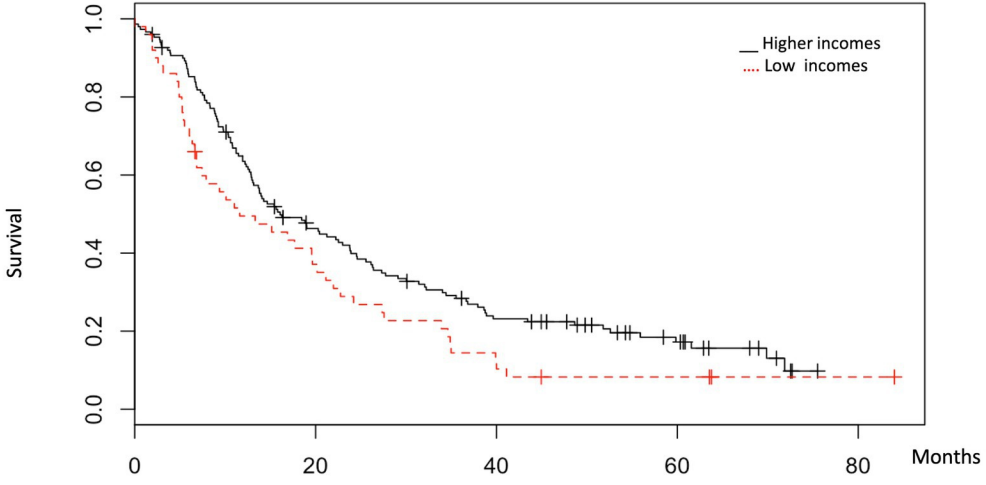
	Progression free survival		Overall survival	
	HR (CI95%)	p-value	HR (CI95%)	p-value
Low income	1.81 (1.24 - 2.62)	**0.002**	1.49 (1.0006 - 2.23)	**0.049**
Age	1.01 (0.91 - 1.02)	0.401	1.01 (0.99-1.03)	0.137
Males	0.93 (0.64 - 1.33)	0.677	0.75 (0.49 - 1.13)	0.170
FVC at inclusion	0.98 (0.97 - 0.98)	**< 0.001**	0.97 (0.95 - 0.97)	**< 0.001**
European origin	1.95 (1.28 - 2.95)	**0.001**	2.29 (1.43 - 3.65)	**< 0.001**
Occupational exposure*	1.02 (0.71 – 1.45)	0.93	0.97 (0.65 – 1.43)	0.866

Abbreviations: IPF: idiopathic pulmonary fibrosis, HR: hazard ration, CI: confident interval, FVC: forced vital capacity.

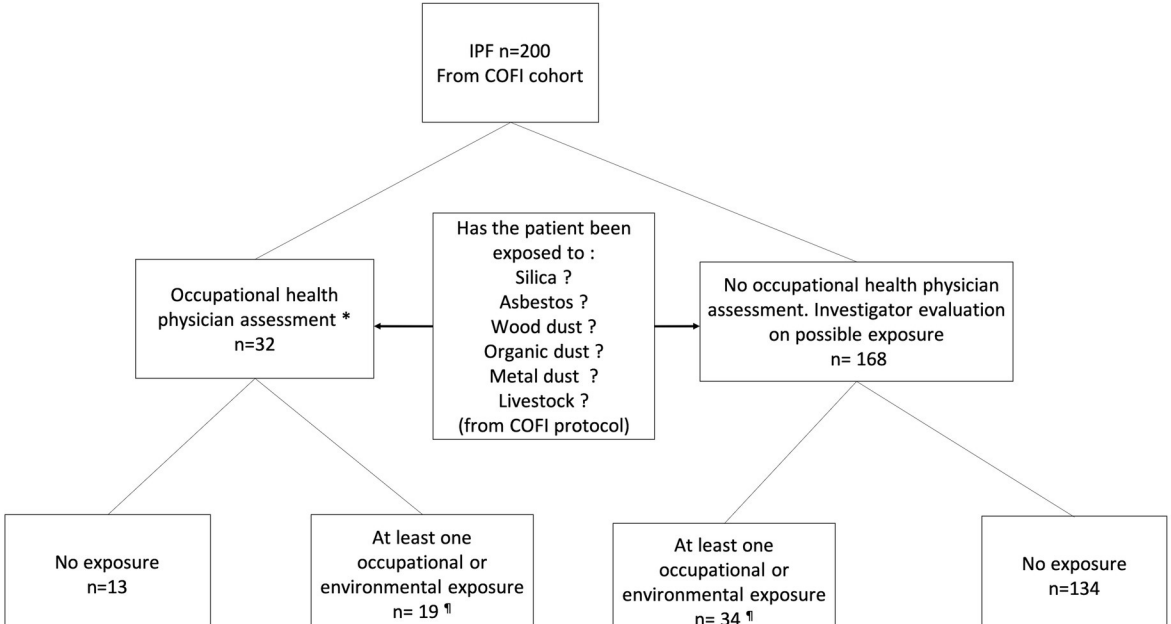
*Any occupational exposure among asbestos, crystalline silica, wood, organic, livestock, or metal dust.

P-value <0.05 was considered significant


COFI cohort
n =245
Missing address n = 25
Withdrawal of consent n= 9
n=211
No INSEE city-level income data available n = 11
Study population
n = 200
Higher income
(>18170€/year)
n= 150
Low income
(< 18170€/year)
n = 50



Number at risk					
Higher income	150	65	31	14	0
Low income	50	18	6	3	1


IPF n=200
From COFI cohort
Has the patient been exposed to :
Silica ?
Asbestos ?
Wood dust ?
Organic dust ?
Metal dust ?
Livestock ?
(from COFI protocol)
Occupational health physician assessment *
n=32
No occupational health physician assessment. Investigator evaluation on possible exposure
n= 168
No exposure
n=13
At least one occupational or environmental exposure
n= 19 ¶
At least one occupational or environmental exposure
n= 34 ¶
No exposure
n=134