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Occupational prestige trajectory and the risk of lung and head and neck cancer among men and women in France

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HAL Authorization

1 **Occupational prestige trajectory and the risk of lung and head and neck cancer among men and**
2 **women in France**

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55
56

57 **Abstract**

58 Objectives: to investigate the associations between occupational prestige trajectories and lung and
59 head and neck (HN) cancer risk, and to assess to what extent smoking and alcohol drinking and
60 occupational exposures contribute to these associations.

61 Methods: Using data from the ICARE case-control study (controls (2676 men/715 women), lung
62 cancers (2019 men/558 women), HN cancers (1793 men/305 women)), we defined occupational
63 prestige trajectories using group-based modeling of longitudinal data. We conducted logistic
64 regression models.

65 Results: Among men, a gradient was observed from the downward “low to very low” trajectory to
66 the stable very high trajectory. The associations were reduced when adjusting for tobacco and
67 alcohol consumption and occupational exposures. Among women, when compared to the stable high
68 trajectory, there was an increased cancer risk in all trajectories. The associations remained globally
69 unchanged or even increased after adjustment for tobacco and alcohol consumption, and did not
70 change when adjusting for occupational exposures. The ORs were smaller for lung than for HN
71 cancers in men.

72 Conclusion: Occupational prestige trajectory is strongly associated with lung and HN cancer risk in
73 men and women.

74

75 **Keywords**

76 Occupational prestige trajectory; alcohol; smoking; occupational exposures; respiratory cancer

77

78 **Introduction**

79 Incidence of lung and head and neck (HN) (lip, mouth, pharynx, larynx) cancers is high among men
80 and increasing among women.(Lortet-Tieulent et al. 2013) In 2012, the European standardized
81 incidence rates were respectively 30.9 (per 100000 person years) for HN cancers and 74.5 for lung
82 cancer in men, and 8.9 and 27.9 in women.(Ferlay et al. 2013) Studies have consistently reported a
83 strong association between socioeconomic status (SES) and lung and HN cancer incidence, with
84 differences by gender and country.(Faggiano et al. 1997)

85

86 SES is a multidimensional construct. Higher education is associated with a higher sensitivity to and a
87 better understanding of prevention messages and a better ability to change his/her behavior
88 whereas income captures more material dimensions such as living conditions, good diet or access to
89 health care. Occupational class, more closely linked to occupation itself, is another frequent indicator
90 of SES. Several classifications exist for occupational class. Classifications such as the international
91 Erikson and Goldthorpe's class categories (EGP) (Erikson and Goldthorpe 1992) or the French PCS
92 classification (Desrosières and Thévenot 2002) are categorical and combine various dimensions such
93 as the level of qualification, the employee/self-employed status, the work characteristics, the level of
94 income or the supervisory position. Other classifications are hierarchical and allow ordering all
95 occupations on the social ladder, either based on the combination of educational requirements and
96 monetary payoffs, such as the International Socio-Economic Index of Occupational Status
97 (Ganzeboom et al. 1992), or based on the popular degree of desirability of occupations, such as the
98 Treiman's Standard International Occupational Prestige Scale.(Treiman 1977)

99

100 Most studies investigating socioeconomic inequalities in respiratory cancer incidence have focused
101 on educational level or occupational class at one point in time and did not capture changes in SES
102 over the life time.(Boing et al. 2011 ; Menvielle et al. 2009 ; Menvielle et al. 2004 ; Nkosi et al. 2012 ;
103 Santi et al. 2013) However, a few studies, most of them were case-control studies, have investigated
104 the association between respiratory cancer incidence and occupational class over the life time,
105 assessed either by the longest occupational class or by trajectories between two points in
106 time.(Behrens et al. 2016 ; Conway et al. 2010 ; Marshall et al. 1999 ; Melchior et al. 2005 ; Menvielle
107 et al. 2004 ; Schmeisser et al. 2010) Therefore the available literature did not consider the
108 development of SES over the whole working life. A hierarchical measure of occupational class
109 available at various points in time over the working life may allow to identify specific social groups
110 and therefore improve our understanding of socioeconomic inequalities in health.

111

112 Several studies have investigated the underlying mechanisms of the socioeconomic differences
113 observed in respiratory cancer incidence trying to identify what risk factors could explain these
114 inequalities. Smoking and alcohol drinking are the two main risk factors for these cancers and are
115 strongly socially patterned. Whatever the SES indicator used, studies have generally reported that
116 smoking and alcohol drinking partly accounted for these inequalities for lung cancer (Behrens et al.
117 2016 ; Menvielle et al. 2009 ; Menvielle et al. 2016) and HN cancer (Boing et al. 2011 ; Menvielle et
118 al. 2004 ; Santi et al. 2013) although in some studies, the associations were strongly attenuated or
119 not any more significant after adjustment.(Conway et al. 2010 ; Melchior et al. 2005 ; Nkosi et al.
120 2012 ; Schmeisser et al. 2010) Few studies have investigated the contribution of occupational
121 exposures to these inequalities and suggested a non-negligible role of these exposures.(Behrens et
122 al. 2016 ; Menvielle et al. 2010 ; Menvielle et al. 2016 ; Menvielle et al. 2004 ; Santi et al. 2013)
123 Finally, most studies focused on men (Behrens et al. 2016 ; Marshall et al. 1999 ; Melchior et al. 2005
124 ; Schmeisser et al. 2010) whereas the situation is likely to differ by gender due to gender differences
125 in the social stratification, the social context, the consumption of tobacco and alcohol, the exposure
126 to carcinogens, and the work history.

127
128 Finally the role of risk factors in socioeconomic inequalities in cancer risk may differ by SES indicator.
129 In particular, the association between health behavior and SES may be stronger when SES is assessed
130 using a prestige indicator, that relates to people's status and social standing in society, than a
131 measure based on employment relations, that is more linked to income and wealth.(Chandola 1998 ;
132 Galobardes et al. 2006) Declining prestige may be associated with decreased self-esteem and
133 psychological health, and might be particularly linked to changes in health behaviors as a way to cope
134 with this adversity.

135
136 The aim of our analysis was, separately among men and women, first to investigate the association
137 between occupational prestige trajectories and lung and HN cancer incidence and second to assess
138 to what extent smoking, alcohol drinking and occupational exposures over the life time contributed
139 to these inequalities.

140

141 **Methods**

142 *Study population*

143 The ICARE study is a multi-center population-based case-control study conducted in France from
144 2001 through 2007 in 10 French "départements" (administrative areas) covered by a cancer register.
145 The cases were all patients newly diagnosed during the study period with a primary, histologically
146 confirmed malignant tumour of oral cavity, pharynx, sinonasal cavities, larynx and lung (International

147 Classification of Diseases, 10th Revision codes C00-C14, C30-C34) and who were aged 75 or less at
148 diagnosis. The control group was selected from the general population of the same geographical
149 areas (*département*) by random digit dialing, with frequency matching to all cases by sex and age.
150 Additional stratification was used to achieve a distribution by socioeconomic status among the
151 controls comparable to that of the general population. Participation rates were 87.1% in lung cancer
152 cases, 82.5% in HN cancer cases and 80.6% among controls. The study design has been described in
153 details previously (Luce and Stucker 2011).

154

155 *Measure of occupational trajectory, smoking, alcohol drinking and occupational exposures*

156 Subjects were interviewed face-to-face by trained interviewers, using a standardized questionnaire
157 including detailed information about socio-demographic characteristics, lifetime tobacco and alcohol
158 consumption (type, period of consumption, frequency of consumption and quantities consumed for
159 each period), and lifetime occupational history (covering all jobs held for at least 1 month and
160 periods of inactivity). For each job period, occupation and industrial activity were coded blind to the
161 case-control status using respectively the International Standard Classification of Occupations 1968
162 (ISCO) (International Labour 1968) and the French Nomenclature of Activities (NAF).

163

164 Using each participant's work history, we defined lifecourse occupational prestige trajectory, using
165 the Treiman's Standard International Occupational Prestige Scale (SIOPS), an internationally
166 comparable scoring system. The score ranges from 14 for unskilled agricultural workers to 78 for
167 physicians and some other occupations with higher education like university teachers. A SIOPS score
168 was assigned to each job period based on the ISCO-code using the Ganzeboom conversion tool
169 (Ganzeboom and Treiman). For periods with two or more parallel jobs, the maximum value of the
170 scores attributed to these jobs was taken. Retirement was considered to end a subject's work
171 history. As recommended by Treiman, intermediate phases of occupational inactivity (training,
172 illness, unemployment) were assigned a score of 30 or the score of the previous occupation if lower
173 than 30. A score of 30 roughly corresponds to the prestige scores of low-skilled manual jobs (such as
174 machinist or plasterer) or low clerical work (such as mail distributor or warehouseman). Other
175 periods of inactivity (e.g. housewife) were assigned a missing value for SIOPS. Members of the armed
176 forces were assigned a score of 42. For each individual, we reconstructed a work history with one
177 SIOPS score per year. People with missing SIOPS score for the whole job history were excluded from
178 the analysis (7.2% of men and 8.0% of women). Then, we used group-based trajectory model on
179 SIOPS repeated measures to identify distinct clusters of individuals following a similar longitudinal
180 pattern separately for men and women. These clusters correspond to the occupational prestige
181 trajectories analyzed in this paper. The fit of the models as well as the homogeneity within each

182 trajectory led us to define 8 trajectories in men and in women (figure 1). We conducted sensitivity
183 analyses excluding people with no SIOPS score for at least 20% (3.2% of men and 23.3% of women)
184 or 30% of their job history (2.0% of men and 15.1% of women). The higher proportion in women
185 accounts for housewife women.

186

187 In the lung cancer analyses, lifelong cigarette smoking was captured using an index specifically
188 developed for this disease, the cumulative smoking index (CSI). The CSI takes into account total
189 duration of smoking, time since cessation and average number of cigarettes smoked per day and is
190 null for never smokers. In our data, the CSI varied linearly with lung cancer risk.(Papadopoulos et al.
191 2014) In the HN cancer analyses, lifelong tobacco consumption was measured using pack-years
192 (restricted cubic splines separately in men and women), smoking status (never/current/former
193 smoker) and the interaction between these variables. The average daily alcohol consumption was
194 calculated as the number of drinks per day by adding the average lifetime daily consumption of each
195 type of alcoholic beverage (restricted cubic splines separately in men and women).

196

197 Occupational exposure to asbestos and crystalline silica was assessed using job-exposure matrices
198 (JEM) specifically developed for France.(Févotte et al. 2011) For each combination of an ISCO and a
199 NAF code, the JEM assigned a probability, an intensity and a frequency of exposure. The indices were
200 provided for different calendar periods between 1947 and 2007 to account for possible variations in
201 exposure over time. For each subject, we derived from its entire occupational history a cumulative
202 level of exposure to asbestos and crystalline silica obtained as the sum over all jobs of the product of
203 the exposure intensity, probability, frequency and duration (using midpoints of each class). Exposure
204 to silica could not be studied in women due to the small number of subjects exposed.

205 Assessment of ever exposure to diesel motor exhaust (DME) was collected for each job period and
206 based on self-report. This information was missing for about 13% of all job periods. We combined the
207 ISCO code with the NAF code for each job period. Missing values for exposure to DME were replaced
208 by the modal category observed in the same ISCO-NAF combination among subjects with complete
209 data. DME exposure was assessed from the questionnaire on a case-by-case basis when the modal
210 category included less than 60% of the subjects. The association between lung cancer and ever
211 exposure to DME was similar when using this variable and when restricting the analysis to complete
212 case data.(Matrat et al. 2015)

213 In lung cancer analyses, we adjusted for occupational exposures to asbestos (restricted cubic splines
214 for men, ever/never for women), silica (restricted cubic splines for men) and DME (ever/never). In
215 HN cancers analyses, we adjusted for occupational exposures to asbestos (restricted cubic splines for
216 men, ever/never for women).

217

218 Logistic regression models were conducted separately for lung and HN cancers, and for men and
219 women. The first model was adjusted for age and residence area. The second model was adjusted
220 additionally for smoking (lung cancer) or alcohol and tobacco consumption (HN cancer). The third
221 model included additional adjustment for occupational exposures. For a large proportion of women,
222 their work history includes long periods of inactivity as housewife. Therefore, among women, we
223 conducted an additional model adjusted for the number of years as housewife (as a continuous
224 variable). Data with missing values on risk factors were excluded (smoking n=59, alcohol n=77,
225 occupational exposures n=175, periods of inactivity as housewife n=129). All analyses were
226 conducted using SAS 9.4 software (SAS Institute, Cary,NC). Overall, our analyses were based on 3391
227 controls (2676 men/715 women), 2577 lung cancers (2019 men/558 women), 2098 HN cancers (1793
228 men/305 women).

229

230 **Results**

231 We identified 8 occupational prestige trajectories in men and in women (figure 1). In men, there
232 were 4 trajectories stable over the working life (stable low, stable middle, stable high, stable very
233 high), 2 upward trajectories (very low to middle, low to high), and 2 slightly downward trajectories
234 (low to very low, middle to low). In women, there were 4 stable trajectories (stable middle, stable
235 middle+, stable high, stable very high), 2 upward trajectories (low to middle, low to high) and 2
236 downward trajectories (low to very low, middle to very low). In total, 19% of male controls and 27%
237 of female controls experienced a downward trajectory. The respective percentages for an upward
238 trajectory were 21% and 26%. The distribution of alcohol and tobacco consumption, the occupational
239 exposure to asbestos, silica and DME as well as the number of years of inactivity as housewife are
240 presented in table 1 by gender and occupational trajectories. The risk factors were more prevalent in
241 the more socially deprived groups. Among men, these differences were especially pronounced for
242 alcohol consumption in HN cancer cases. Among women, the stable very high trajectory, although
243 based on very small numbers, displayed the worst profile with high alcohol and tobacco
244 consumption.

245

246 The results of the logistic models are presented in tables 2 and 3.

247 In men, a gradient was observed amongst all occupational prestige trajectories. A decreased HN
248 cancer risk was observed in the stable very high trajectory and an increased HN cancer risk was
249 observed in all other trajectories when compared with the stable high trajectory. The increased risk
250 was especially pronounced among men who experienced a low to very low or a stable low trajectory.

251 The risk in the upward trajectories was close to the risk of the group they joined. The associations
252 were substantially reduced when adjusting for tobacco and alcohol consumption and for
253 occupational exposures in all trajectories except in the low to high and in the stable very high
254 trajectories where the ORs hardly changed. The ORs were statistically significant after full adjustment
255 in all trajectories but the low to high and the stable very high trajectory. The pattern was similar for
256 lung cancer, although the ORs were much lower than those observed for HN cancers. When
257 compared with the stable very high trajectory, a significantly increased lung cancer risk was
258 observed in all trajectories but the stable very high and the low to high trajectories. The associations
259 were reduced when adjusting for smoking and then for occupational exposures (the OR although
260 higher than 1 became non-significant for the low to middle trajectory).

261

262 In women, when compared to the stable high trajectory, there was an increased HN cancer risk in all
263 trajectories in particular in the stable very high trajectory. The ORs were nonetheless significant only
264 for the low to very low, stable middle and very high trajectories. After adjustment for tobacco and
265 alcohol consumption, the associations remained globally unchanged or even increased. The ORs
266 hardly changed when adjusting for the number of years as housewife, except for the stable very high
267 trajectory. Contrary to men, the ORs were only slightly lower for lung than for HN cancer, and even
268 higher and statistically significant for the low to high trajectory. When adjusting for smoking, the ORs
269 increased for the low to very low, stable middle and stable middle+ trajectories, decreased and
270 became non-significant for the low to high and the stable very high trajectories, and did not change
271 for the other trajectories. For both lung and HN cancer analyses, additional adjustment for
272 occupational exposures hardly changed the estimates.

273

274 Results from the sensitivity analyses excluding people with no SIOPS score for at least 20% or 30% of
275 their job history led to similar conclusions (results not shown).

276

277 **Discussion**

278 Although there is now a substantial body of literature on SES and cancer risk, little is known on SES
279 over the life time and cancer risk. Using a continuous variable for occupational prestige, we precisely
280 modelled people's trajectories over the whole working life and identified 8 groups of occupational
281 prestige trajectories in men and in women. This classification was more discriminatory than the
282 French categorical occupational class classification; e.g. in our data, 47% of the women were clerks
283 most of their working life. In men, we did not identify pronounced downward trajectories. However
284 we observed a low and slightly downward trajectory that accounted for a non-negligible part of the
285 population (4% of controls, 8% of lung cancers, 12% of HN cancers). This trajectory was characterized

286 by a high consumption of alcohol. It is likely that alcohol played a role in this trajectory, probably
287 both by impacting the first job at the bottom of the occupational prestige ladder and by preventing
288 an upward trajectory over the life time.

289 Both in men and women, we identified a small group who experienced a stable very high
290 occupational prestige trajectory. Among women, this extremely small group is very specific: when it
291 is grouped with the much larger stable high trajectory and used as the reference category, no
292 differences in respiratory cancer risk between occupational prestige trajectories appear any more.
293 That is why we kept this small group separate in our analyses. In men this socially very privileged
294 group displayed the best health profile and our results suggest that a socioeconomic gradient in
295 respiratory cancers risk exists until the very top of the social ladder. In women however, this socially
296 very privileged group showed the highest lung and HN cancer risk, partly due to a high alcohol and
297 tobacco consumption. We acknowledge that our estimates are based on small numbers and that no
298 firm conclusion can be drawn. However, our results suggest that in this birth cohort, the most socially
299 privileged women had the worst health behaviors, which may reflect their higher
300 emancipation.(Schaap et al. 2009 ; Waldron 1991)

301

302 Before discussing the results, some methodological issues should be discussed. The ICARE study is
303 among the largest case–control studies worldwide on respiratory cancers, with high participation
304 rates (82.5% among HN cancer cases, 87.1% among lung cancer cases and 80.6% among controls).
305 Cases were recruited through a collaboration with the French network of cancer registries, which
306 allowed a nearly complete identification of eligible cases. Controls were selected to have a
307 socioeconomic distribution comparable to that of the general population of the same geographical
308 area. Recall bias is a well-known weakness of case–control studies. Therefore, we paid special
309 attention to data collection. Detailed information was collected by trained interviewers during face-
310 to-face interviews, with a standardised questionnaire, and in a similar manner, among cases and
311 controls.

312

313 We collected detailed information on lifetime tobacco and alcohol consumption, with information on
314 the different types and quantity consumed for the different consumption periods. However, we did
315 not account for differences in the type of tobacco smoked (brown or blond, use of filter) in our
316 measure of lifelong smoking. We could identify occasional drinkers and exclude them from the ‘never
317 drinker’ group. In France, in 2005, only 8.4% of individuals reported never having consumed
318 alcohol,(Legleye 2005) a proportion close to the proportion of never drinkers among controls in the
319 ICARE study (8.6%). In addition, in France, in 2005, around 26% of men (age standardised figure)
320 reported being never smokers, a proportion close to our figures (28%).(Peretti-Watel et al. 2007)

321 However differential reporting between cases and controls cannot be excluded, and we cannot rule
322 out an underestimation of tobacco or alcohol consumption, which may differ by SES.(Huerta et al.
323 2005) We nevertheless believe that any misreporting in lifetime tobacco or alcohol consumption is
324 not likely to substantially affect our main conclusions.

325
326 Occupational exposures were assessed thanks to the lifetime job history. Self-reported occupational
327 history is usually considered as reliable.(Blair et al. 2007) Occupations were coded blind to the case-
328 control status. Occupational exposure to asbestos and silica was assessed through specific JEMs
329 developed for France. A JEM generates only non-differential misclassification which could result in an
330 underestimation of the association between the carcinogens and cancer and an underestimation of
331 the role of these occupational exposures in socioeconomic inequalities in respiratory cancers risk.
332 However previous studies have validated these JEMs.(Guida et al. 2013 ; Lacourt et al. 2012) In
333 addition, lifetime prevalence of asbestos exposure among our male and female controls (24.3% and
334 4.1%) is comparable to an estimation from 2007 based on the general French population (26.7% and
335 2.7% resp.).(Févotte et al. 2011) Overall, we accounted for occupational exposures to asbestos and
336 silica in a much more precise way than in previous studies on socioeconomic inequalities in cancer
337 risk (Behrens et al. 2016 ; Santi et al. 2013) due to both the detailed measure of exposures (weighted
338 combination of intensity, duration, frequency, and probability) and the modeling of the association
339 with cancer risk (splines). Regarding exposure to DME, we cannot exclude a recall bias. However,
340 26.2% of our male controls reported at least one job with DME exposure, a proportion close to that
341 found in an Italian study.(Richiardi et al. 2006)

342
343 We investigated the association between occupational prestige trajectory and lung and HN cancer
344 risk using data from the ICARE study. Data for lung cancer have been previously included in a pooled
345 analysis on social mobility for occupational prestige.(Behrens et al. 2016) However, in the latter
346 study, trajectories were assessed using only the first and the last or longest occupation and
347 occupational exposures were assessed in a crude way using ever employment in a job with known
348 lung carcinogen exposure. We observed strong associations between occupational prestige
349 trajectory and lung and HN cancer risk. These associations were reduced when adjusting for people's
350 education but most remained elevated (results not shown), suggesting that education and prestige
351 have an independent effect on cancer risk and do not account for the same dimensions of people's
352 SEP.(Galobardes et al. 2006)

353
354 The SIOPS classification has been developed for men and this may impact our results in women due
355 to differences in occupational prestige between men and women for some occupations. However,

356 prestige scores measure the classical sociological hypothesis that occupational status constitutes the
357 single most important dimension in social interactions and this hierarchy is not likely to
358 fundamentally differ by gender. Investigating work history in women is complexified because of
359 inactivity periods as housewife. We chose to adjust for the duration of these episodes. Finally, we
360 assessed occupational prestige using people's own occupation. Several studies have shown that
361 women's but also men's health were related to their partner's SEP.(Chandola 1998 ; Skalicka and
362 Kunst 2008 ; Torssander and Erikson 2009) Therefore our results may be different when using the
363 occupational prestige of the household. However the lifetime occupational history of the partner was
364 not available in our study.

365

366 Our results confirm the substantial role of smoking and alcohol drinking in socioeconomic
367 inequalities in respiratory cancers incidence in men. Consistently with most of the available literature
368 (Behrens et al. 2016 ; Boing et al. 2011 ; Menvielle et al. 2009 ; Menvielle et al. 2016 ; Menvielle et al.
369 2004 ; Santi et al. 2013), we observed that these risk factors only partly accounted for these
370 inequalities. We cannot rule out residual confounding by smoking and alcohol drinking. This would
371 occur in all groups but may be larger among men with a low occupational prestige due to longer and
372 heavier consumptions. However it is unlikely that residual confounding account for all remaining
373 inequalities.

374

375 Our analyses stress the importance of work-related factors in socioeconomic inequalities in
376 respiratory cancer incidence. Interestingly, we observe a stronger gradient relating occupational
377 prestige to occupational exposures than to health behaviors in men. We may have underestimated
378 the contribution of occupational exposures as we did not account for all carcinogens because of no
379 data availability. For lung cancer, we adjusted for the three carcinogens with the highest number of
380 attributable lung cancer cases (Brown et al. 2012) but could not include several known or suspected
381 carcinogens for HN cancers (e.g. strong acid mists, wood dust or formaldehyde). This may explain
382 why the decrease in socioeconomic inequalities after adjustment for occupational exposures was
383 more pronounced for lung than HN cancers and residual confounding may be larger for HN cancers.

384

385 In women, although smoking and alcohol drinking contributed to socioeconomic inequalities in
386 respiratory cancer incidence, the situation is more complex. Our results suggested that the women
387 with the highest occupational prestige had the highest tobacco consumption: when compared with
388 women with a stable high occupational prestige trajectory, adjustment for smoking decreased the
389 risk of lung cancer for the stable very high trajectory and did not change or even increased the risk in
390 the other groups. This is consistent with the literature that shows that France has now reached the

391 last stage of the smoking epidemic: tobacco consumption is now among the highest SES women only
392 in the oldest age group, i.e. among women born before 1955, close to our population (mean age of
393 60.4 in controls and 57.5 in cases).(Bricard et al. 2016) Although residual confounding due to
394 misreporting of alcohol and tobacco consumption is likely to occur in women as in men, it is less clear
395 to assess how this would have impacted the results because of the lack of gradient between SES and
396 smoking. We observed a negligible contribution of occupational exposures to socioeconomic
397 inequalities in respiratory cancers incidence. This reflects the low prevalence of these exposures in
398 female occupations, at least for the high levels of exposure.

399

400 Finally, other risk factors such as poor diet (Lagiou et al. 2009 ; Skuladottir et al. 2004) or physical
401 inactivity (Steindorf et al. 2006) may account for part of the remaining inequalities. (Malon et al.
402 2010 ; Menai et al. 2015) There is also an increasing body of literature suggesting that exposure to
403 infections may account for part of the worst health in low SES groups, either through a higher and/or
404 an earlier exposure during the lifecourse and/or a higher vulnerability.(Dowd et al. 2009) Although it
405 has been very little investigated, this is likely to be more important for HN (through human
406 papillomavirus infection) than for lung cancer (D'Souza et al. 2007 ; Rotnaglova et al. 2011) and this
407 could explain part of the remaining inequalities in HN cancer risk. Factors associated with SES during
408 childhood (including infections) may also explain part of the remaining inequalities (Kelly-Irving et al.
409 2013), especially in groups with low occupational prestige at the beginning of their carrier, as the first
410 occupation is more closely linked to childhood SES. This may in particular account for the differences
411 observed between men in the stable high and low to high occupational prestige trajectories for HN
412 cancers risk. Future studies are needed to investigate these issues.

413

414 We investigated the role of occupational prestige trajectories on respiratory cancers risk in men and
415 women in France. Our results confirmed the existence of large socioeconomic inequalities both in
416 men and women, but they also highlighted specific patterns that were not observed with other SES
417 indicators. Our study therefore underlines the importance of using various measures of SES to fully
418 understand the complex mechanisms at stake in socioeconomic inequalities in health.

419

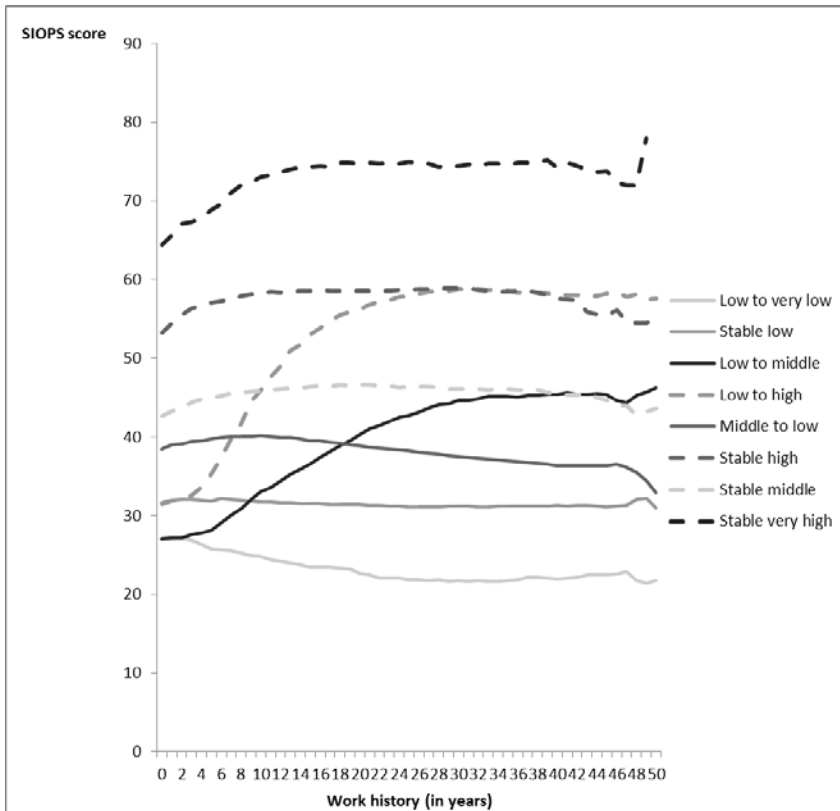
420 **Compliance with ethical standards**

421 Conflict of interest: The authors declare that they have no conflict of interest.

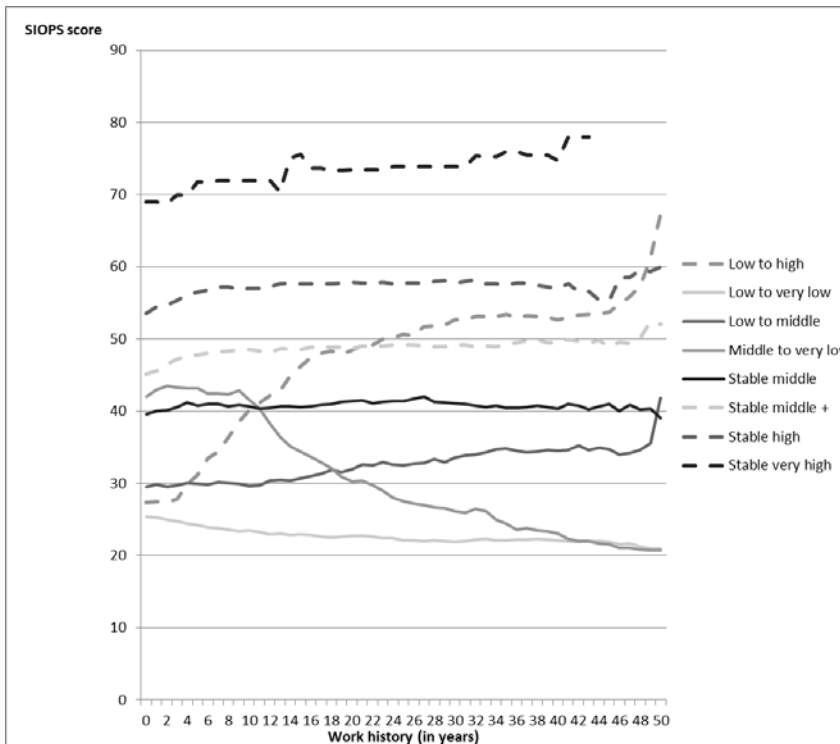
422 Informed consent: Informed consent was obtained from all participants included in the study.

423

424 Fig1.: Occupational prestige trajectories over the whole working life in men (upper panel) and
 425 women (lower panel). The ICARE case-control study, France, 2002-2005



426
 427



428
 429 SIOPS: Standard International Occupational Prestige Scale

430 Table 1: Distribution of tobacco and alcohol consumption and occupational exposures by gender and
 431 occupational prestige trajectories among controls, lung and head and neck cancers. The ICARE case-
 432 control study, France, 2002-2005

Occupational prestige trajectory		Nb alcoholic drink/day*	Light drinkers** N (%)	Never smokers N (%)	Pack-years* Mean	CSI* Mean	Ever exposed to			Nb years as housewife Mean	
							asbestos N (%)	silica N (%)	DME N (%)		
		N	Mean	N (%)	N (%)	Mean	Mean	N (%)	N (%)	N (%)	Mean
CONTROLS											
Men	Low to very low	115	4.4	42 (36.5)	33 (28.7)	21.3	1.1	67 (58.3)	30 (26.1)	38 (33.0)	-
	Stable low	588	3.5	249 (42.4)	148 (25.2)	22.6	0.9	428 (72.8)	208 (35.4)	192 (32.7)	-
	Middle to low	382	3.2	159 (41.6)	99 (25.9)	22.8	1	272 (71.2)	99 (25.9)	100 (26.2)	-
	Low to middle	291	3.5	111 (38.1)	88 (30.2)	22.2	0.9	229 (78.7)	95 (32.7)	104 (35.7)	-
	Stable middle	492	2.9	247 (50.2)	124 (25.2)	21.8	0.9	293 (59.6)	111 (22.6)	151 (30.7)	-
	Low to high	272	2.6	129 (47.4)	76 (27.9)	17.9	0.8	141 (51.8)	32 (11.8)	68 (25.0)	-
	Stable high	464	2.4	234 (50.4)	136 (29.3)	18.9	0.9	100 (21.6)	32 (6.9)	50 (10.8)	-
	Stable very high	72	2.1	43 (59.7)	25 (34.7)	20.8	0.8	16 (22.2)	8 (11.1)	3 (4.2)	-
Women	Low to high	46	1.3	7 (15.2)	26 (56.5)	18.5	0.9	8 (17.4)	-	2 (4.4)	2.8
	Low to very low	134	0.9	38 (28.4)	104 (77.6)	19.8	1.1	36 (26.9)	-	10 (7.5)	5.1
	Low to middle	138	0.7	26 (18.8)	92 (66.7)	12.3	0.8	40 (29.0)	-	13 (9.4)	3.7
	Middle to very low	57	1.3	18 (31.6)	30 (52.6)	12.3	0.8	12 (21.1)	-	8 (14.0)	5.8
	Stable middle	97	1.1	26 (26.8)	62 (63.9)	11.2	0.7	26 (26.8)	-	10 (10.3)	2.5
	Stable middle+	120	1.1	24 (20.0)	81 (67.5)	13.6	0.9	14 (11.7)	-	7 (5.8)	2.4
	Stable high	120	1.0	19 (15.8)	76 (63.3)	17.4	1	8 (6.7)	-	4 (3.3)	0.6
	Stable very high	3	1.5	1 (33.3)	2 (66.7)	9.8	1.2	0 (0)	-	0 (0)	0.0
LUNG CANCER											
Men	Low to very low	171	-	-	0(0)	-	1.7	119 (69.6)	56 (32.8)	51 (29.8)	-
	Stable low	701	-	-	14 (2.0)	-	1.7	578 (82.5)	347 (49.5)	261 (37.2)	-
	Middle to low	337	-	-	14 (4.2)	-	1.6	271 (80.4)	112 (33.2)	97 (28.8)	-
	Low to middle	180	-	-	5 (2.8)	-	1.6	150 (83.3)	80 (44.4)	66 (36.7)	-
	Stable middle	309	-	-	6 (1.9)	-	1.6	214 (69.3)	83 (26.9)	83 (26.9)	-
	Low to high	127	-	-	3(2.4)	-	1.6	65 (51.2)	23 (18.1)	28 (22.1)	-
	Stable high	164	-	-	4(2.4)	-	1.6	40 (24.4)	9 (5.5)	24 (14.6)	-
	Stable very high	30	-	-	2(6.7)	-	1.5	1 (3.3)	1(3.3)	4 (13.3)	-
Women	Low to high	39	-	-	14 (35.9)	-	1.6	5 (12.8)	-	6 (15.4)	1.9
	Low to very low	111	-	-	40 (36.0)	-	1.5	26 (23.4)	-	4 (3.6)	4.2
	Low to middle	96	-	-	21 (21.9)	-	1.6	33 (34.4)	-	12 (12.5)	2.8
	Middle to very low	46	-	-	11 (23.9)	-	1.5	8 (17.4)	-	7 (15.2)	4.2
	Stable middle	102	-	-	33 (32.4)	-	1.6	25 (24.5)	-	9 (8.8)	2.3
	Stable middle+	90	-	-	26 (28.9)	-	1.5	16 (17.8)	-	6 (6.7)	2.0
	Stable high	65	-	-	19 (29.2)	-	1.6	4 (6.2)	-	4 (6.2)	1.2
	Stable very high	9	-	-	0 (0)	-	1.6	0 (0)	-	0 (0)	0.2
HEAD AND NECK CANCERS											
Men	Low to very low	207	11.3	17 (8.2)	6 (2.9)	39.9	-	152 (73.4)	-	-	-
	Stable low	700	8.4	98 (14.0)	23 (3.3)	40.2	-	568 (81.1)	-	-	-
	Middle to low	331	7.9	49 (14.8)	16 (4.8)	39.3	-	270 (81.6)	-	-	-
	Low to middle	146	7.4	21 (14.4)	11 (7.5)	40.8	-	114 (78.1)	-	-	-
	Stable middle	221	6.9	37 (16.7)	12 (5.4)	39.1	-	142 (64.3)	-	-	-
	Low to high	84	6.0	15 (17.9)	4 (4.8)	39.4	-	49 (58.3)	-	-	-
	Stable high	97	5.3	23 (23.7)	6 (6.2)	38.2	-	24 (24.7)	-	-	-
	Stable very high	7	4.9	0 (0)	0 (0)	46.6	-	1 (14.3)	-	-	-
Women	Low to high	15	2.3	4 (26.7)	8 (53.3)	24.8	-	5 (33.3)	-	-	4.9
	Low to very low	68	3.6	13 (19.1)	20 (29.4)	36.1	-	15 (22.1)	-	-	4.5
	Low to middle	61	3.7	7 (11.5)	10 (16.4)	33.2	-	11 (18.0)	-	-	4.0
	Middle to very low	28	3.6	5 (17.9)	6 (21.4)	27.8	-	10 (35.7)	-	-	6.4
	Stable middle	49	4.2	8 (16.3)	11 (22.5)	34.2	-	7 (14.3)	-	-	2.4

Stable middle+	47	2.1	6 (12.8)	19 (40.4)	38.3	-	7 (14.9)	-	-	2.1
Stable high	32	2.7	3 (9.4)	4 (12.5)	26.3	-	3 (9.4)	-	-	1.0
Stable very high	5	3.7	0 (0)	0 (0)	31.7	-	1 (20.0)	-	-	0.0

433 N: number of subjects; CSI: Comprehensive Smoking Index; DME: Diesel Motor Exhaust, Nb: number
434 * Among people who ever smoked or drink ; ** Light drinkers: 0 drink/day in women,]0-2]
435 drinks/day in men; - Not included in the analyses

Table 2: Odds ratios (OR) and 95% confidence intervals (CI) associated with occupational prestige trajectories for lung and head and neck cancers risk. Men (4695 men in the lung cancer analyses, 4469 men in the head and neck cancers analyses). The ICARE case-control study, France, 2002-2005

Occupational prestige trajectory	Lung cancer			Head and neck cancers		
	OR ¹ (95% CI)	OR ² (95% CI)	OR ³ (95% CI)	OR ¹ (95% CI)	OR ² (95% CI)	OR ³ (95% CI)
Low to very low	4.55 (3.37-6.15)	3.05 (2.13-4.38)	2.66 (1.85-3.84)	8.10 (5.88-11.2)	4.52 (3.09-6.62)	4.25 (2.89-6.24)
Stable low	3.52 (2.85-4.36)	2.67 (2.07-3.46)	2.13 (1.62-2.81)	5.52 (4.31-7.08)	3.58 (2.67-4.79)	3.22 (2.38-4.37)
Middle to low	2.57 (2.04-3.25)	2.16 (1.63-2.87)	1.88 (1.40-2.52)	4.10 (3.14-5.35)	2.86 (2.08-3.92)	2.62 (1.89-3.63)
Low to middle	1.68 (1.29-2.18)	1.55 (1.13-2.13)	1.29 (0.93-1.79)	2.18 (1.62-2.95)	1.73 (1.21-2.48)	1.61 (1.12-2.32)
Stable middle	1.80 (1.43-2.26)	1.52 (1.15-2.01)	1.37 (1.03-1.82)	2.13 (1.62-2.80)	1.69 (1.22-2.33)	1.57 (1.13-2.19)
Low to high	1.26 (0.95-1.67)	1.26 (0.89-1.77)	1.18 (0.84-1.66)	1.42 (1.02-1.98)	1.48 (1.00-2.19)	1.42 (0.96-2.11)
Stable high	1	1	1	1	1	1
Stable very high	1.14 (0.71-1.82)	1.24 (0.70-2.22)	1.26 (0.71-2.25)	0.49 (0.22-1.10)	0.51 (0.21-1.26)	0.51 (0.21-1.27)

1: Model adjusted for age and residence area

2: Model 1 further adjusted for smoking (lung cancer) or tobacco and alcohol consumption (HN cancer)

3: Model 2 further adjusted for occupational exposures (asbestos, silica and DME for lung cancer; asbestos for HN cancers)

Table 3: Odds ratios (OR) and 95% confidence intervals (CI) associated with occupational prestige trajectories for lung and head and neck cancers risk. Women (1273 women in the lung cancer analyses, 1020 women in the head and neck cancers analyses). The ICARE case-control study, France, 2002-2005

	Lung cancer			Head and neck cancers		
	OR ¹ (95% CI)	OR ² (95% CI)	OR ³ (95% CI)	OR ¹ (95% CI)	OR ² (95% CI)	OR ³ (95% CI)
Model without adjustment for years of inactivity						
Occupational prestige trajectory						
Low to high	1.76 (1.03-3.01)	1.70 (0.92-3.12)	1.70 (0.93-3.13)	1.34 (0.66-2.76)	1.72 (0.74-3.99)	1.70 (0.73-3.95)
Low to very low	1.70 (1.13-2.55)	2.09 (1.51-3.33)	2.09 (1.313-3.33)	1.95 (1.18-3.21)	2.12 (1.15-3.92)	2.08 (1.12-3.86)
Low to middle	1.35 (0.89-2.02)	1.39 (0.87-2.21)	1.39 (0.87-2.24)	1.60 (0.97-2.65)	1.62 (0.87-3.00)	1.59 (0.86-2.96)
Middle to very low	1.38 (0.83-2.29)	1.39 (0.78-2.47)	1.39 (0.78-2.48)	1.72 (0.93-3.18)	1.65 (0.78-3.48)	1.61 (0.76-3.42)
Stable middle	1.93 (1.27-2.94)	2.19 (1.36-3.55)	2.20 (1.36-3.58)	1.86 (1.10-3.15)	1.82 (0.95-3.47)	1.79 (0.93-3.42)
Stable middle+	1.41 (0.93-2.13)	1.59 (0.99-2.54)	1.59 (0.99-2.55)	1.47 (0.87-2.48)	1.77 (0.94-3.34)	1.76 (0.94-3.33)
Stable high	1	1	1	1	1	1
Stable very high	5.21 (1.35-20.2)	3.54 (0.73-17.1)	3.53 (0.73-17.1)	7.49 (1.66-33.9)	7.27 (1.23-43.2)	7.21 (1.21-43.0)
Model with adjustment for years of inactivity (as a continuous variable)						
Occupational prestige trajectory						
Low to high	1.79 (1.05-3.05)	1.74 (0.95-3.19)	1.74 (0.95-3.19)	1.31 (0.64-2.70)	1.69 (0.73-3.93)	1.67 (0.72-3.89)
Low to very low	1.77 (1.17-2.67)	2.20 (1.38-3.53)	2.21 (1.38-3.55)	1.88 (1.13-3.11)	2.07 (1.11-3.84)	2.03 (1.09-3.78)
Low to middle	1.38 (0.92-2.08)	1.44 (0.90-2.29)	1.44 (0.90-2.32)	1.56 (0.94-2.59)	1.59 (0.85-2.95)	1.56 (0.84-2.91)
Middle to very low	1.45 (0.87-2.41)	1.49 (0.83-2.67)	1.49 (0.83-2.68)	1.63 (0.88-3.05)	1.59 (0.75-3.39)	1.55 (0.72-3.33)
Stable middle	1.97 (1.29-3.00)	2.26 (1.39-3.65)	2.26 (1.39-3.68)	1.83 (1.08-3.11)	1.79 (0.94-3.43)	1.77 (0.92-3.38)
Stable middle+	1.43 (0.94-2.16)	1.62 (1.01-2.60)	1.62 (1.01-2.61)	1.45 (0.86-2.45)	1.76 (0.93-3.32)	1.75 (0.93-3.30)
Stable high	1	1	1	1	1	1
Stable very high	5.17 (1.33-20.0)	3.48 (0.72-16.8)	3.48 (0.72-16.8)	7.59 (1.68-34.3)	7.32 (1.23-43.5)	7.23 (1.22-43.3)
Year of inactivity	0.99 (0.97-1.01)	0.98 (0.96-1.01)	0.98 (0.96-1.01)	1.01 (0.99-1.03)	1.01 (0.98-1.03)	1.01 (0.98-1.03)

1: Model adjusted for age and residence area

2: Model 1 further adjusted for smoking (lung cancer) or tobacco and alcohol consumption (head and neck cancers)

3: Model 2 further adjusted for occupational exposures (asbestos and Diesel Motor Exhaust for lung cancer; asbestos for head and neck cancers)

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