Cancer by migrant background in Belgium

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Chapter 3

Neighbourhood migrant composition and tobacco-related cancer mortality:

A census-linked study among five migrant origin groups in urban Belgium

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Abstract

We studied the role of 'ethnic density' in the neighbourhood for tobacco-related cancer mortality among five migrant origin groups in urban Belgium. Using full population linked census data, multilevel Poisson models were applied to model effects of three linear and categorical indicators of same-origin presence for each origin group, and to test effect mediation by migrant generation and educational level. We first of all found that increased same migrant-origin presence in the neighbourhood had protective effects on tobacco-related cancer mortality for men in most groups. Second, only Turkish men had a mortality disadvantage when Turkish concentration was higher. Third, effects were not detected across all indicators of same-origin presence, nor among most groups of women. Finally, for several groups, neighbourhood effects were mediated by generational status and educational level.

3.1 Introduction

European cities have become more ethnically diverse due to international immigration [162]. Urban settings are important destinations for international migrants due to job and housing options [163] and the existing local clusters of peers from the same country of origin [31,164]. The thus established local migrant networks contain social capital that members can draw on to navigate life in the country of destination [162].

Social capital can broadly be understood as the sum of actual or potential resources (e.g. economic, cultural) that are linked to the possession of a durable network of relationships, or membership in a group [88]. This form of capital has been linked to psychological benefits and decreased stress and risk behaviour such as tobacco smoking, alcohol consumption, and detrimental dietary habits [90]. Especially social capital that consists of ties with a variety of people from different backgrounds has been thought to promote healthy behaviour and was associated with better survival among those that were already ill. This, because their network ties provided them with new information, support, and instrumental resources otherwise unavailable to the individual [90]. More homogeneous networks of close relationships, in contrast, might limit the amount of new information and resources that are available to network members and illicit high levels of social influence. Lifestyle traits in such networks were shown to be more similar across members [90].

Connecting local social capital to the health of migrants or ethnic minority group members has been a subject of the so-called 'ethnic density' literature. In this body of research, 'ethnic density' is referred to as the proportion of racial or ethnic group members in a given neighbourhood. It is traditionally thought of in relation to negative ties between residential segregation, deprivation, and health in cities in the United States (US), but might also be interpreted as 'living among other migrants and ethnic minority members' with particular social capital effects [104]. Most studies on effects of ethnic density were so far conducted in the US and the United Kingdom (UK). They have focused on mental and subjective health benefits of living in a high ethnically dense neighbourhood through social cohesion among group members. Other studies in these countries have also pointed to protective effects on health behaviour [165]. However, studies that focus on the health behaviour and physical health of migrants in Europe are scarce and mostly find null or protective associations with ethnic density [104]. More specifically, protective ties with ethnic density were more common in the research on mortality, physical morbidity, and health behaviour, especially for tobacco consumption [104]. Focusing on a specific health outcome, namely cancer, the predominantly US oriented literature finds both detrimental and positive ethnic density effects. Studies found higher risks of infection-related cancer sites (e.g. liver, cervix), later stages at diagnosis, and lower survival for Hispanics living in more Hispanic-concentrated areas [166,167]. Cancer mortality was found higher with higher ethnic density among Black individuals, and was attributed to shared cultural norms and beliefs that might affect cancer risk and health-care seeking behaviour [105]. Specific pathways that either positively or negatively connect ethnic density to these cancer outcomes are, however, rarely formulated and tested.

The findings for cancer are moreover inconsistent overall, but it is furthermore unclear how local migrant capital could have a different role for migrants of the first- versus second-generation (i.e. foreign versus host country-born migrants), and may depend on and interact with migrants' socioeconomic resources (e.g. educational level, income, activity status). A study on low birthweight in the US, for example, found worse outcomes for children of second-generation Mexican migrant women than for children of first-generation Mexican migrant women [168]. The authors suggested that ethnic density translates into social support for first-generation migrants, whereas it may reflect social and residential blockage for the second generation [168]. A similar logic may apply to the utility of social capital for individuals with different socioeconomic positions (SEP). Social capital effects that result from living among people with the same country of origin may allow individuals with low SEP to compensate for negative health outcomes by using health-relevant information and support obtained through their network (the 'buffer hypothesis') [169,170]. This would result in larger positive ethnic density effects for people in low SEPs. Larger social capital effects on child health and depression were previously identified for individuals with a lower compared to those with a higher SEP [171,172], but the same line of reasoning could be extended to cancer mortality.

Little work has been done on neighbourhood ethnic density or 'same migrant group capital' effects on cancer outcomes in Europe. Given the vastly different migration histories, origin groups and settlement patterns between the US and Europe, such work however contributes to a more comprehensive body of evidence about ethnic density effects on cancer. Belgium is an interesting study setting for this topic due to its diverse population with around 20% of the population having a migrant origin [173], and its high cancer risk levels compared to the rest of Europe [174]. The country's largest cities are furthermore known to have comparatively high levels of ethnic and socioeconomic segregation that mainly result from housing policies and Belgium's immigration history [100]. Large-scale post-World War II suburbanisation of high-income households occurred simultaneously with the recruitment of international migrants from the Mediterranean to fill in ill-paid (mostly industrial) jobs. This combination of events has initially led Italian (1950s) and later also Turkish and Moroccan labour migrants (1960s) to settle in urban areas left behind by the Belgian middle-class, marked by cheap and low-quality dwellings on the private rental market. Family reunification during the 1970s economic crisis enhanced further clustering of these groups in more deprived areas. Parallel to this deliberate labour recruitment policy, immigration to Belgium is also characterised by European citizens who can freely move in the European context and many come to work in Belgium and Brussels as the 'political capital of Europe' in particular. Of these free movements in the European context, more recent Italian immigrants target Brussels to settle, whereas steady flows of border migration through time are reflected by a substantial share of Dutch migrants in Antwerp (and to lesser extent Liège), and French migrants in Charleroi and Liège.

Because the pathways by which ethnic density effects operate on health are generally poorly understood [104] and studies rarely focus on a specific aspect of ethnic density, the aim of this study was to analyse the relationship between the neighbourhood's same migrant group presence and cancer mortality among the largest migrant origin groups in urban Belgium (also called 'same-origin effects' from here on). The presence of peers from the same origin country was used as a proxy for an individual's same-origin migrant capital in our analyses. We studied all 'tobacco-related' cancer (pooled), lung cancer, and tobacco-related cancer without including lung cancer to verify the role of lung cancer in the pooled results. These cancer sites were selected due to their combined 'behavioural amenability' and lower-than-average 5-year survival rates in Belgium [175]. A condition with behavioural amenability was defined as 'having a combined population-attributable fraction (PAF) of deaths for smoking, alcohol abuse, overweight, low fruit and vegetable intake, physical inactivity and unsafe sex >50% in the Global Burden of Disease study 2000' [176]. In selecting these cancer sites, we argue that the same-origin effects found on cancer mortality were likely due to same-origin effects on major behavioural risk factors for the cancer sites considered [19,177].

We first examined same-origin effects for each group under study. We did so by using three indicators for 'same-origin presence' to verify if these yielded different study results. We furthermore aimed to investigate whether same-origin effects had differential effects depending on individual migrant generational status and SEP and did so by applying interaction effects. We expected that increases in same-origin presence would decrease cancer mortality less strongly among second- compared to first-generation migrants, and anticipated that decreases in cancer mortality due to higher same-origin presence would be larger among individuals with a lower versus a higher SEP [178–180]. We used unique linked census- and registry data for Belgium between October 1st 2001 and December 31st 2014 to test these hypotheses.

3.2 Materials and methods

3.2.1 Data and study population

Data for this study were derived from a linkage between the 2001 population census, containing sociodemographic information at baseline (October 1, 2001), and registry information on emigration, death, and cause of death until December 31st, 2014. A two-level data structure was used in which individuals were nested in statistical sectors, based on their legal address at census (2001).

We limited the study population to individuals aged 40 to 69 of Dutch, French, Italian, Turkish, and Moroccan origin (first and second generation) living in the largest Belgian urban regions (i.e., Antwerp, Brussels, Ghent, Charleroi, Liège; N = 196,513). We focused on this age range because cancer mortality before the age of 40 is uncommon and only a small part of the Turkish and Moroccan migrant origin groups had reached older ages in Belgium in 2001, particularly in the second generation.

This study was approved by the Commission for the Protection of Privacy Belgium. Individual record linkage between census and register data was conducted by Statistics Belgium. All personal identifying information was removed from the dataset prior to analysis.

3.2.2 Measures

3.2.2.1 Outcome and exposure

We focused on deaths from pooled tobacco-related cancers; cancer of the lung, bronchus, and trachea (coined 'lung cancer' through the remainder of this paper); and tobacco-related cancer without lung cancer to verify whether our findings were mainly attributable to lung cancer as the majority of cases. Tobacco-related cancer consisted of the following tumour sites and ICD-10 codes (International Classification of Diseases 10th Revision): cancer of the oral cavity and pharynx (C00-14); oesophagus (C15); larynx (C32); lung, bronchus and trachea (C33-34), and cancer of the lower urinary tract (C65-68).[181] Exposure time was calculated as the time that passed between census 2001 and the event of interest (i.e., tobacco-related death), emigration, death due to another cause, or the end of follow-up (2014).

3.2.2.2 Individual

We distinguished our study population by country of origin, which we identified by combining information from the 2001 census on (i) nationality at birth of the father, (ii) the mother, or (iii) the person under study; or (iv) the current nationality of the person under study [182]. Anyone who was categorised as non-Belgian on at least one of these four variables was considered as having a migrant origin. The following countries of origin were included in the analysis: France, the Netherlands, Italy, Turkey, and Morocco. Country of birth of the individual was furthermore used to define migrant generation. The members of the selected migrant origin groups that were foreign-born and migrating from the age of one onwards were considered first-generation, and those Belgian-born or moving to Belgium before the age of one second-generation migrants. Information on the country of birth could not be used to determine the country of origin for a large part of the second-generation migrants because their parents' birth country was known only for those still living in the parental household at the time of the census. We therefore used a combination of the available origin and birth country variables to maximise the available information to denote an individual's country origin and generational status.

To adjust for individual SEP and introduce interaction terms between SEP and ethnic density, educational attainment was included in the analyses. This variable was categorised into four groups according to the International Standard Classification of Education (ISCED, version 1997): 'up to primary education (ISCED 0-1)', 'lower secondary education (ISCED 2)', 'higher secondary education (ISCED 3-4)', 'tertiary education (ISCED 5+)'. We also retained a group of individuals with missing information, since the proportion of unknown educational level differs quite strongly between migrant origin groups and this category tends to be at a significant mortality disadvantage compared to the tertiary educated [183].

3.2.2.3 Neighbourhood

Our neighbourhood measures were based on statistical sectors defined by Statistics Belgium (StatBel). These are spatial units at a level smaller than ZIP-codes that are considered synonymous to neighbourhoods, and are based on social, economic, urban development, and morphological criteria. Statistical sectors are meant to support policy makers and other local actors by using sector-level data for development plans and local community support [184]. We retained 5811 sectors with a population of 200 or more for our analyses (mean=1558.14, range 200 - 6384). Doing so permitted us to balance out using the smallest unit possible with robust mortality estimates [185] .

We calculated same-origin group presence at the neighbourhood level as the main variable of interest, based on the population residing in Belgium at the time of census (2001). Three indicators were used: group concentration (C), the location quotient

(LQ), and the localised isolation index (Lis). The first measure, concentration ($C_m(i)$), is a percentage measured as:

$$C_m(i) = \frac{x_{im}}{x_i} \times 100$$

where i is a specific neighbourhood, m is a particular migrant origin group, x_{im} is the number of individuals from that specific origin group in the neighbourhood, and x_i is the total number of individuals living in the neighbourhood. This measure generally corresponds to 'ethnic density' in other studies.

Second, the location quotient ($LQ_m(i)$) is a measure of relative density of the group under study in a neighbourhood as compared to the total urban area and calculated as follows [186]:

$$LQ_m(i) = \frac{x_{im}/x_i}{X_m/X}$$

X_m in this equation is the total number of individuals for the group under study in the total urban area, X is the total population size of the urban area. A value of one implies that a group's share of the population in the neighbourhood matches that in the urban area; values lower than one indicate underrepresentation, higher than one overrepresentation in the neighbourhood.

Third, the localised isolation index ($Lis_m(i)$) aims to measure the probability that two individuals from the same country of origin living in the same neighbourhood will interact. It uses the assumption that individuals are randomly mixed in a statistical sector, and is calculated for neighbourhood i following Bemanian and Beyer's (2017) approach [187]:

$$Lis_m(i) = \log\left(\frac{p_{im} \times p_{im}}{1 - p_{im} \times p_{im}}\right) - \log\left(\frac{P_m \times P_m}{1 - P_m \times P_m}\right)$$

in which p_{im} is the proportion of migrant origin group m in the neighbourhood, and P_m is the proportion of the migrant origin group m in the urban area. A zero value indicates that the estimated probability that two individuals of the same migrant group within a neighbourhood will interact is equal to the expected probability if the urban area were perfectly mixed. Values greater than zero mean that interaction is more likely to occur than in the urban area, less than zero that it is less likely. This index was exponentiated in our statistical models to obtain odds ratios of the same-origin exposure (or 'isolation') in the neighbourhood of interest relative to the urban area.

We used the Carstairs deprivation index [188] that was adapted for the Belgian context[1] [185,189] and measured at baseline to account for neighbourhood deprivation levels. Research has in fact shown links between area deprivation and cancer mortality [190,191], as well as overlaps between areas of high deprivation and migrant concentration [100]. Higher Carstairs scores implied higher deprivation levels in our analyses.

3.2.3 Analysis

We used age-adjusted two-level random intercept Poisson regression modelling for each origin group, sex, and cancer site, producing mortality rate ratios (MRR). These models nested individuals in neighbourhoods, and the exposure time since the Census 2001 was used as the model offset. First, the crude association between cancer mortality and same-origin presence controlled for age was assessed for each of our three measures. Second, an adjusted model was fitted where individual educational level and neighbourhood deprivation were added to age and same-origin presence. All models were run both with continuous same-origin presence indicators and

[1]The Carstairs-index adapted for the Belgian context in 2001 contains: (a) the percentage of unemployed men aged 18-64 in the neighbourhood, (b) the percentage of households without a car, and (c) the percentage of inhabitants aged 25 – 64 who were lower educated (lower secondary educated or lower). The index was constructed by summing the z-scores of the variables by statistical sector, weighted by the population size of the statistical sector at the time of the 2001 census.

categorised ones based on tertiles. Tertiles were computed specific to each origin group, and interpreted as low, moderate, and high same-origin presence in the neighbourhood. Third, we examined interaction effects between continuous measures of same-origin presence and (i) migrant generation and (ii) educational level by using a product term for each of these separately. Also here crude models as well as adjusted ones were fitted. We did not fit models for Turkish women due to the limited number of cancer deaths observed in this group (N<35) and also excluded Dutch and Moroccan women from the analyses on tobacco-related cancer without lung cancer for the same reason (N<20). We performed sensitivity analyses whereby the lung cancer MRR for same-origin group presence were calculated for individuals with at least 20 years of stay in Belgium or that were born in Belgium to at least one migrant parent (second generation). We did so to verify if our results were mainly attributable to determinants other than the neighbourhood composition in 2001 given the lag times of about 20 years between tobacco consumption and the manifestation of lung cancer mortality [192,193]. We also verified whether there were interaction effects by duration of stay for first-generation migrants in the sensitivity checks. All analyses were run in STATA 16 software.

3.3 Results

Table 3.1 describes our study population. It includes Belgian natives for a more comprehensive view on how characteristics of the migrant origin populations compare to those of the majority population. In 2001, individuals with origins in neighbouring countries (i.e., the Netherlands and France) generally lived in less deprived neighbourhoods and had higher individual educational levels (min. 23% tertiary education) than the other three migrant origin groups. Moroccan and Turkish individuals, in contrast, had lower education (>50% no or primary education) and higher neighbourhood deprivation levels. Our Italian study population took on a position in between these two extremes. In terms of settlement, most French (66%) and Moroccan (72%) individuals lived in the capital region of Brussels. Although each of the five groups in the study population was well represented in Brussels, the majority of Dutch individuals settled in Antwerp (51%), most Italians settled in Charleroi (31%) and Liège (40%), and the Turkish group was more equally distributed across the urban areas. The Turkish group furthermore lived in densely Turkish populated neighbourhoods according to all measures of same origin presence. We found also relatively high neighbourhood concentration for Italians (16%) and Moroccans (25%). Nevertheless, the local quotient and localised isolation were moderate for the Moroccans and Dutch, and low for Italian and French individuals. Finally, the mortality rates for all three tobacco-related cancer outcomes (i.e., tobacco, lung, tobacco without lung) were highest among individuals of French origin, followed by Belgians, Dutch, Italian, Turkish, and Moroccan individuals. We observe some differences by gender. Overall, rates were far higher among men than women, with larger gender differences among non-Europeans. Among Dutch and Moroccan men, similar levels of tobacco-related cancer mortality consisted of higher lung cancer mortality among Moroccans but elevated tobacco-related cancer mortality without lung cancer among Dutch men. Tobacco-related cancer mortality that does not include lung cancer was up to twice as high among western European men (i.e., Belgian, French, Dutch, min. 65.8 per 100,000 person years [PY]) than among men of Mediterranean origin (i.e., Italian, Turkish, Moroccan; max. 38.4 per 100,000 PY for men). Among women, gaps in tobacco-related cancer mortality were large between western European and Turkish and Moroccan women, with for example threefold higher lung cancer mortality among Belgian and French women compared to Moroccan women.

Table 3.1 Characteristics of the study population at baseline (2001) by migrant origin group, listed as percentages unless otherwise stated

	Belgian	French	Dutch
Individual			
N	1,589,917	32,908	24,053
Age, mean (SE)	53.3 (0.01)	52.4 (0.04)	53.4 (0.05)
% Male	48.7	46.0	51.5
Educational level			
Tertiary	23.5	23.6	27.3
Higher Secondary	23.7	19.1	25.1
Lower Secondary	26	20.3	22.4
(Pre)primary	19.7	19.8	15.8
Unknown	7.1	17.2	9.4
Generational status			
First-generation	N/A	81.9	72.9
Second-generation	N/A	18.1	17.1
City region			
Antwerp	23.8	4.8	51.2
Brussels	43.8	66.3	28.7
Ghent	12.3	2.4	9.2
Charleroi	8.2	13.5	0.7
Liège	11.8	13.0	10.2
ISMR 2001-2014 (95% CI)			
Men			
Tobaco-related	252.7 [249.5 - 255.9]	303.8 [276.5 - 333.0]	184.5 [162.9 - 208.1]
Lung	179.8 [177.1 - 182.5]	215.3 [192.4 - 240.3]	118.7 [101.6 - 138.0]
Tobacco-related not lung	72.9 [71.2 – 74.6]	88.4 [74.2 – 104.6]	65.8 [53.1 – 80.5]
Women			
Tobaco-related	82.2 [80.5 - 84.0]	87.8 [75.4 - 101.8]	65.3 [52.7 - 80.1]
Lung	64.1 [62.6 - 65.7]	70.7 [59.6 - 83.3]	54.8 [43.43 - 68.4]
Tobacco-related not lung	18.1 [17.3 – 18.9]	17.1 [11.8 – 23.9]	10.5 [5.9 – 17.4]
Neighbourhood			
Concentration (C), m(SE)	82.7 (0.01)	4.9 (0.02)	6.2 (0.1)
Low	[9.0 - 80.1[	[0.05 - 2.9[	[0.1 - 1.7[
Moderate	[80.1 - 93.0[	[2.9 - 4.9[	[1.7 - 5.0[
High	[93.0 - 100]	[4.9 - 43.4]	[5.0 - 46.7]
(LQ, m(SE)	1.1 (0.00)	1.7 (0.01)	3.2 (0.03)
Low	[0.1 - 1.0[	[0.02 - 1.1[	[0.04 - 1.0[
Moderate	[1.0 - 1.1[	[1.1 - 1.8[	[1.0 - 2.7[
High	[1.1 - 1.4]	[1.8 - 21.4]	[2.7 - 42.0]
Lis, m(SE)	0.6 (0.00)	0.6 (0.01)	1.2 (0.01)
Low	[-5.0 - 0.1[	[-7.8 - 0.2[	[-6.7 - 0.01[
Moderate	[0.1 - 1.1[	[0.2 - 1.1[	[0.01 - 2.0[
High	[1.1 - 5.4]	[1.1 - 6.1]	[2.0 - 7.7]
Deprivation*, m(SE)	-0.3 (0.00)	0.7 (0.02)	-1.0 (0.02)

*N= absolute number; m= mean; SE=standard error; ISMR= indirectly standardised mortality rate; CI= confidence interval; LQ: Local Quotient, Lis: Localised Isolation Index, *Carstairs index*

Table 3.1 (Continued)

	Italian	Turkish	Moroccan
Individual			
N	79,507	17,076	42,969
Age, mean (SE)	52.1 (0.03)	50.6 (0.1)	51.1 (0.04)
% Male	52.8	53.0	54.5
Educational level			
Tertiary	9.2	5.6	5.3
Higher Secondary	16.5	7.3	8.3
Lower Secondary	27.0	11.1	13.0
(Pre)primary	33.0	58.1	54.3
Unknown	14.3	18.9	19.2
Generational status			
First-generation	68.4	97.3	97.2
Second-generation	31.6	2.9	2.8
City region			
Antwerp	1.1	14.4	15.5
Brussels	27.9	46.8	71.5
Ghent	0.5	13.6	1.4
Charleroi	31.1	12.3	4.1
Liège	39.5	12.9	7.5
ISMR 2001-2014 (95% CI)			
Men			
Tobaco-related	204.2 [191.4 - 217.7]	196.7 [168.7 - 227.9]	184.3 [168.0 - 201.7]
Lung	166.4 [154.8 - 178.6]	167.7 [141.9 - 196.9]	154.2 [139.3 - 170.3]
Tobacco-related not lung	38.4 [33.0 – 44.4]	30.1 [20.0 – 43.6]	30.5 [24.1 – 38.0]
Women			
Tobaco-related	58.7 [51.8 - 66.3]	39.3 [27.1 - 55.3]	31.1 [24.0 - 39.7]
Lung	49.0 [42.8 - 56.0]	31.7 [20.9 - 46.2]	21.7 [15.9 - 29.0]
Tobacco-related not lung	9.6 [6.9 – 13.0]	7.5 [2.7 – 16.5]	9.6 [5.8 – 15.0]
Neighbourhood			
Concentration (C), m(SE)	16.3 (0.04)	16.0 (0.1)	25.0 (0.1)
Low	[0.04 - 8.4[	[0.05 - 5.2[	[0.04 - 11.1[
Moderate	[8.4 - 20.5[	[5.2 - 20.5[	[11.1 - 33.7[
High	[20.5 - 62.2]	[20.5 - 62.2]	[33.7 - 68.0]
LQ, m(SE)	1.7 (0.00)	9.2 (0.1)	5.0 (0.02)
Low	[0.02 - 1.2[	[0.02 - 3.2[	[0.01 - 2.8[
Moderate	[1.2 - 1.8[	[3.2 - 11.8[	[2.8 - 6.4[
High	[1.8 - 12.2]	[11.8 - 37.7]	[6.4 - 21.2]
Lis, m(SE)	0.7 (0.00)	3.3 (0.02)	2.5 (0.01)
Low	[-8.4 - 0.3[	[-7.8 - 2.3[	[-9.6 - 2.1[
Moderate	[0.3 - 1.2[	[2.3 - 5.0[	[2.1 - 3.8[
High	[1.2 - 5.1]	[5.0 - 7.7]	[3.8 - 6.1]
Deprivation*, m(SE)	2.1 (0.01)	4.0 (0.02)	4.4 (0.01)

*N= absolute number; m= mean; SE=standard error; ISMR= indirectly standardised mortality rate; CI= confidence interval; LQ: Local Quotient, Lis: Localised Isolation Index, *Carstairs index*

The next step of analyses focused on associations between same group presence and tobacco-related cancer mortality within the selected migrant origin groups, stratified by gender. The results are presented in Tables 3.2a and b. Mortality rate ratios (MRR) in Table 3.2a represent the change in mortality rate with one unit increase in concentration, LQ, or Lis and are presented with three decimals because effects are small. MRR in Table 3.2b compare rates for individuals in 'moderate' and 'high' versus 'low same origin presence' neighbourhoods and are reported with two decimals. The MRR for model 1 were age-adjusted, whereas those for model 2 are fully adjusted for educational level and neighbourhood deprivation as well.

Overall, the MRR suggest protective associations between same group presence and tobacco-related cancer mortality, whereby mortality decreases as group presence increases. Importantly, this pattern was mainly observed among men whereas limited effects were found for women. Furthermore, Turkish men were the exception as for this group we found tobacco-related mortality to increase with an increased Turkish concentration in the neighbourhood. Effects of own group were however not found across all three same group presence indicators to the same extent and effects were sometimes dichotomous rather than linear: those living in high-versus-low presence neighbourhoods differed from each other rather than experiencing a linear change with increase in same group presence.

Table 3.2a Tobacco-related and lung cancer mortality rate ratios for same-group presence by migrant origin with 95% confidence intervals, continuous indicators for same-group presence

	French	Dutch	Italian	Turkish	Moroccan
Men					
Tobacco-Related					
Concentration					
Model 1	0.963 [0.932 - 0.996]	0.977 [0.959 - 0.995]	1.002 [0.996 - 1.008]	1.013 [1.003 - 1.023]	0.999 [0.994 - 1.004]
Model 2	0.987 [0.957 - 1.019]	0.987 [0.969 - 1.005]	0.996 [0.990 - 1.002]	1.012 [1.000 - 1.024]	0.995 [0.989 - 1.002]
Location quotient					
Model 1	0.925 [0.846 - 1.012]	0.958 [0.924 - 0.994]	0.988 [0.935 - 1.044]	1.013 [0.995 - 1.032]	0.990 [0.965 - 1.017]
Model 2	0.965 [0.894 - 1.042]	0.980 [0.949 - 1.012]	1.000 [0.995 - 1.006]	1.009 [0.987 - 1.031]	0.973 [0.939 - 1.007]
Localised isolation index					
Model 1	0.997 [0.990 - 1.004]	1.000 [0.999 - 1.001]	0.958 [0.905 - 1.014]	1.000 [1.000 - 1.001]	1.000 [0.998 - 1.001]
Model 2	0.997 [0.992 - 1.003]	1.000 [0.999 - 1.001]	0.999 [0.993 - 1.005]	1.000 [1.000 - 1.001]	0.999 [0.998 - 1.001]
Lung					
Concentration					
Model 1	0.971 [0.933 - 1.009]	0.971 [0.947 - 0.995]	1.002 [0.996 - 1.008]	1.010 [1.000 - 1.020]	1.000 [0.994 - 1.005]
Model 2	0.993 [0.957 - 1.031]	0.980 [0.957 - 1.005]	0.996 [0.990 - 1.002]	1.011 [0.999 - 1.023]	0.995 [0.988 - 1.003]
Location quotient					
Model 1	0.932 [0.839 - 1.036]	0.930 [0.879 - 0.985]	0.979 [0.922 - 1.400]	1.008 [0.990 - 1.027]	0.995 [0.967 - 1.024]
Model 2	0.969 [0.884 - 1.062]	0.957 [0.909 - 1.007]	0.948 [0.891 - 1.009]	1.007 [0.985 - 1.029]	0.977 [0.940 - 1.015]
Localised isolation index					
Model 1	0.998 [0.991 - 1.006]	0.999 [0.997 - 1.001]	0.999 [0.993 - 1.005]	1.000 [1.000 - 1.001]	1.000 [0.998 - 1.001]
Model 2	0.998 [0.992 - 1.004]	0.999 [0.998 - 1.001]	0.998 [0.992 - 1.004]	1.000 [1.000 - 1.001]	0.999 [0.997 - 1.001]
Tobacco-related no lung					
Concentration					
Model 1	0.944 [0.888 - 1.003]	0.987 [0.960 - 1.015]	1.002 [0.990 - 1.014]	1.028 [1.003 - 1.053]	0.997 [0.985 - 1.009]
Model 2	0.974 [0.921 - 1.031]	0.997 [0.969 - 1.025]	0.996 [0.983 - 1.009]	1.023 [0.995 - 1.052]	0.995 [0.978 - 1.011]
Location quotient					
Model 1	0.901 [0.767 - 1.058]	0.992 [0.948 - 1.039]	1.013 [0.909 - 1.128]	1.042 [0.998 - 1.088]	0.966 [0.904 - 1.032]
Model 2	0.955 [0.839 - 1.086]	1.006 [0.967 - 1.048]	0.992 [0.883 - 1.114]	1.030 [0.981 - 1.083]	0.950 [0.868 - 1.041]
Localised isolation index					
Model 1	0.988 [0.960 - 1.017]	1.000 [0.999 - 1.001]	1.003 [0.993 - 1.013]	1.001 [1.000 - 1.002]	0.999 [0.995 - 1.002]
Model 2	0.994 [0.979 - 1.008]	1.000 [0.999 - 1.001]	1.002 [0.992 - 1.013]	1.001 [1.000 - 1.002]	0.999 [0.994 - 1.003]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation

Table 3.2a (Continued)

		French	Dutch	Italian	Turkish	Moroccan
Women						
Tobacco-Related						
Concentration						
	Model 1	0.980 [0.932 - 1.031]	0.996 [0.969 - 1.023]	0.985 [0.974 - 0.996]	N/A	0.998 [0.985 - 1.011]
	Model 2	1.001 [0.951 - 1.052]	1.005 [0.978 - 1.033]	0.983 [0.971 - 0.994]		0.992 [0.974 - 1.010]
Location quotient						
	Model 1	0.999 [0.889 - 1.223]	0.961 [0.904 - 1.022]	0.927 [0.828 - 1.037]		0.969 [0.901 - 1.043]
	Model 2	1.028 [0.930 - 1.136]	0.980 [0.927 - 1.036]	0.922 [0.8221 -		0.935 [0.844 - 1.036]
Localised isolation index						
	Model 1	1.001 [0.995 - 1.008]	0.999 [0.997 - 1.001]	0.995 [0.982 - 1.008]		0.998 [0.994 - 1.002]
	Model 2	1.001 [0.996 - 1.007]	0.999 [0.998 - 1.001]	0.995 [0.982 - 1.008]		0.997 [0.992 - 1.002]
Lung						
Concentration						
	Model 1	0.992 [0.940 - 1.046]	1.004 [0.978 - 1.032]	0.982 [0.970 - 0.994]	N/A	0.994 [0.979 - 1.010]
	Model 2	1.011 [0.958 - 1.067]	1.011 [0.984 - 1.039]	0.980 [0.967 - 0.992]		0.988 [0.967 - 1.010]
Location quotient						
	Model 1	1.029 [0.918 - 1.154]	0.981 [0.927 - 1.038]	0.913 [0.807 - 1.033]		0.9566 [0.876 -
	Model 2	1.050 [0.950 - 1.162]	0.992 [0.942 - 1.045]	0.910 [0.803 - 1.032]		0.9210 [0.8125 -
Localised isolation index						
	Model 1	1.002 [0.996 - 1.008]	0.999 [0.998 - 1.001]	0.994 [0.980 - 1.008]		0.997 [0.991 - 1.002]
	Model 2	1.002 [0.997 - 1.008]	1.000 [0.998 - 1.001]	0.994 [0.979 - 1.008]		0.995 [0.988 - 1.002]
Tobacco-related no lung						
Concentration						
	Model 1	0.917 [0.799 - 1.053]	N/A	0.997 [0.971 - 1.023]	N/A	N/A
	Model 2	0.946 [0.820 - 1.091]		0.997 [0.970 - 1.024]		
Location quotient						
	Model 1	0.792 [0.526 - 1.192]		0.983 [0.765 - 1.263]		
	Model 2	0.871 [0.588 - 1.900]		0.971 [0.754 - 1.251]		
Localised isolation index						
	Model 1	0.967 [0.883 - 1.059]		0.999 [0.974 - 1.026]		
	Model 2	0.987 [0.922 - 1.057]		0.998 [0.972 - 1.025]		

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; N/A=not available because the number of deaths is below 35

Table 3.2b Tobacco-related and lung cancer mortality rate ratios for same-group presence by migrant origin with 95% confidence intervals, categorical indicators for same-group presence

		French		Dutch		Italian	
Men		Model1	Model2	Model1	Model2	Model1	Model2
Tobacco-related							
Concentration							
	Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Moderate	0.83 [0.66 - 1.04]	0.81 [0.65 - 1.02]	0.67 [0.50 - 0.90]	0.72 [0.53 - 0.97]	1.12 [0.95 - 1.33]	0.94 [0.73 - 1.21]
	High	0.86 [0.67 - 1.10]	1.11 [0.86 - 1.42]	0.61 [0.45 - 0.82]	0.74 [0.54 - 1.02]	1.17 [0.98 - 1.38]	0.88 [0.65 - 1.19]
LQ							
	Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Moderate	0.92 [0.74 - 1.16]	0.95 [0.76 - 1.19]	0.69 [0.51 - 0.92]	0.79 [0.59 - 1.07]	0.98 [0.83 - 1.16]	0.98 [0.75 - 1.28]
	High	0.79 [0.62 - 1.02]	0.99 [0.77 - 1.28]	0.62 [0.46 - 0.83]	0.80 [0.58 - 1.11]	0.96 [0.81 - 1.13]	0.79 [0.58 - 1.08]
Lis							
	Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Moderate	0.92 [0.74 - 1.16]	0.95 [0.76 - 1.19]	0.69 [0.51 - 0.92]	0.79 [0.59 - 1.07]	0.99 [0.84 - 1.17]	0.99 [0.76 - 1.30]
	High	0.79 [0.62 - 1.02]	0.99 [0.77 - 1.28]	0.62 [0.46 - 0.83]	0.80 [0.58 - 1.11]	0.96 [0.81 - 1.14]	0.81 [0.59 - 1.11]
Lung							
Concentration							
	Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Moderate	0.85 [0.65 - 1.12]	0.84 [0.64 - 1.10]	0.76 [0.53 - 1.10]	0.82 [0.56 - 1.18]	1.13 [0.94 - 1.35]	0.90 [0.68 - 1.19]
	High	0.84 [0.62 - 1.14]	1.08 [0.80 - 1.47]	0.64 [0.43 - 0.95]	0.77 [0.51 - 1.17]	1.14 [0.95 - 1.37]	0.87 [0.63 - 1.20]
LQ							
	Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Moderate	0.86 [0.65 - 1.13]	0.89 [0.68 - 1.16]	0.67 [0.47 - 0.97]	0.76 [0.52 - 1.11]	0.98 [0.82 - 1.17]	0.96 [0.71 - 1.29]
	High	0.76 [0.56 - 1.02]	0.93 [0.69 - 1.27]	0.58 [0.40 - 0.85]	0.73 [0.49 - 1.10]	0.94 [0.79 - 1.13]	0.82 [0.59 - 1.16]
Lis							
	Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Moderate	0.86 [0.65 - 1.13]	0.89 [0.68 - 1.16]	0.67 [0.47 - 0.97]	0.76 [0.52 - 1.11]	0.98 [0.82 - 1.17]	0.95 [0.70 - 1.28]
	High	0.76 [0.56 - 1.02]	0.93 [0.69 - 1.27]	0.58 [0.40 - 0.85]	0.73 [0.49 - 1.10]	0.94 [0.78 - 1.12]	0.84 [0.60 - 1.18]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; LQ=Location quotient, Lis=Localised isolation index

Table 3.2b (Continued)

	French		Dutch		Italian	
Tobacco-related not lung	Model1	Model2	Model1	Model2	Model1	Model2
Concentration						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	0.79 [0.53 - 1.19]	0.77 [0.51 - 1.15]	0.52 [0.31 - 0.85]	0.55 [0.33 - 0.92]	1.14 [0.79 - 1.64]	1.17 [0.63 - 2.17]
High	0.87 [0.57 - 1.32]	1.19 [0.78 - 1.83]	0.57 [0.35 - 0.92]	0.69 [0.41 - 1.16]	1.23 [0.86 - 1.76]	0.97 [0.46 - 2.05]
LQ						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	1.11 [0.75 - 1.64]	1.13 [0.77 - 1.67]	0.72 [0.44 - 1.18]	0.85 [0.51 - 1.41]	1.04 [0.73 - 1.48]	1.09 [0.57 - 2.08]
High	0.88 [0.57- 1.34]	1.15 [0.74 - 1.79]	0.71 [0.44 - 1.16]	0.95 [0.56 - 1.61]	1.01 [0.71 - 1.45]	0.61 [0.28 - 1.33]
Lis						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	1.11 [0.75 - 1.64]	1.13 [0.77 - 1.67]	0.72 [0.44 - 1.18]	0.85 [0.51 - 1.41]	1.06 [0.74 - 1.51]	1.21 [0.64 - 2.32]
High	0.88 [0.57 - 1.36]	1.15 [0.74 - 1.79]	0.71 [0.44 - 1.16]	0.95 [0.56 - 1.61]	1.04 [0.73 - 1.49]	0.64 [0.29 - 1.42]
Women						
Tobacco-related						
Concentration						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	0.81 [0.57 - 1.14]	0.80 [0.56 - 1.13]	0.89 [0.55 - 1.46]	1.01 [0.61 - 1.67]	1.02 [0.76 - 1.36]	0.97 [0.72 - 1.31]
High	0.86 [0.60 - 1.24]	1.02 [0.70 - 1.50]	0.89 [0.54 - 1.46]	1.13 [0.65 - 1.96]	0.63 [0.46 - 0.87]	0.60 [0.43 - 0.83]
LQ						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	0.77 [0.55 - 1.10]	0.79 [0.55 - 1.11]	0.81 [0.50 - 1.32]	1.00 [0.61 - 1.67]	0.97 [0.72 - 1.30]	0.97 [0.72 - 1.30]
High	0.83 [0.58 - 1.19]	0.98 [0.67 - 1.44]	0.74 [0.45 - 1.23]	0.99 [0.57 - 1.72]	0.73 [0.54 - 1.00]	0.72 [0.53 - 0.99]
Lis						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	0.77 [0.55 - 1.10]	0.79 [0.55 - 1.11]	0.81 [0.50 - 1.32]	1.00 [0.61 - 1.67]	0.99 [0.74 - 1.33]	0.99 [0.74 - 1.33]
High	0.83 [0.58 - 1.19]	0.98 [0.67 - 1.44]	0.74 [0.45 - 1.23]	0.99 [0.57 - 1.72]	0.71 [0.52 - 0.97]	0.70 [0.51 - 0.96]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; LQ=Location quotient, Lis=Localised isolation index

Table 3.2b (Continued)

	French		Dutch		Italian	
Lung	Model1	Model2	Model1	Model2	Model1	Model2
Concentration						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	0.90 [0.61 - 1.33]	0.89 [0.60 - 1.32]	1.17 [0.68 - 2.01]	1.32 [0.76 - 2.30]	0.95 [0.70 - 1.29]	0.89 [0.65 - 1.23]
High	0.95 [0.63 - 1.43]	1.11 [0.72 - 1.69]	1.13 [0.65 - 1.97]	1.42 [0.77 - 2.62]	0.59 [0.42 - 0.83]	0.55 [0.39 - 0.79]
LQ						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	0.88 [0.59 - 1.30]	0.89 [0.60 - 1.32]	0.92 [0.54 - 1.57]	1.14 [0.65 - 1.99]	0.98 [0.72 - 1.33]	0.97 [0.71 - 1.33]
High	0.98 [0.66 - 1.47]	1.15 [0.75 - 1.75]	0.91 [0.53 - 1.56]	1.18 [0.65 - 2.15]	0.69 [0.49 - 0.96]	0.68 [0.48 - 0.96]
Lis						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	0.88 [0.59 - 1.30]	0.89 [0.60 - 1.32]	0.92 [0.54 - 1.57]	1.14 [0.65 - 1.99]	0.99 [0.73 - 1.35]	0.99 [0.72 - 1.35]
High	0.98 [0.66 - 1.47]	1.15 [0.75 - 1.75]	0.91 [0.53 - 1.56]	1.18 [0.65 - 2.15]	0.67 [0.48 - 0.95]	0.66 [0.47 - 0.94]
Tobacco-related not lung						
Concentration						
Low	Ref.	Ref.	N/A		Ref.	Ref.
Moderate	0.52 [0.23 - 1.16]	0.52 [0.23 - 1.16]			1.49 [0.70 - 3.13]	1.55 [0.72 - 3.37]
High	0.58 [0.25 - 1.34]	0.75 [0.31 - 1.80]			0.88 [0.39 - 2.01]	0.91 [0.38 - 2.14]
LQ						
Low	Ref.	Ref.			Ref.	Ref.
Moderate	0.48 [0.22 - 1.06]	0.50 [0.22 - 1.10]			0.86 [0.40 - 1.83]	0.86 [0.40 - 1.85]
High	0.40 [0.16 - 1.00]	0.50 [0.19 - 1.30]			0.97 [0.47 - 2.03]	0.95 [0.45 - 2.00]
Lis						
Low	Ref.	Ref.			Ref.	Ref.
Moderate	0.48 [0.22 - 1.06]	0.50 [0.22 - 1.10]			0.93 [0.44 - 1.95]	0.93 [0.44 - 1.97]
High	0.40 [0.16 - 1.00]	0.50 [0.19 - 1.30]			0.91 [0.43 - 1.91]	0.88 [0.41 - 1.88]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; LQ=Location quotient, Lis=Localised isolation index; N/A=not available because the number of deaths is below 20

Table 3.2b (Continued)

		Turkish		Moroccan	
		Model1	Model2	Model1	Model2
Men					
Tobacco-related					
Concentration					
	Low	Ref.	Ref.	Ref.	Ref.
	Moderate	1.10 [0.75 - 1.62]	1.04 [0.70 - 1.56]	1.02 [0.81 - 1.27]	0.94 [0.73 - 1.21]
	High	1.26 [0.86 - 1.86]	1.14 [0.73 - 1.78]	1.00 [0.80 - 1.25]	0.88 [0.65 - 1.19]
LQ					
	Low	Ref.	Ref.	Ref.	Ref.
	Moderate	1.12 [0.76 - 1.64]	1.06 [0.71 - 1.57]	1.11 [0.89 - 1.39]	0.98 [0.75 - 1.28]
	High	1.22 [0.82 - 1.80]	1.09 [0.70 - 1.70]	0.92 [0.73 - 1.16]	0.79 [0.58 - 1.08]
Lis					
	Low	Ref.	Ref.	Ref.	Ref.
	Moderate	1.12 [0.76 - 1.65]	1.06 [0.71 - 1.57]	1.11 [0.89 - 1.39]	0.99 [0.76 - 1.30]
	High	1.22 [0.82 - 1.80]	1.09 [0.70 - 1.69]	0.93 [0.74 - 1.18]	0.81 [0.59 - 1.11]
Lung					
Concentration					
	Low	Ref.	Ref.	Ref.	Ref.
	Moderate	1.21 [0.81 - 1.80]	1.15 [0.76 - 1.75]	0.99 [0.78 - 1.27]	0.90 [0.68 - 1.19]
	High	1.18 [0.79 - 1.77]	1.12 [0.70 - 1.79]	1.01 [0.79 - 1.29]	0.87 [0.63 - 1.20]
LQ					
	Low	Ref.	Ref.	Ref.	Ref.
	Moderate	1.15 [0.77 - 1.73]	1.12 [0.73 - 1.70]	1.09 [0.86 - 1.40]	0.96 [0.71 - 1.29]
	High	1.21 [0.81 - 1.80]	1.18 [0.74 - 1.86]	0.97 [0.76 - 1.24]	0.82 [0.59 - 1.16]
Lis					
	Low	Ref.	Ref.	Ref.	Ref.
	Moderate	1.18 [0.79 - 1.77]	1.17 [0.77 - 1.77]	1.08 [0.85 - 1.38]	0.95 [0.70 - 1.28]
	High	1.18 [0.79 - 1.77]	1.16 [0.73 - 1.85]	0.98 [0.77 - 1.26]	0.84 [0.60 - 1.18]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; LQ=Location quotient, Lis=Localised isolation index

Table 3.2b (Continued)

	Turkish		Moroccan	
	Model1	Model2	Model1	Model2
Tobacco-related not lung				
Concentration				
Low	Ref.	Ref.	Ref.	Ref.
Moderate	0.50 [0.15 - 1.70]	0.46 [0.13 - 1.59]	1.14 [0.67 - 1.95]	1.17 [0.63 - 2.17]
High	1.90 [0.77 - 4.71]	1.47 [0.53 - 4.10]	0.96 [0.55 - 1.67]	0.97 [0.46 - 2.05]
LQ				
Low	Ref.	Ref.	Ref.	Ref.
Moderate	0.87 [0.31 - 2.47]	0.77 [0.27 - 2.22]	1.19 [0.71 - 1.99]	1.09 [0.57 - 2.08]
High	1.42 [0.54 - 3.75]	1.04 [0.36 - 3.01]	0.69 [0.39 - 1.24]	0.61 [0.28 - 1.33]
Lis				
Low	Ref.	Ref.	Ref.	Ref.
Moderate	0.74 [0.25 - 2.17]	0.65 [0.22 - 1.97]	1.28 [0.77 - 2.14]	1.21 [0.64 - 2.32]
High	1.60 [0.62 - 4.13]	1.21 [0.43 - 3.41]	0.70 [0.39 - 1.27]	0.64 [0.29 - 1.42]
Women				
Tobacco-related				
Concentration				
Low	N/A		Ref.	Ref.
Moderate			1.17 [0.64 - 2.13]	1.08 [0.54 - 2.18]
High			1.00 [0.54 - 1.84]	0.89 [0.39 - 2.03]
LQ				
Low			Ref.	Ref.
Moderate			1.00 [0.56 - 1.82]	0.94 [0.40 - 1.74]
High			0.85 [0.47 - 1.56]	0.66 [0.29 - 1.53]
Lis				
Low			Ref.	Ref.
Moderate			1.02 [0.57 - 1.84]	0.84 [0.41 - 1.74]
High			0.83 [0.45 - 1.53]	0.63 [0.27 - 1.47]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; LQ=Location quotient, Lis=Localised isolation index; N/A=not available because the number of deaths is below 35

Table 3.2b (Continued)

	Turkish		Moroccan	
	Model1	Model2	Model1	Model2
Lung				
Concentration				
Low	N/A		Ref.	Ref.
Moderate			1.11 [0.55 - 2.25]	1.03 [0.45 - 2.35]
High			0.92 [0.44 - 1.90]	0.82 [0.31 - 2.20]
LQ				
Low			Ref.	Ref.
Moderate			1.09 [0.55 - 2.16]	0.91 [0.39 - 2.14]
High			0.73 [0.35 - 1.54]	0.57 [0.21 - 1.58]
Lis				
Low			Ref.	Ref.
Moderate			1.06 [0.53 - 2.11]	0.89 [0.38 - 2.10]
High			0.75 [0.36 - 1.58]	0.59 [0.21 - 1.62]
Tobacco-related not lung				
	N/A		N/A	

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; LQ=Location quotient, Lis=Localised isolation index; N/A=not available because the number of deaths is below 35 for lung cancer, and below 20 for tobacco-related cancer that excludes lung cancer

Looking specifically at the results for men, same-origin effects were protective for individuals with French, Dutch, and Italian origin. An increase in same-origin concentration brought about a decrease of 4% (MRR 0.964, 95%CI 0.932 - 0.996) in French, and 2% (MRR 0.977, 95%CI 0.959 - 0.995) in Dutch tobacco-related cancer mortality (Table 3.2a, Model 1). For Dutch men, the protective association with mortality was somewhat larger according to the LQ (MRR 0.958, 95%CI 0.924 - 0.994). The protective effect could also be observed for high and moderate versus low concentrated, LQ, and Lis neighbourhoods (Table 3.2b, Model1). We observed similar decreases in lung cancer mortality among Dutch men when concentration and LQ increased (Table 3.2a, Model 1), and for neighbourhoods with high (concentration, LQ, Lis) and moderate (LQ, Lis) versus low Dutch presence (Table 3.2b, Model1). For tobacco-related cancer mortality excluding lung cancer, protective effects were limited to neighbourhoods with high (MRR 0.57, 95% CI 0.35 - 0.92) and moderate (MRR 0.52, 95%CI 0.31 - 0.85) compared to low Dutch concentration (Table 3.2a, Model1). The protective effects observed for French and Dutch men were attenuated in the model adjusted for individual education and neighbourhood deprivation (Tables 3.2a and b, Model2), except for tobacco-related cancer mortality for Dutch men in highly Dutch-concentrated neighbourhoods. For Italian men, a protective same-origin effect for tobacco-related and lung cancer was only apparent in this fully adjusted model, and was limited to high- versus low-Italian-populated neighbourhoods (measured with LQ and Lis). Still for men, tobacco-related mortality among individuals with Turkish origin was ca. 1% higher as Turkish concentration in the neighbourhood increased (MRR 1.013, 95%CI 1.003 - 1.023), and almost 3% when lung cancer mortality was excluded from the analysis (MRR 1.028, 95%CI 1.003 - 1.053) (Table 3.1a, Model1). This detrimental effect among Turkish men persisted upon adjustment for neighbourhood and individual socioeconomic resources, but not when we excluded lung cancer from the group of cancers studied (Table 2a, Model2). A small detrimental effect was also visible for increases in the Turkish Lis, while for other groups this indicator only manifested same-origin effects in its categorical form (i.e., for individuals in high and moderate versus low Lis neighbourhoods). The Lis therefore appears to be a more powerful indicator when it is categorised.

Among women, same-origin effects were only detected in the group of Italian origin. For these women, tobacco-related (MRR 0.985, 95%CI 0.974 - 0.996) and lung cancer mortality rates (MRR 0.982, 95%CI 0.970 - 0.994) significantly decreased with increased Italian neighbourhood concentration. These effects persisted in the fully adjusted models (Table 3.2a, Models 1 and 2). Protective effects were also visible for women in high versus low Italian-populated neighbourhoods for these two outcomes and each of the three presence-indicators used.

Tables 3.3 and 3.4 show tobacco-related cancer MRR for the product terms between same-origin presence with generational status and educational level, respectively. Our findings suggest interaction effects by generational status: the effect of same-origin presence in the neighbourhood was more detrimental for second- versus first-generation male Turkish and Moroccan migrants. However, the main effect for same-origin presence was not statistically significant in these models, implying that a detrimental same-origin effect was limited to the second generation (Table 3.3). For the product terms with educational level (Table 3.4), we found a more protective effect of same-origin presence on tobacco-related cancer mortality among those in (pre)primary education compared to tertiary education for Dutch men, and Moroccan men and women for whom information on education was absent. Interaction effects for lung cancer were not statistically significant and were therefore only included in the supplemental materials for this paper (Tables S3.1a and b). For tobacco-related cancer mortality without lung cancer, the models with interaction effects can also be found in Tables S3.2a and b, and we only observed effect medication among Italian men (Table S3.2b): for those with lower secondary, (pre)primary, and unknown educational levels mortality was lower than for the tertiary educated when the Italian LQ increased.

Additional sensitivity analyses for same-origin effects on lung cancer mortality with a restricted cohort according to duration of stay (min. 20 years) did not yield substantially different results than the ones we reported before without limiting duration of stay. We also did not find interaction effects between same-group presence and duration of stay in the first generation (results not shown but available upon request from first author).

Table 3.3 Tobacco-related cancer mortality rate ratios for the product terms between same-group presence and generational status and their basic effects, by migrant origin with 95% confidence intervals

	French		Dutch		Italian	
Men	Model1	Model2	Model1	Model2	Model1	Model2
C	0.97 [0.93 - 1.00]	0.90 [0.96 - 1.02]	0.98 [0.96 - 1.00]	0.99 [0.97 - 1.01]	1.00 [1.00 - 1.01]	1.00 [0.99 - 1.00]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.07 [0.71 - 1.63]	1.11 [0.74 - 1.67]	1.13 [0.82 - 1.55]	1.00 [0.73 - 1.37]	1.27 [0.97 - 1.67]	1.50 [1.14 - 1.98]
C x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
C x SG	0.98 [0.89 - 1.07]	0.99 [0.90 - 1.08]	0.99 [0.94 - 1.04]	0.99 [0.94 - 1.04]	1.00 [0.99 - 1.01]	1.00 [0.99 - 1.01]
LQ	0.92 [0.83 - 1.01]	0.96 [0.88 - 1.04]	0.95 [0.91 - 0.99]	0.97 [0.94 - 1.01]	0.99 [0.94 - 1.05]	0.97 [0.91 - 1.03]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	0.91 [0.60 - 1.39]	0.93 [0.63 - 1.37]	1.02 [0.75 - 1.39]	0.94 [0.69 - 1.27]	1.27 [0.97 - 1.65]	1.47 [1.11 - 1.94]
LQ x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LQ x SG	1.05 [0.82 - 1.35]	1.10 [0.89 - 1.36]	1.04 [0.96 - 1.12]	1.02 [0.95 - 1.09]	1.01 [0.88 - 1.15]	1.00 [0.87 - 1.16]
Lis	1.00 [0.99 - 1.00]	1.00 [0.99 - 1.00]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [0.99 - 1.01]	1.00 [0.99 - 1.01]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	0.95 [0.75 - 1.22]	1.02 [0.80 - 1.30]	1.15 [0.89 - 1.49]	0.98 [0.75 - 1.28]	1.30 [1.09 - 1.55]	1.51 [1.26 - 1.82]
Lis x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Lis x SG	1.01 [1.00 - 1.03]	1.01 [1.00 - 1.02]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [0.98 - 1.01]	1.00 [0.98 - 1.01]
Women						
C	0.98 [0.92 - 1.04]	1.00 [0.94 - 1.06]	1.00 [0.98 - 1.03]	1.01 [0.98 - 1.04]	0.98 [0.97 - 1.00]	0.98 [0.97 - 0.99]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.41 [0.77 - 2.59]	1.43 [0.78 - 2.63]	1.42 [0.79 - 2.56]	1.26 [0.70 - 2.26]	1.42 [0.90 - 2.23]	1.53 [0.97 - 2.43]
C x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
C x SG	1.02 [0.90 - 1.16]	1.02 [0.90 - 1.16]	0.92 [0.79 - 1.07]	0.93 [0.81 - 1.07]	1.01 [0.99 - 1.03]	1.01 [0.98 - 1.03]
LQ	0.98 [0.85 - 1.13]	1.01 [0.90 - 1.14]	0.97 [0.91 - 1.03]	0.98 [0.93 - 1.04]	0.96 [0.85 - 1.09]	0.95 [0.84 - 1.08]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.23 [0.69 - 2.18]	1.22 [0.72 - 2.09]	1.24 [0.67 - 2.30]	1.11 [0.61 - 2.01]	1.83 [1.13 - 2.96]	1.95 [1.19 - 3.19]
LQ x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LQ x SG	1.16 [0.87 - 1.56]	1.19 [0.91 - 1.54]	0.90 [0.68 - 1.21]	0.92 [0.71 - 1.20]	0.93 [0.72 - 1.21]	0.93 [0.71 - 1.21]
Lis	1.00 [0.99 - 1.01]	1.00 [0.99 - 1.01]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [0.98 - 1.01]	1.00 [0.98 - 1.01]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.00 [0.99 - 1.01]	1.52 [1.07 - 2.16]	1.26 [0.77 - 2.05]	1.11 [0.67 - 1.82]	1.71 [1.25 - 2.34]	1.83 [1.32 - 2.53]
Lis x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Lis x SG	1.51 [1.06 - 2.14]	1.01 [0.99 - 1.03]	0.97 [0.90 - 1.04]	0.97 [0.91 - 1.04]	0.99 [0.95 - 1.03]	0.99 [0.95 - 1.03]

FG= First generation, SG= Second generation; Model 1: age at baseline; Model 2: age at baseline, level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index

Table 3.3 (Continued)

	Turkish		Moroccan	
Men	Model1	Model2	Model1	Model2
C	1.01 [1.00 - 1.02]	1.01 [1.00 - 1.02]	1.00 [0.99 - 1.00]	1.00 [0.99 - 1.00]
FG	Ref.	Ref.	Ref.	Ref.
SG	1.70 [0.70 - 4.12]	1.62 [0.66 - 3.99]	3.12 [1.85 - 5.27]	3.05 [1.79 - 5.19]
C x FG	Ref.	Ref.	Ref.	Ref.
C x SG	1.04 [1.01 - 1.08]	1.05 [1.01 - 1.08]	1.01 [0.99 - 1.03]	1.01 [0.99 - 1.03]
LQ	1.01 [0.99 - 1.03]	1.01 [0.98 - 1.03]	0.99 [0.96 - 1.02]	0.97 [0.94 - 1.01]
FG	Ref.	Ref.	Ref.	Ref.
SG	2.12 [0.95 - 4.71]	2.06 [0.91 - 4.68]	3.06 [1.77 - 5.27]	2.98 [1.70 - 5.21]
LQ x FG	Ref.	Ref.	Ref.	Ref.
LQ x SG	1.05 [1.00 - 1.11]	1.06 [1.00 - 1.12]	1.06 [0.97 - 1.17]	1.06 [0.96 - 1.17]
Lis	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]
FG	Ref.	Ref.	Ref.	Ref.
SG	2.46 [1.30 - 4.68]	2.48 [1.28 - 4.80]	3.40 [2.32 - 4.99]	3.29 [2.22 - 4.87]
Lis x FG	Ref.	Ref.	Ref.	Ref.
Lis x SG	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	1.00 [1.00 - 1.01]
Women				
C	N/A		1.00 [0.99 - 1.02]	1.00 [0.98 - 1.01]
FG			Ref.	Ref.
SG			9.50 [3.69 - 24.44]	9.90 [3.49 - 28.08]
C x FG			Ref.	Ref.
C x SG			1.00 [0.96 - 1.04]	1.00 [0.96 - 1.04]
LQ			0.99 [0.92 - 1.07]	0.95 [0.86 - 1.06]
FG			Ref.	Ref.
SG			8.92 [3.33 - 23.91]	9.59 [3.19 - 28.81]
LQ x FG			Ref.	Ref.
LQ x SG			1.01 [0.82 - 1.24]	1.00 [0.81 - 1.24]
Lis			1.00 [1.00 - 1.00]	1.00 [0.99 - 1.00]
FG			Ref.	Ref.
SG			10.18 [4.86 - 21.35]	11.47 [4.80 - 27.38]
Lis x FG			Ref.	Ref.
Lis x SG			1.00 [0.98 - 1.01]	0.99 [0.97 - 1.01]

FG= First generation, SG= Second generation; Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; N/A=not available because the number of deaths is below 35

Table 3.4 Tobacco-related cancer mortality rate ratios for the product terms between same-group presence and educational level and their basic effects, by migrant origin with 95% confidence intervals

	French		Dutch		Italian	
Men	Model1	Model2	Model1	Model2	Model1	Model2
C	0.98 [0.90 - 1.07]	0.99 [0.90 - 1.08]	0.99 [0.95 - 1.03]	1.00 [0.96 - 1.04]	1.01 [0.98 - 1.04]	1.00 [0.97 - 1.03]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.65 [0.80 - 3.41]	1.56 [0.75 - 3.24]	1.24 [0.74 - 2.07]	1.21 [0.73 - 2.02]	2.41 [1.39 - 4.20]	2.21 [1.26 - 3.89]
Lower secondary	1.86 [0.95 - 3.63]	1.67 [0.85 - 3.29]	2.24 [1.37 - 3.65]	2.07 [1.27 - 3.37]	1.99 [1.18 - 3.35]	1.71 [1.00 - 2.91]
(Pre)primary	3.34 [1.78 - 6.27]	2.87 [1.52 - 5.42]	3.37 [2.07 - 5.49]	2.94 [1.80 - 4.80]	2.51 [1.53 - 4.12]	1.96 [1.18 - 3.27]
Unknown	4.76 [2.52 - 9.01]	3.96 [2.09 - 7.48]	4.55 [2.65 - 7.83]	4.04 [2.35 - 6.95]	2.64 [1.55 - 4.50]	2.09 [1.21 - 3.61]
C x Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	0.99 [0.86 - 1.13]	0.98 [0.86 - 1.13]	1.02 [0.97 - 1.07]	1.02 [0.97 - 1.07]	0.97 [0.94 - 1.01]	0.97 [0.94 - 1.01]
C x Lower secondary	1.04 [0.93 - 1.18]	1.04 [0.92 - 1.18]	0.98 [0.92 - 1.03]	0.98 [0.93 - 1.03]	0.99 [0.96 - 1.02]	1.00 [0.96 - 1.03]
C x (Pre)primary	1.04 [0.93 - 1.16]	1.03 [0.92 - 1.15]	0.94 [0.88 - 1.01]	0.95 [0.88 - 1.01]	0.99 [0.96 - 1.02]	1.00 [0.97 - 1.03]
C x Unknown	0.97 [0.88 - 1.08]	0.98 [0.88 - 1.08]	0.96 [0.89 - 1.04]	0.96 [0.90 - 1.04]	0.99 [0.96 - 1.02]	1.00 [0.97 - 1.03]
LQ	0.93 [0.70 - 1.24]	0.96 [0.72 - 1.27]	0.98 [0.91 - 1.06]	1.00 [0.93 - 1.07]	1.18 [0.94 - 1.47]	1.15 [0.92 - 1.46]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.36 [0.64 - 2.86]	1.29 [0.62 - 2.69]	1.28 [0.77 - 2.12]	1.29 [0.79 - 2.10]	2.41 [1.34 - 4.35]	2.31 [1.26 - 4.23]
Lower secondary	1.98 [0.98 - 3.99]	1.79 [0.89 - 3.61]	1.98 [1.21 - 3.23]	1.88 [1.17 - 3.02]	2.23 [1.31 - 3.78]	1.96 [1.14 - 3.37]
(Pre)primary	3.45 [1.82 - 6.53]	2.97 [1.57 - 5.63]	3.43 [2.06 - 5.61]	3.00 [1.81 - 4.97]	3.39 [2.04 - 5.64]	2.83 [1.67 - 4.76]
Unknown	5.04 [2.54 - 10.00]	4.14 [2.09 - 8.20]	4.60 [2.61 - 8.09]	4.02 [2.32 - 6.98]	3.26 [1.88 - 5.65]	2.71 [1.54 - 4.77]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	1.11 [0.77 - 1.60]	1.09 [0.76 - 1.56]	1.03 [0.94 - 1.13]	1.02 [0.93 - 1.11]	0.78 [0.58 - 1.04]	0.76 [0.55 - 1.03]
LQ x Lower secondary	1.07 [0.75 - 1.52]	1.05 [0.74 - 1.49]	1.00 [0.90 - 1.10]	0.99 [0.90 - 1.08]	0.88 [0.69 - 1.12]	0.88 [0.69 - 1.14]
LQ x (Pre)primary	1.08 [0.80 - 1.46]	1.05 [0.78 - 1.42]	0.86 [0.73 - 1.01]	0.87 [0.74 - 1.02]	0.79 [0.63 - 1.00]	0.80 [0.63 - 1.02]
LQ x Unknown	0.90 [0.65 - 1.25]	0.91 [0.66 - 1.26]	0.91 [0.77 - 1.08]	0.93 [0.80 - 1.08]	0.83 [0.64 - 1.07]	0.84 [0.65 - 1.10]
Lis	0.98 [0.93 - 1.05]	0.99 [0.93 - 1.05]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.01 [0.99 - 1.04]	1.01 [0.99 - 1.04]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.49 [0.92 - 2.43]	1.40 [0.87 - 2.27]	1.39 [0.92 - 2.08]	1.35 [0.90 - 2.03]	1.78 [1.21 - 2.63]	1.65 [1.12 - 2.44]
Lower secondary	2.13 [1.33 - 3.42]	1.89 [1.19 - 3.00]	1.97 [1.33 - 2.93]	1.82 [1.22 - 2.71]	1.88 [1.31 - 2.68]	1.67 [1.16 - 2.39]
(Pre)primary	3.71 [2.39 - 5.74]	3.09 [2.00 - 4.78]	3.16 [2.12 - 4.71]	2.71 [1.80 - 4.08]	2.54 [1.80 - 3.59]	2.14 [1.50 - 3.03]
Unknown	4.15 [2.63 - 6.55]	3.52 [2.23 - 5.54]	4.20 [2.69 - 6.57]	3.65 [2.33 - 5.73]	2.62 [1.81 - 3.78]	2.21 [1.52 - 3.20]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.02 [0.96 - 1.08]	1.01 [0.95 - 1.08]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	0.98 [0.95 - 1.01]	0.98 [0.94 - 1.01]
Lis x Lower secondary	1.01 [0.93 - 1.09]	1.00 [0.94 - 1.08]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	0.99 [0.97 - 1.01]	0.99 [0.97 - 1.02]
Lis x (Pre)primary	1.01 [0.95 - 1.08]	1.01 [0.95 - 1.07]	0.97 [0.95 - 1.00]	0.98 [0.96 - 1.00]	0.98 [0.96 - 1.00]	0.98 [0.96 - 1.00]
Lis x Unknown	1.01 [0.95 - 1.07]	1.00 [0.95 - 1.07]	0.99 [0.98 - 1.01]	0.99 [0.98 - 1.01]	0.98 [0.96 - 1.01]	0.98 [0.96 - 1.01]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; Turkish women are not included because their case count is below 35

Table 3.4 (Continued)

	Turkish		Moroccan	
Men	Model1	Model2	Model1	Model2
C	1.01 [0.95 - 1.09]	1.01 [0.94 - 1.08]	1.02 [1.00 - 1.05]	1.02 [0.99 - 1.04]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.29 [0.54 - 0.81]	2.23 [0.51 - 9.66]	2.30 [0.94 - 5.62]	2.09 [0.84 - 5.22]
Lower secondary	2.79 [0.72 - 10.82]	2.62 [0.66 - 10.38]	1.87 [0.79 - 4.42]	1.87 [0.78 - 4.48]
(Pre)primary	1.91 [0.55 - 6.69]	2.18 [0.61 - 7.81]	1.76 [0.80 - 3.90]	1.69 [0.76 - 3.78]
Unknown	3.16 [0.86 - 11.58]	3.16 [0.84 - 11.86]	3.63 [1.61 - 8.17]	3.49 [1.53 - 7.92]
C x Tertiary	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	1.00 [0.92 - 1.08]	1.01 [0.93 - 1.09]	0.97 [0.94 - 1.00]	0.97 [0.94 - 1.00]
C x Lower secondary	0.99 [0.92 - 1.07]	1.01 [0.93 - 1.09]	0.98 [0.96 - 1.01]	0.98 [0.96 - 1.01]
C x (Pre)primary	1.00 [0.93 - 1.07]	1.01 [0.94 - 1.09]	0.98 [0.95 - 1.00]	0.98 [0.96 - 1.01]
C x Unknown	0.99 [0.92 - 1.06]	1.00 [0.93 - 1.08]	0.97 [0.95 - 1.00]	0.97 [0.95 - 1.00]
LQ	1.03 [0.93 - 1.15]	1.01 [0.90 - 1.14]	1.11 [0.99 - 1.26]	1.10 [0.96 - 1.25]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.52 [0.59 - 10.86]	2.39 [0.55 - 10.49]	2.36 [0.96 - 5.81]	2.18 [0.85 - 5.60]
Lower secondary	3.11 [0.79 - 12.20]	2.84 [0.71 - 11.42]	1.93 [0.82 - 4.56]	1.92 [0.78 - 4.69]
(Pre)primary	2.29 [0.65 - 8.09]	2.49 [0.68 - 9.07]	1.80 [0.82 - 3.97]	1.78 [0.78 - 4.06]
Unknown	3.62 [0.98 - 13.42]	3.48 [0.91 - 13.24]	3.91 [1.74 - 8.79]	3.84 [1.65 - 8.91]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	0.98 [0.86 - 1.11]	1.00 [0.87 - 1.14]	0.85 [0.73 - 1.00]	0.86 [0.73 - 1.01]
LQ x Lower secondary	0.97 [0.86 - 1.10]	0.99 [0.88 - 1.13]	0.92 [0.80 - 1.06]	0.92 [0.79 - 1.07]
LQ x (Pre)primary	0.98 [0.88 - 1.10]	1.00 [0.89 - 1.12]	0.89 [0.79 - 1.01]	0.89 [0.78 - 1.02]
LQ x Unknown	0.97 [0.87 - 1.09]	0.99 [0.88 - 1.11]	0.86 [0.75 - 0.98]	0.86 [0.74 - 0.99]
Lis	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.01 [1.00 - 1.01]	1.01 [1.00 - 1.01]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.30 [0.68 - 7.80]	2.26 [0.65 - 7.87]	1.69 [0.85 - 3.37]	1.60 [0.79 - 3.25]
Lower secondary	2.80 [0.89 - 8.80]	2.69 [0.83 - 8.70]	1.77 [0.93 - 3.38]	1.78 [0.92 - 3.44]
(Pre)primary	1.97 [0.68 - 5.71]	2.21 [0.73 - 6.67]	1.42 [0.78 - 2.59]	1.40 [0.76 - 2.59]
Unknown	3.05 [1.02 - 9.17]	3.11 [1.00 - 9.65]	2.73 [1.48 - 5.04]	2.67 [1.43 - 5.00]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	0.99 [0.98 - 1.00]	0.99 [0.98 - 1.00]
Lis x Lower secondary	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	0.99 [0.99 - 1.00]	0.99 [0.99 - 1.00]
Lis x (Pre)primary	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	0.99 [0.99 - 1.00]	0.99 [0.99 - 1.00]
Lis x Unknown	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	0.99 [0.99 - 1.00]	0.99 [0.99 - 1.00]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; Turkish women are not included because their case count is below 35

Table 3.4 (Continued)

	French		Dutch	
Women	Model1	Model2	Model1	Model2
C	1.00 [0.89 - 1.12]	1.01 [0.90 - 1.13]	0.92 [0.77 - 1.09]	0.93 [0.78 - 1.10]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.28 [0.51 - 3.23]	1.23 [0.49 - 3.10]	0.84 [0.30 - 2.32]	0.84 [0.31 - 2.30]
Lower secondary	2.20 [0.82 - 5.91]	2.11 [0.78 - 5.73]	1.06 [0.40 - 2.79]	1.03 [0.40 - 2.66]
(Pre)primary	2.56 [1.04 - 6.30]	2.34 [0.94 - 5.83]	2.81 [1.10 - 7.19]	2.45 [0.96 - 6.24]
Unknown	1.22 [0.48 - 3.09]	1.12 [0.44 - 2.83]	2.90 [0.96 - 8.74]	2.57 [0.86 - 7.67]
C x Tertiary	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	1.05 [0.90 - 1.21]	1.05 [0.90 - 1.21]	1.12 [0.94 - 1.35]	1.11 [0.93 - 1.32]
C x Lower secondary	0.83 [0.67 - 1.04]	0.82 [0.66 - 1.03]	1.12 [0.93 - 1.34]	1.11 [0.93 - 1.32]
C x (Pre)primary	0.93 [0.77 - 1.11]	0.91 [0.76 - 1.10]	1.03 [0.85 - 1.25]	1.03 [0.85 - 1.24]
C x Unknown	1.03 [0.90 - 1.17]	1.02 [0.90 - 1.16]	1.03 [0.83 - 1.28]	1.04 [0.84 - 1.27]
L**Q**	0.90 [0.61 - 1.31]	0.92 [0.63 - 1.34]	0.93 [0.73 - 1.18]	0.94 [0.75 - 1.19]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.16 [0.46 - 2.94]	1.15 [0.46 - 2.89]	1.21 [0.43 - 3.34]	1.22 [0.45 - 3.30]
Lower secondary	1.35 [0.47 - 3.88]	1.26 [0.43 - 3.65]	1.37 [0.52 - 3.62]	1.36 [0.52 - 3.51]
(Pre)primary	1.59 [0.67 - 3.81]	1.45 [0.60 - 3.48]	3.28 [1.23 - 8.74]	2.94 [1.12 - 7.74]
Unknown	0.95 [0.36 - 2.52]	0.87 [0.33 - 2.32]	4.18 [1.28 - 13.70]	3.67 [1.13 - 11.87]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	1.18 [0.77 - 1.83]	1.16 [0.76 - 1.79]	1.07 [0.82 - 1.40]	1.06 [0.83 - 1.36]
LQ x Lower secondary	0.88 [0.47 - 1.63]	0.87 [0.47 - 1.63]	1.09 [0.85 - 1.40]	1.07 [0.85 - 1.36]
LQ x (Pre)primary	1.13 [0.75 - 1.71]	1.11 [0.73 - 1.68]	0.94 [0.69 - 1.28]	0.95 [0.71 - 1.27]
LQ x Unknown	1.22 [0.80 - 1.86]	1.21 [0.80 - 1.83]	0.84 [0.53 - 1.35]	0.87 [0.55 - 1.36]
Lis	0.97 [0.89 - 1.06]	0.98 [0.90 - 1.06]	0.99 [0.97 - 1.02]	0.99 [0.97 - 1.02]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.37 [0.73 - 2.57]	1.35 [0.72 - 2.51]	1.34 [0.58 - 3.09]	1.34 [0.58 - 3.09]
Lower secondary	1.10 [0.56 - 2.16]	1.02 [0.52 - 1.99]	1.55 [0.69 - 3.47]	1.51 [0.67 - 3.36]
(Pre)primary	1.77 [0.97 - 3.23]	1.58 [0.86 - 2.90]	3.05 [1.37 - 6.78]	2.72 [1.22 - 6.11]
Unknown	1.15 [0.57 - 2.33]	1.06 [0.53 - 2.15]	3.76 [1.46 - 9.72]	3.35 [1.29 - 8.69]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.03 [0.94 - 1.12]	1.03 [0.94 - 1.12]	1.01 [0.98 - 1.03]	1.00 [0.98 - 1.03]
Lis x Lower secondary	1.02 [0.90 - 1.15]	1.01 [0.90 - 1.14]	1.01 [0.98 - 1.03]	1.01 [0.98 - 1.03]
Lis x (Pre)primary	1.03 [0.94 - 1.12]	1.02 [0.94 - 1.11]	1.00 [0.96 - 1.03]	1.00 [0.96 - 1.03]
Lis x Unknown	1.03 [0.95 - 1.13]	1.03 [0.95 - 1.12]	0.97 [0.89 - 1.05]	0.97 [0.90 - 1.05]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index

Table 3.4 (Continued)

	Italian		Moroccan	
Women	Model1	Model2	Model1	Model2
C	1.00 [0.93 - 1.07]	1.00 [0.93 - 1.07]	1.04 [0.97 - 1.11]	1.03 [0.96 - 1.11]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	3.35 [1.08 - 10.41]	3.33 [1.07 - 10.38]	3.36 [0.27 - 42.62]	3.36 [0.25 - 44.54]
Lower secondary	2.13 [0.70 - 6.45]	2.09 [0.69 - 6.40]	0.73 [0.05 - 11.56]	0.69 [0.04 - 11.48]
(Pre)primary	2.79 [0.95 - 8.18]	2.73 [0.92 - 8.09]	0.93 [0.09 - 10.08]	0.85 [0.07 - 9.68]
Unknown	3.36 [1.08 - 10.46]	3.29 [1.04 - 10.35]	2.15 [0.18 - 25.87]	2.03 [0.16 - 25.69]
C x Tertiary	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	0.97 [0.90 - 1.05]	0.97 [0.90 - 1.05]	0.95 [0.88 - 1.03]	0.95 [0.88 - 1.04]
C x Lower secondary	0.99 [0.92 - 1.07]	0.99 [0.92 - 1.07]	0.98 [0.90 - 1.06]	0.98 [0.90 - 1.06]
C x (Pre)primary	0.98 [0.91 - 1.05]	0.98 [0.91 - 1.05]	0.96 [0.90 - 1.03]	0.97 [0.90 - 1.04]
C x Unknown	0.98 [0.91 - 1.05]	0.98 [0.91 - 1.05]	0.93 [0.86 - 1.00]	0.93 [0.86 - 1.01]
LQ	0.43 [0.13 - 1.43]	0.43 [0.13 - 1.43]	1.20 [0.85 - 1.71]	1.14 [0.76 - 1.69]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	0.88 [0.19 - 4.06]	0.89 [0.19 - 4.10]	2.64 [0.23 - 30.11]	2.71 [0.21 - 35.58]
Lower secondary	0.69 [0.16 - 2.99]	0.70 [0.16 - 3.04]	0.48 [0.03 - 7.00]	0.42 [0.02 - 7.43]
(Pre)primary	0.87 [0.20 - 3.72]	0.88 [0.20 - 3.82]	0.94 [0.10 - 8.84]	0.86 [0.08 - 9.31]
Unknown	1.05 [0.23 - 4.77]	1.06 [0.23 - 4.90]	2.44 [0.23 - 26.12]	2.51 [0.21 - 30.73]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	2.22 [0.63 - 7.76]	2.22 [0.63 - 7.74]	0.82 [0.54 - 1.26]	0.82 [0.52 - 1.20]
LQ x Lower secondary	2.37 [0.70 - 8.04]	2.37 [0.70 - 8.02]	0.95 [0.63 - 1.45]	0.97 [0.61 - 1.55]
LQ x (Pre)primary	2.09 [0.62 - 7.06]	2.09 [0.62 - 7.03]	0.82 [0.57 - 1.18]	0.83 [0.56 - 1.25]
LQ x Unknown	2.08 [0.60 - 7.15]	2.07 [0.60 - 7.12]	0.64 [0.42 - 0.99]	0.63 [0.39 - 1.01]
Lis	0.68 [0.37 - 1.27]	0.68 [0.36 - 1.30]	1.00 [0.98 - 1.03]	1.00 [0.98 - 1.03]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.29 [0.43 - 3.89]	1.30 [0.42 - 4.02]	1.67 [0.28 - 9.81]	1.66 [0.27 - 10.30]
Lower secondary	1.00 [0.34 - 2.91]	1.01 [0.34 - 3.04]	0.47 [0.07 - 3.09]	0.43 [0.06 - 2.97]
(Pre)primary	1.05 [0.36 - 3.06]	1.07 [0.36 - 3.22]	0.54 [0.11 - 2.69]	0.47 [0.09 - 2.49]
Unknown	1.25 [0.42 - 3.72]	1.27 [0.41 - 3.92]	0.94 [0.16 - 5.34]	0.92 [0.15 - 5.47]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.42 [0.76 - 2.65]	1.41 [0.74 - 2.71]	0.99 [0.96 - 1.02]	0.99 [0.96 - 1.02]
Lis x Lower secondary	1.47 [0.79 - 2.73]	1.46 [0.77 - 2.79]	1.00 [0.97 - 1.02]	1.00 [0.97 - 1.03]
Lis x (Pre)primary	1.45 [0.78 - 2.71]	1.45 [0.76 - 2.77]	0.99 [0.97 - 1.02]	1.00 [0.97 - 1.02]
Lis x Unknown	1.46 [0.78 - 2.71]	1.45 [0.76 - 2.77]	0.97 [0.94 - 1.01]	0.97 [0.93 - 1.01]

Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; Turkish women are not included because their case count is below 35

3.4 Discussion

This study aimed to understand the role of ethnic density in the neighbourhood for tobacco-related cancer mortality among different migrant origin groups in urban Belgium. We found mostly protective same-origin presence effects for tobacco-related cancer in general, and lung cancer in particular among migrant origin groups in Belgium. However, a consistently detrimental peer concentration effect on tobacco-related cancer mortality without lung cancer was observed for Turkish men. We also found different and not all significant effects when using diverse measures of same-origin presence, indicating that these measures capture different aspects of ethnic density. Furthermore, differences in cancer mortality were more pronounced for individuals in high and moderate versus low-presence neighbourhoods rather than for each point increase in the continuous indicators. Effect modification suggests a same-origin disadvantage that is only found among second-generation male Turkish and Moroccan migrants. Advantageous effects were larger for tobacco-related cancer among (pre)primary educated Dutch men, individuals of Moroccan origin with unknown educational levels, and tobacco-related cancer excluding lung cancer for all lower educated Italian men.

Earlier studies were inconclusive when it comes to ethnic density effects for cancer outcomes partially due to study variation in the cancer sites and migrant and ethnic minority groups studied, but also the different density measures and scales employed [105]. Our study first of all confirms the importance of carefully choosing one or multiple indicators that fit the concept one is trying to measure. We showed that different measures of same-origin presence yielded different results. Furthermore, one should not automatically assume a linear effect of same group presence as we showed that categorical measures help to identify particularly advantaged or disadvantaged groups. We, for example, found that Italian men in highly Italian-dense neighbourhoods had lower tobacco-related and lung cancer mortality, although point increases in Italian presence did not significantly lower the mortality rates for this group. This is important for how we approach same-origin effects on health outcomes.

Second, our study shows the importance of not treating migrants as a homogeneous category as effects clearly differ by migrant origin group. Also others have emphasised this: Fang and Tseng (2018) for example argue that this is logical considering the different health behaviours of particular origin groups, that thus contribute to different site-specific cancer risk profiles [105]. The different histories of immigration, socioeconomic profiles, and potentially health behaviour (changes) of the five origin groups included in our study population further mirror the importance of studying group-specific dynamics.

Furthermore, attention should be given to gendered dynamics and effects. Especially for French, Dutch, and Turkish groups we found differences in the presence of a same-origin effect between men and women. For French and Dutch men, we saw that the apparent advantage of same-origin presence was attenuated by taking individual education and area deprivation into account, which demonstrates that lower tobacco-related mortality in highly French and Dutch migrant origin concentrated areas seems more related to socioeconomic circumstances than social capital. The fact that we observe this for men, but not women, seems to correspond to other studies demonstrating that risk behaviour such as tobacco and alcohol consumption and their related mortality are more strongly related to SEP among men than women [177,194,195]. For Turkish men, the detrimental effect persisted upon adjustment but no effects were found for women. Furthermore, the Turkish concentration effect was not observed for lung cancer and may imply effects on other risk factors for the cancers included in this study in addition to or instead of smoking, namely alcohol consumption (oral cavity and pharynx, oesophagus), intake of fruits and vegetables (oesophagus, bladder), human papilloma virus (HPV) infection (oral cavity and pharynx, oesophagus), and occupational exposures (oesophagus, lung) [49]. Because the detrimental same-origin effect was limited to the second generation and also observable for Moroccan men when product terms were introduced, a higher presence of same-migrant group members may imply strong peer influence effects on smoking and other health behaviours that predispose to the tobacco-related cancer sites selected for this study [90]. Alternatively, this effect among men and lack thereof among women may mean that gender roles and differential participation in the labour market between men and women are important. Increased Turkish and Moroccan presence might have correlated with having an occupation at higher risk of carcinogenic exposures for second-generation migrant men, or with more frequent social interactions at work that influence health behaviour [140]. Furthermore, counteracting forces on risk factors for tobacco-related cancers may explain why we did not detect an effect among women. Future research would greatly benefit from additional inquiry into how social capital effects on specific risk behaviours may differ by gender and migrant generation for various migrant origin groups.

Finally, our work contributes to the literature by showing that same-origin effects on tobacco-related cancer mortality differ by migrant generation and by socioeconomic background. The disadvantage of same-origin presence we found among Turkish and Moroccan male second- versus first-generation migrants corresponds to a 'social blockage'-hypothesis for these groups in particular [168]. This finding suggests that these men may be in a vulnerable position in terms of smoking and other health behaviour, and requires further examination into how neighbourhood effects and potential residential immobility may translate into detrimental health outcomes. We furthermore found more beneficial same-origin effects among (pre)primary educated Dutch men and Moroccan men and women whose educational level was unknown. Our findings in this regard seem to be in line with the 'buffer hypothesis', which suggests a more beneficial same-origin capital effect among individuals with lower SEP than among those with higher SEP [169,170]. However, regarding missing information about educational levels it is important to realise that in the 2001 Belgian census this in many cases refers to those with missing replies because the census was administered by survey in 2001. This could mean that proficiency in French or Dutch was too limited to indicate the highest educational attainment, and may correlate with lower educational levels in our study population. Nevertheless, our data do not allow us to verify this.

3.4.1 Strengths and limitations

The data of our study are both its strongest asset as well as subject to a range of limitations. First, we can include the full population of Belgium in our analyses. However, the neighbourhoods in this study were predefined. There is an ongoing debate about the appropriate delineation of neighbourhoods; Not only can the chosen spatial unit of analysis affect study results [93,196–199], but choosing a unit with administrative boundaries in itself also has its limitations. In effect, the spatial context of importance may not be administratively bounded, nor limited to the neighbourhood in which an individual resides [200,201]. Second, the relevant timing and duration of important influences for cancer risk and survival are up for debate [202], which is especially important to bear in mind for cancers with long lag times between exposure and disease presentation such as lung cancer. We did perform additional sensitivity analyses for lung cancer restricting the study population to those who arrived in Belgium at least 20 years ago or were born in Belgium with at least one parent that migrated. The results by and large corroborated the findings as reported in the results section. This is most likely due to the fact that migration generally occurs in young adulthood and our study population was aged 40 to 69, implying the largest share had already been in Belgium for decades [30,31]. Nevertheless, smoking uptake may have occurred prior to the census or even migration for some. Third, the cross-sectional nature of the 2001 census that we use for our neighbourhood level indicators of same-origin presence and deprivation does not allow us to take changes in residence into account. Nevertheless, the delays between smoking and lung cancer mortality are expected to be around 20 to even 30 years, so that the earliest measure of neighbourhood composition might be the most meaningful for lung cancer mortality. For other tobacco-related cancers, delays between exposure and death rates are, however, less clear [192]. Other spatial approaches and longitudinal data structures would be an asset to expand and complement our work [94,202]. An interesting line of research for the future would be to use individualised neighbourhoods in this type of study [102], although its success will depend on the availability of detailed data and time series. Finally, our measures of same-origin presence were used as proxies for local migrant network capital and were hypothesised to influence health behaviour. Information on social interactions with same-origin peers in the neighbourhood, complemented with survey information on (the timing of uptake of) health behaviours would open routes to test the hypothesised mechanism more precisely. Notwithstanding these limitations, our data cover the entire official population residing in Belgium with a fine level of geographic detail. Cause-of-death information allowed us to model cancer sites separately, which is essential since cancer is a 'set of diseases' with distinct etiological factors and prognoses, for each of which different aspects of same-origin capital are likely to affect risk and mortality [49]. Finally, we used an innovative methodological approach by specifying different measures for same-origin presence, and examining effect modification by individual characteristics.

3.4.2 Conclusion

Our findings show that for several migrant origin groups in urban Belgium, mortality from cancers highly related to tobacco consumption was less likely for those living in ethnic dense neighbourhoods with many of the same origin. The main exceptions to this pattern are second-generation Turkish and Moroccan men, for whom mortality was higher when same-origin presence in the neighbourhood was increased. The local community network may play a crucial role for individual risk behaviour, and our findings suggest this may especially be the case for men. Our study, in consequence, suggests that the role of and mechanisms at play at the neighbourhood level may operate differently for men and women. Future research needs to better understand the potentially gendered associations between social capital and health-related behaviour in neighbourhoods. Our findings nevertheless already point to the importance of the neighbourhood for health behaviour in urban areas. This is potentially the place where preventive health interventions could successfully be made and as such may reduce inequalities between life chances of people of different (migrant) origin.

3.5 Supplemental materials

Table S3.1a Lung cancer mortality rate ratios for the product terms between same-group presence and generational status as well as their basic effects, by migrant origin with 95% confidence intervals

	French		Dutch		Italian	
Men	Model1	Model2	Model1	Model2	Model1	Model2
C	0.97 [0.93 - 1.01]	1.00 [0.96 - 1.03]	0.98 [0.95 - 1.01]	0.99 [0.96 - 1.01]	1.00 [1.00 - 1.01]	1.00 [0.99 - 1.00]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.04 [0.62 - 1.72]	1.06 [0.64 - 1.75]	1.28 [0.85 - 1.93]	1.14 [0.76 - 1.71]	1.12 [0.82 - 1.52]	1.33 [0.97 - 1.83]
C x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
C x SG	0.97 [0.86 - 1.09]	0.98 [0.88 - 1.10]	0.95 [0.88 - 1.04]	0.96 [0.88 - 1.03]	1.00 [0.98 - 1.01]	1.00 [0.98 - 1.01]
LQ	0.91 [0.81 - 1.03]	0.95 [0.86 - 1.05]	0.94 [0.88 - 1.00]	0.96 [0.91 - 1.02]	0.98 [0.92 - 1.05]	0.96 [0.90 - 1.02]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	0.76 [0.46 - 1.23]	0.79 [0.51 - 1.23]	1.16 [0.76 - 1.78]	1.06 [0.71 - 1.60]	1.11 [0.81 - 1.52]	1.31 [0.94 - 1.82]
LQ x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LQ x SG	1.15 [0.88 - 1.49]	1.16 [0.93 - 1.45]	0.96 [0.82 - 1.13]	0.96 [0.83 - 1.10]	0.98 [0.83 - 1.16]	0.97 [0.81 - 1.17]
Lis	1.00 [0.99 - 1.01]	1.00 [0.99 - 1.00]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [0.99 - 1.01]	1.00 [0.99 - 1.01]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	0.88 [0.66 - 1.19]	0.94 [0.70 - 1.27]	1.24 [0.88 - 1.74]	1.06 [0.75 - 1.50]	1.12 [0.91 - 1.38]	1.31 [1.06 - 1.63]
Lis x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Lis x SG	1.01 [1.00 - 1.03]	1.01 [1.00 - 1.02]	0.99 [0.97 - 1.01]	0.99 [0.98 - 1.01]	0.99 [0.96 - 1.02]	0.99 [0.96 - 1.02]
Women						
C	0.99 [0.94 - 1.05]	1.01 [0.95 - 1.07]	1.01 [0.98 - 1.04]	1.01 [0.99 - 1.04]	0.98 [0.97 - 0.99]	0.98 [0.96 - 0.99]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.50 [0.76 - 2.93]	1.51 [0.77 - 2.96]	1.26 [0.67 - 2.36]	1.13 [0.61 - 2.12]	1.18 [0.72 - 1.95]	1.25 [0.75 - 2.08]
C x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
C x SG	1.01 [0.88 - 1.15]	1.01 [0.88 - 1.16]	0.95 [0.84 - 1.08]	0.96 [0.85 - 1.08]	1.01 [0.99 - 1.04]	1.01 [0.99 - 1.04]
LQ	1.01 [0.89 - 1.16]	1.04 [0.92 - 1.17]	0.98 [0.93 - 1.04]	0.99 [0.94 - 1.05]	0.93 [0.81 - 1.07]	0.92 [0.80 - 1.06]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.22 [0.66 - 2.26]	1.21 [0.68 - 2.16]	1.11 [0.58 - 2.10]	1.01 [0.54 - 1.89]	1.46 [0.86 - 2.50]	1.53 [0.89 - 2.63]
LQ x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LQ x SG	1.16 [0.86 - 1.56]	1.18 [0.90 - 1.55]	0.95 [0.75 - 1.22]	0.96 [0.77 - 1.20]	1.00 [0.75 - 1.33]	0.99 [0.74 - 1.33]
Lis	1.00 [1.00 - 1.01]	1.00 [1.00 - 1.01]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [0.98 - 1.01]	1.00 [0.98 - 1.01]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.49 [1.01 - 2.20]	1.49 [1.01 - 2.20]	1.15 [0.67 - 1.96]	1.03 [0.60 - 1.78]	1.49 [1.06 - 2.10]	1.54 [1.08 - 2.20]
Lis x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Lis x SG	1.01 [0.99 - 1.03]	1.01 [0.99 - 1.03]	0.98 [0.92 - 1.04]	0.98 [0.93 - 1.04]	1.00 [0.96 - 1.04]	1.00 [0.96 - 1.04]

FG= First generation, SG= Second generation; Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index

Table S3.1a (Continued)

	Turkish		Moroccan	
Men	Model1	Model2	Model1	Model2
C	1.01 [1.00 - 1.02]	1.01 [1.00 - 1.02]	1.00 [0.99 - 1.00]	1.00 [0.99 - 1.00]
FG	Ref.	Ref.	Ref.	Ref.
SG	0.92 [0.27 - 3.18]	0.87 [0.25 - 3.08]	2.00 [1.00 - 3.97]	2.00 [0.99 - 4.01]
C x FG	Ref.	Ref.	Ref.	Ref.
C x SG	1.04 [0.99 - 1.09]	1.05 [1.00 - 1.10]	1.02 [0.99 - 1.04]	1.01 [0.99 - 1.04]
LQ	1.01 [0.99 - 1.03]	1.17 [0.38 - 3.58]	1.00 [0.97 - 1.03]	0.98 [0.94 - 1.02]
FG	Ref.	Ref.	Ref.	Ref.
SG	1.20 [0.40 - 3.59]	1.00 [0.98 - 1.03]	2.15 [1.07 - 4.33]	2.15 [1.05 - 4.42]
LQ x FG	Ref.	Ref.	Ref.	Ref.
LQ x SG	1.04 [0.96 - 1.13]	1.05 [0.97 - 1.14]	1.06 [0.93 - 1.20]	1.05 [0.92 - 1.20]
Lis	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]
FG	Ref.	Ref.	Ref.	Ref.
SG	1.24 [0.50 - 3.07]	1.25 [0.50 - 3.11]	2.46 [1.50 - 4.03]	2.44 [1.48 - 4.03]
Lis x FG	Ref.	Ref.	Ref.	Ref.
Lis x SG	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	1.00 [1.00 - 1.01]
Women				
C	N/A		1.00 [0.98 - 1.02]	0.99 [0.97 - 1.02]
FG			Ref.	Ref.
SG			13.37 [4.76 - 37.57]	13.83 [4.41 - 43.35]
C x FG			Ref.	Ref.
C x SG			0.99 [0.95 - 1.03]	0.99 [0.95 - 1.03]
LQ			0.99 [0.90 - 1.09]	0.95 [0.83 - 1.08]
FG			Ref.	Ref.
SG			12.44 [4.19 - 36.91]	13.41 [3.96 - 45.46]
LQ x FG			Ref.	Ref.
LQ x SG			0.97 [0.76 - 1.23]	0.95 [0.73 -1.22]
Lis			1.00 [0.99 - 1.00]	1.00 [0.99 - 1.00]
FG			Ref.	Ref.
SG			12.69 [5.55 - 28.98]	14.38 [5.41 - 38.22]
Lis x FG			Ref.	Ref.
Lis x SG			0.99 [0.97 - 1.02]	0.99 [0.96 - 1.02]

FG= First generation, SG= Second generation; Model 1: age at baseline; Model 2: age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; N/A= not available because the number of deaths is below 35

Table S3.1b Lung cancer mortality rate ratios for the product terms between same-group presence and educational level as well as their basic effects, by migrant origin with 95% confidence intervals

	French		Dutch		Italian	
Men	Model1	Model2	Model1	Model2	Model1	Model2
C	1.02 [0.92 - 1.13]	1.03 [0.93 - 1.13]	0.95 [0.89 - 1.02]	0.96 [0.90 - 1.03]	1.00 [0.97 - 1.04]	0.99 [0.96 - 1.03]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.06 [0.86 - 4.93]	1.96 [0.82 - 4.70]	1.01 [0.52 - 1.95]	1.00 [0.52 - 1.92]	1.98 [1.06 - 3.70]	1.81 [0.96 - 3.42]
Lower secondary	2.48 [1.11 - 5.52]	2.26 [1.01 - 5.05]	1.73 [0.93 - 3.21]	1.64 [0.89 - 3.04]	1.85 [1.04 - 3.30]	1.59 [0.88 - 2.86]
(Pre)primary	3.82 [1.81 - 8.05]	3.30 [1.56 - 6.98]	2.90 [1.57 - 5.37]	2.60 [1.40 - 4.83]	2.44 [1.41 - 4.22]	1.90 [1.08 - 3.35]
Unknown	5.61 [2.64 - 11.91]	4.75 [2.24 - 10.04]	3.99 [2.05 - 7.75]	3.64 [1.88 - 7.07]	2.40 [1.37 - 4.32]	1.89 [1.03 - 3.45]
C x Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	0.94 [0.80 - 1.10]	0.93 [0.79 - 1.10]	1.05 [0.97 - 1.14]	1.05 [0.97 - 1.13]	0.98 [0.94 - 1.02]	0.98 [0.94 - 1.02]
C x Lower secondary	0.98 [0.85 - 1.13]	0.97 [0.84 - 1.13]	1.03 [0.95 - 1.12]	1.03 [0.95 - 1.11]	1.00 [0.96 - 1.04]	1.00 [0.97 - 1.04]
C x (Pre)primary	1.02 [0.90 - 1.16]	1.01 [0.89 - 1.15]	0.97 [0.87 - 1.07]	0.97 [0.88 - 1.07]	1.00 [0.96 - 1.03]	1.00 [0.97 - 1.04]
C x Unknown	0.94 [0.84 - 1.06]	0.95 [0.85 - 1.06]	1.01 [0.92 - 1.11]	1.01 [0.92 - 1.11]	1.00 [0.97 - 1.04]	1.01 [0.97 - 1.07]
LQ	1.07 [0.79 - 1.44]	1.09 [0.81 - 1.47]	0.91 [0.79 - 1.04]	0.92 [0.80 - 1.06]	1.05 [0.76 - 1.45]	1.02 [0.73 - 1.43]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.67 [0.69 - 4.02]	1.59 [0.67 - 3.78]	1.12 [0.57 - 2.20]	1.12 [0.58 - 2.18]	2.04 [1.00 - 4.19]	1.95 [0.93 - 4.10]
Lower secondary	2.63 [1.14 - 6.05]	2.39 [1.04 - 5.47]	1.56 [0.83 - 2.92]	1.53 [0.82 - 2.84]	1.85 [0.98 - 3.48]	1.60 [0.83 - 3.08]
(Pre)primary	4.38 [2.08 - 9.24]	3.81 [1.82 - 8.01]	2.77 [1.44 - 5.33]	2.54 [1.32 - 4.88]	3.00 [1.62 - 5.56]	2.48 [1.31 - 4.69]
Unknown	6.57 [2.94 - 14.66]	5.48 [2.47 - 12.14]	4.09 [2.01 - 8.30]	3.75 [1.87 - 7.53]	2.76 [1.44 - 5.29]	2.26 [1.16 - 4.42]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	0.98 [0.65 - 1.47]	0.96 [0.65 - 1.43]	1.06 [0.89 - 1.27]	1.05 [0.89 - 1.25]	0.80 [0.53 - 1.21]	0.78 [0.51 - 1.20]
LQ x Lower secondary	0.90 [0.60 - 1.36]	0.89 [0.59 - 1.34]	1.09 [0.93 - 1.28]	1.08 [0.93 - 1.25]	1.00 [0.71 - 1.40]	1.01 [0.71 - 1.44]
LQ x (Pre)primary	0.95 [0.69 - 1.31]	0.93 [0.67 - 1.28]	0.93 [0.74 - 1.17]	0.93 [0.75 - 1.17]	0.86 [0.62 - 1.20]	0.88 [0.62 - 1.24]
LQ x Unknown	0.78 [0.54 - 1.11]	0.79 [0.55 - 1.12]	0.99 [0.79 - 1.25]	1.00 [0.81 - 1.24]	0.96 [0.68 - 1.36]	0.99 [0.69 - 1.41]
Lis	1.00 [0.96 - 1.04]	1.00 [0.97 - 1.04]	0.99 [0.98 - 1.01]	1.00 [0.98 - 1.01]	1.00 [0.97 - 1.04]	1.00 [0.96 - 1.04]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.57 [0.93 - 2.66]	1.46 [0.87 - 2.45]	1.24 [0.71 - 2.16]	1.24 [0.72 - 2.14]	1.60 [1.01 - 2.51]	1.49 [0.94 - 2.35]
Lower secondary	2.30 [1.38 - 3.83]	2.02 [1.22 - 3.33]	1.78 [1.06 - 3.01]	1.71 [1.02 - 2.88]	1.82 [1.22 - 2.73]	1.62 [1.07 - 2.43]
(Pre)primary	3.97 [2.51 - 5.29]	3.32 [2.10 - 5.25]	2.87 [1.69 - 4.87]	2.59 [1.52 - 4.41]	2.52 [1.70 - 3.72]	2.11 [1.42 - 3.15]
Unknown	4.42 [2.72 - 7.17]	3.75 [2.32 - 6.07]	4.12 [2.33 - 7.28]	3.76 [2.13 - 6.64]	2.68 [1.77 - 4.05]	2.25 [1.48 - 3.43]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.00 [0.96 - 1.04]	1.00 [0.96 - 1.04]	1.00 [0.99 - 1.02]	1.00 [0.99 - 1.02]	0.98 [0.93 - 1.04]	0.98 [0.92 - 1.04]
Lis x Lower secondary	0.99 [0.91 - 1.06]	0.99 [0.92 - 1.05]	1.01 [0.99 - 1.02]	1.00 [0.99 - 1.02]	1.00 [0.96 - 1.04]	1.00 [0.96 - 1.05]
Lis x (Pre)primary	1.00 [0.96 - 1.04]	1.00 [0.96 - 1.03]	0.98 [0.95 - 1.01]	0.98 [0.95 - 1.01]	0.99 [0.95 - 1.03]	0.99 [0.95 - 1.03]
Lis x Unknown	0.99 [0.95 - 1.03]	0.99 [0.96 - 1.03]	1.00 [0.98 - 1.02]	1.00 [0.98 - 1.02]	0.99 [0.96 - 1.04]	1.00 [0.96 - 1.04]

Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index

Table S3.1b (Continued)

	Turkish		Moroccan	
Men	Model1	Model2	Model1	Model2
C	0.99 [0.89 - 1.11]	0.99 [0.88 - 1.11]	1.02 [0.99 - 1.05]	1.02 [0.99 - 1.05]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.27 [0.46 - 11.30]	2.36 [0.47 - 11.72]	2.80 [0.95 - 8.28]	2.80 [0.94 - 8.33]
Lower secondary	2.17 [0.49 - 9.71]	2.30 [0.51 - 10.34]	2.24 [0.79 - 6.38]	2.20 [0.77 - 6.31]
(Pre)primary	1.81 [0.46 - 7.11]	1.93 [0.49 - 7.65]	2.45 [0.93 - 6.44]	2.37 [0.90 - 6.29]
Unknown	3.28 [0.80 - 13.52]	3.48 [0.84 - 14.50]	4.98 [1.86 - 13.32]	4.84 [1.80 - 13.03]
C x Tertiary	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	1.01 [0.88 - 1.14]	1.00 [0.88 - 1.14]	0.96 [0.93 - 1.00]	0.96 [0.93 - 1.00]
C x Lower secondary	1.03 [0.91 - 1.16]	1.03 [0.91 - 1.16]	0.98 [0.95 - 1.02]	0.98 [0.95 - 1.02]
C x (Pre)primary	1.03 [0.92 - 1.16]	1.03 [0.91 - 1.15]	0.98 [0.95 - 1.01]	0.98 [0.95 - 1.01]
C x Unknown	1.01 [0.90 - 1.14]	1.01 [0.90 - 1.13]	0.97 [0.94 - 1.00]	0.97 [0.94 - 1.00]
LQ	0.97 [0.78 - 1.20]	0.97 [0.74-8 - 1.20]	1.10 [0.95 - 1.28]	1.08 [0.93 - 1.27]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.30 [0.47 - 11.36]	2.32 [0.47 - 11.48]	2.62 [0.90 - 7.65]	2.67 [0.90 - 7.93]
Lower secondary	2.16 [0.48 - 9.61]	2.18 [0.48 - 9.80]	2.07 [0.75 - 5.71]	2.04 [0.72 - 5.76]
(Pre)primary	1.98 [0.51 - 7.74]	2.00 [0.51 - 7.92]	2.20 [0.86 - 5.60]	2.14 [0.82 - 5.56]
Unknown	3.43 [0.84 - 14.05]	3.46 [0.83 - 14.38]	4.71 [1.81 - 12.24]	4.63 [1.75 - 12.28]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	1.01 [0.80 - 1.28]	1.01 [0.80 - 1.28]	0.84 [0.69 - 1.02]	0.83 [0.68 - 1.02]
LQ x Lower secondary	1.06 [0.85 - 1.32]	1.06 [0.85 - 1.32]	0.93 [0.79 - 1.10]	0.93 [0.78 - 1.11]
LQ x (Pre)primary	1.05 [0.84 - 1.30]	1.05 [0.84 - 1.30]	0.90 [0.78 - 1.05]	0.91 [0.77 - 1.06]
LQ x Unknown	1.02 [0.82 - 1.27]	1.02 [0.82 - 1.27]	0.88 [0.75 - 1.03]	0.88 [0.74 - 1.03]
Lis	0.99 [0.96 - 1.03]	0.99 [0.96 - 1.03]	1.00 [1.00 - 1.01]	1.00 [1.00 - 1.01]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.19 [0.53 - 9.11]	2.20 [0.53 - 9.17]	1.67 [0.74 - 3.79]	1.67 [0.73 - 3.81]
Lower secondary	2.35 [0.63 - 8.76]	2.36 [0.62 - 8.91]	1.86 [0.87 - 3.98]	1.84 [0.85 - 3.96]
(Pre)primary	1.89 [0.56 - 6.45]	1.90 [0.55 - 6.61]	1.68 [0.83 - 3.41]	1.64 [0.80 - 3.35]
Unknown	3.02 [0.85 - 10.67]	3.03 [0.84 - 10.90]	3.28 [1.60 - 6.74]	3.21 [1.55 - 6.63]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.01 [0.97 - 1.04]	1.01 [0.97 - 1.04]	0.99 [0.98 - 1.01]	0.99 [0.98 - 1.01]
Lis x Lower secondary	1.01 [0.97 - 1.04]	1.01 [0.97 - 1.04]	1.00 [0.99 - 1.01]	1.00 [0.99 - 1.01]
Lis x (Pre)primary	1.01 [0.97 - 1.04]	1.01 [0.97 - 1.04]	1.00 [0.99 - 1.00]	1.00 [0.99 - 1.00]
Lis x Unknown	1.01 [0.97 - 1.04]	1.01 [0.97 - 1.04]	0.99 [0.99 - 1.00]	0.99 [0.99 - 1.00]

Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index

Table S3.1b (Continued)

	French		Dutch	
Women	Model1	Model2	Model1	Model2
C	0.99 [0.87 - 1.12]	0.99 [0.88 - 1.13]	0.95 [0.81 - 1.12]	0.96 [0.82 - 1.12]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.20 [0.44 - 3.24]	1.15 [0.43 - 3.12]	1.07 [0.33 - 3.43]	1.07 [0.34 - 3.39]
Lower secondary	1.79 [0.62 - 5.15]	1.71 [0.59 - 4.97]	1.74 [0.59 - 5.11]	1.68 [0.58 - 4.89]
(Pre)primary	2.06 [0.77 - 5.52]	1.89 [0.70 - 5.14]	3.33 [1.14 - 9.76]	2.98 [1.01 - 8.74]
Unknown	0.76 [0.27 - 2.15]	0.71 [0.25 - 2.00]	4.34 [1.16 - 16.24]	3.85 [1.03 - 14.30]
C x Tertiary	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	1.05 [0.89 - 1.24]	1.05 [0.89 - 1.24]	1.09 [0.92 - 1.28]	1.08 [0.92 - 1.27]
C x Lower secondary	0.88 [0.70 - 1.11]	0.88 [0.70 - 1.10]	1.07 [0.91 - 1.27]	1.07 [0.91 - 1.26]
C x (Pre)primary	0.94 [0.77 - 1.15]	0.93 [0.75 - 1.14]	1.01 [0.85 - 1.21]	1.01 [0.85 - 1.20]
C x Unknown	1.06 [0.92 - 1.21]	1.05 [0.92 - 1.21]	0.92 [0.68 - 1.23]	0.93 [0.70 - 1.23]
LQ	0.86 [0.56 - 1.31]	0.88 [0.57 - 1.34]	1.00 [0.83 - 1.20]	1.00 [0.84 - 1.19]
Tertiary	Ref.	Ref.	Ref.	Re.
Upper secondary	1.04 [0.38 - 2.81]	1.03 [0.38 - 2.77]	1.68 [0.55 - 5.14]	1.67 [0.56 - 5.00]
Lower secondary	1.09 [0.36 - 3.33]	1.02 [0.33 - 3.13]	2.40 [0.84 - 6.85]	2.33 [0.83 - 6.55]
(Pre)primary	1.22 [0.48 - 3.12]	1.12 [0.44 - 2.87]	4.10 [1.40 - 11.99]	3.75 [1.29 - 10.88]
Unknown	0.60 [0.20 - 1.78]	0.56 [0.19 - 1.66]	6.63 [1.63 - 26.91]	5.84 [1.44 - 23.67]
LQ x Tertiary	Ref.	Ref.	Ref.	
LQ x Upper secondary	1.24 [0.77 - 1.99]	1.22 [0.76 - 1.95]	1.01 [0.82 - 1.25]	1.01 [0.83 - 1.23]
LQ x Lower secondary	1.02 [0.54 - 1.92]	1.02 [0.54 - 1.92]	1.01 [0.83 - 1.23]	1.01 [0.84 - 1.22]
LQ x (Pre)primary	1.21 [0.77 - 1.90]	1.19 [0.76 - 1.86]	0.93 [0.72 - 1.19]	0.93 [0.74 - 1.18]
LQ x Unknown	1.33 [0.85 - 2.09]	1.31 [0.84 - 2.07]	0.66 [0.33 - 1.31]	0.68 [0.35 - 1.33]
Lis	0.96 [0.88 - 1.06]	0.97 [0.88 - 1.07]	1.00 [0.98 - 1.02]	1.00 [0.98 - 1.01]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.29 [0.66 - 2.53]	1.27 [0.65 - 2.47]	1.70 [0.66 - 4.41]	1.69 [0.66 - 4.33]
Lower secondary	1.04 [0.52 - 2.09]	0.98 [0.49 - 1.95]	2.40 [0.97 - 5.94]	2.33 [0.96 - 5.69]
(Pre)primary	1.47 [0.76 - 2.82]	1.32 [0.68 - 2.56]	3.60 [1.44 - 9.00]	3.32 [1.33 - 8.29]
Unknown	0.82 [0.37 - 1.82]	0.76 [0.34 - 1.69]	5.23 [1.65 - 16.56]	4.69 [1.48 - 14.89]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.04 [0.94 - 1.14]	1.03 [0.94 - 1.14]	1.00 [0.98 - 1.02]	1.00 [0.98 - 1.02]
Lis x Lower secondary	1.03 [0.93 - 1.15]	1.03 [0.93 - 1.14]	1.00 [0.98 - 1.02]	1.00 [0.99 - 1.02]
Lis x (Pre)primary	1.04 [0.94 - 1.14]	1.03 [0.94 - 1.13]	1.00 [0.97 - 1.02]	1.00 [0.97 - 1.02]
Lis x Unknown	1.04 [0.95 - 1.15]	1.04 [0.95 - 1.14]	0.87 [0.67 - 1.14]	0.88 [0.68 - 1.15]

Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; Turkish women are not included because their case count is below

Table S3.1b (Continued)

	Italian		Moroccan	
Women	Model1	Model2	Model1	Model2
C	0.99 [0.91 - 1.07]	0.98 [0.90 - 1.07]	1.01 [0.89 - 1.13]	0.99 [0.87 - 1.13]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	3.04 [0.91 - 10.16]	3.03 [0.90 - 10.18]	1.78 [0.09 - 36.03]	1.65 [0.08 - 35.68]
Lower secondary	1.84 [0.57 - 5.96]	1.82 [0.56 - 5.93]	0.69 [0.03 - 15.19]	0.60 [0.03 - 14.30]
(Pre)primary	2.50 [0.80 - 7.81]	2.37 [0.75 - 7.54]	0.58 [0.04 - 9.42]	0.49 [0.03 - 8.56]
Unknown	2.18 [0.64 - 7.43]	2.07 [0.60 - 7.17]	2.16 [0.12 - 38.06]	1.92 [0.10 - 36.25]
C x Tertiary	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	0.98 [0.89 - 1.07]	0.98 [0.89 - 1.07]	1.00 [0.88- 1.14]	1.00 [0.88 - 1.15]
C x Lower secondary	1.01 [0.93 - 1.10]	1.01 [0.93 - 1.10]	1.01 [0.89 - 1.15]	1.01 [0.89 - 1.16]
C x (Pre)primary	0.99 [0.91 - 1.08]	0.99 [0.91 - 1.08]	1.00 [0.88 - 1.12]	1.00 [0.88 - 1.14]
C x Unknown	1.00 [0.92 - 1.09]	1.00 [0.92 - 1.10]	0.94 [0.82 - 1.07]	0.94 [0.82 - 1.08]
LQ	0.33 [0.08 - 1.30]	0.33 [0.08 - 1.30]	1.01 [0.50 - 2.03]	0.91 [0.42 - 1.96]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	0.68 [0.13 - 3.50]	0.70 [0.14 - 3.58]	1.35 [0.06 - 27.99]	1.13 [0.05 - 27.26]
Lower secondary	0.54 [0.11 - 2.54]	0.55 [0.12 - 2.63]	0.47 [0.02 - 10.83]	0.36 [0.01 - 9.86]
(Pre)primary	0.69 [0.15 - 3.28]	0.70 [0.15 - 3.30]	0.64 [0.04 - 10.27]	0.51 [0.03 - 9.33]
Unknown	0.58 [0.12 - 2.90]	0.58 [0.12 - 2.92]	2.65 [0.15 - 47.06]	2.45 [0.12 - 48.79]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	2.76 [0.66 - 11.62]	2.72 [0.65 - 11.38]	1.07 [0.51 - 2.23]	1.13 [0.50 - 2.52]
LQ x Lower secondary	3.11 [0.77 - 12.58]	3.08 [0.77 - 12.36]	1.14 [0.55 - 2.38]	1.21 [0.54 - 2.71]
LQ x (Pre)primary	2.54 [0.63 - 10.27]	2.52 [0.63 - 10.12]	0.97 [0.48 - 1.97]	1.02 [0.47 - 2.21]
LQ x Unknown	3.00 [0.74 - 12.24]	2.98 [0.74 - 12.05]	0.68 [0.31 - 1.47]	0.68 [0.30 - 1.57]
Lis	0.59 [0.23 - 1.48]	0.59 [0.21 - 1.60]	0.98 [0.86 - 1.12]	0.97 [0.83 - 1.14]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.06 [0.29 - 3.89]	1.06 [0.27 - 4.17]	1.49 [0.13 - 16.50]	1.24 [0.10 - 15.17]
Lower secondary	0.87 [0.25 - 3.06]	0.87 [0.23 - 3.30]	0.65 [0.06 - 7.32]	0.49 [0.04 - 6.26]
(Pre)primary	0.84 [0.24 - 2.94]	0.84 [0.22 - 3.19]	0.50 [0.05 - 4.75]	0.38 [0.04 - 3.98]
Unknown	0.87 [0.24 - 3.13]	0.87 [0.22 - 3.40]	1.26 [0.12 - 13.16]	1.10 [0.10 - 12.51]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.63 [0.64 - 4.12]	1.63 [0.59 - 4.47]	1.02 [0.89 - 1.17]	1.03 [0.88 - 1.21]
Lis x Lower secondary	1.71 [0.68 - 4.30]	1.71 [0.63 - 4.67]	1.02 [0.89 - 1.17]	1.04 [0.88 - 1.21]
Lis x (Pre)primary	1.68 [0.67 - 4.23]	1.68 [0.62 - 4.59]	1.02 [0.89 - 1.16]	1.03 [0.88 - 1.21]
Lis x Unknown	1.71 [0.68 - 4.29]	1.71 [0.62 - 4.66]	0.98 [0.85 - 1.13]	0.99 [0.84 - 1.16]

Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; Turkish women are not included because their case count is below 35

Table S3.2a Tobacco-related cancer mortality rate ratios excluding lung cancer for the product terms between same-group presence and generational status as well as their basic effects, by migrant origin with 95% confidence intervals

	French		Dutch		Italian	
Men	Model1	Model2	Model1	Model2	Model1	Model2
C	0.94 [0.88 - 1.01]	0.97 [0.92 - 1.04]	0.98 [0.95 - 1.01]	0.99 [0.96 - 1.02]	1.00 [0.99 -1.02]	1.00 [0.98 - 1.01]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.13 [0.55 - 2.32]	1.20 [0.60 - 2.40]	0.96 [0.56 - 1.62]	0.85 [0.50 - 1.44]	2.05 [1.19 - 3.54]	2.43 [1.38 - 4.28]
C x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
C x SG	1.01 [0.86 - 1.18]	1.01 [0.87 - 1.18]	1.02 [0.96 - 1.09]	1.02 [0.96 - 1.08]	1.01 [0.98 - 1.04]	1.01 [0.98 - 1.04]
LQ	0.92 [0.78 - 1.09]	0.97 [0.85 - 1.10]	0.97 [0.91 - 1.04]	0.99 [0.94 - 1.05]	1.03 [0.91 - 1.16]	1.01 [0.88 - 1.15]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.45 [0.67 - 3.14]	1.40 [0.66 - 2.97]	0.93 [0.56 - 1.54]	0.84 [0.51 - 1.38]	2.18 [1.30 - 3.65]	2.52 [1.46 - 4.34]
LQ x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LQ x SG	0.85 [0.51 - 1.40]	0.91 [0.56 - 1.48]	1.06 [0.97 - 1.16]	1.04 [0.97 - 1.13]	1.05 [0.83 - 1.33]	1.05 [0.81 - 1.35]
Lis	0.99 [0.97 - 1.02]	0.99 [0.98 - 1.01]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [0.99 - 1.01]	1.00 [0.99 - 1.01]
FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
SG	1.27 [0.77 - 2.07]	1.27 [0.79 -2.02]	1.08 [0.70 - 1.68]	0.92 [0.59 - 1.44]	2.34 [1.64 - 3.35]	2.72 [1.87 - 3.94]
Lis x FG	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Lis x SG	0.97 [0.86 - 1.09]	0.99 [0.90 - 1.09]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [0.98 - 1.03]	1.00 [0.98 - 1.03]
Women						
C	0.89 [0.75 - 1.05]	0.92 [0.77 - 1.09]	N/A		1.01 [0.97 - 1.04]	1.00 [0.97 - 1.04]
FG	Ref.	Ref.			Ref.	Ref.
SG	1.02 [0.25 - 4.08]	1.05 [0.26 - 4.32]			3.79 [1.27 - 11.30]	4.59 [1.51 - 13.95]
C x FG	Ref.	Ref.			Ref.	Ref.
C x SG	1.12 [0.83 - 1.52]	1.13 [0.83 - 1.54]			0.98 [0.93 - 1.04]	0.99 [0.93 - 1.04]
LQ	0.75 [0.46 - 1.23]	0.83 [0.52 - 1.34]			1.12 [0.88 - 1.42]	1.10 [0.86 - 1.40]
FG	Ref.	Ref.			Ref.	Ref.
SG	1.11 [0.25 - 4.91]	1.19 [0.28 - 5.01]			5.34 [1.72 - 16.54]	6.59 [2.04 - 21.26]
LQ x FG	Ref.	Ref.			Ref.	Ref.
LQ x SG	1.27 [0.51 - 3.15]	1.28 [0.53 - 3.07]			0.68 [0.36 - 1.28]	0.68 [0.35 - 1.31]
Lis	0.96 [0.86 - 1.07]	0.98 [0.89 - 1.08]			1.01 [0.98 - 1.03]	1.01 [0.98 - 1.03]
FG	Ref.	Ref.			Ref.	Ref.
SG	1.39 [0.56 - 3.44]	1.56 [0.67 - 3.61]			3.59 [1.64 - 7.85]	4.49 [1.98 - 10.2]
Lis x FG	Ref.	Ref.			Ref.	Ref.
Lis x SG	1.04 [0.87 - 1.24]	1.03 [0.90 - 1.17]			0.94 [0.80 - 1.10]	0.94 [0.80 - 1.10]

FG= First generation, SG= Second generation; Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; N/A= not available because the number of deaths is below 20

Table S3.2a (Continued)

	Turkish		Moroccan	
Men	Model1	Model2	Model1	Model2
C	1.03 [1.00 - 1.06]	1.02 [0.99 - 1.06]	1.00 [0.99 - 1.01]	1.00 [0.98 - 1.01]
FG	Ref.	Ref.	Ref.	Ref.
SG	11.18 [2.68 - 46.65]	11.50 [2.62 - 50.51]	9.67 [4.08 - 22.94]	8.46 [3.53 - 20.23]
C x FG	Ref.	Ref.	Ref.	Ref.
C x SG	1.03 [0.98 - 1.09]	1.03 [0.98 - 1.09]	1.01 [0.98 - 1.04]	1.01 [0.98 - 1.04]
LQ	1.05 [1.00 - 1.10]	1.03 [0.98 - 1.09]	0.97 [0.90 - 1.04]	0.95 [0.86 - 1.05]
FG	Ref.	Ref.	Ref.	Ref.
SG	13.33 [3.50 - 50.78]	13.87 [3.46 - 55.57]	7.69 [3.08 - 19.21]	6.67 [2.60 - 17.09]
LQ x FG	Ref.	Ref.	Ref.	Ref.
LQ x SG	1.04 [0.95 - 1.13]	1.04 [0.95 - 1.13]	1.09 [0.93 - 1.28]	1.09 [0.93 - 1.29]
Lis	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.00 [0.99 - 1.00]	1.00 [0.99 - 1.00]
FG	Ref.	Ref.	Ref.	Ref.
SG	14.73 [5.19 - 41.76]	16.06 [5.28 - 48.85]	8.60 [4.48 - 16.51]	7.44 [3.77 - 14.68]
Lis x FG	Ref.	Ref.	Ref.	Ref.
Lis x SG	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.01 [1.00 - 1.01]	1.01 [1.00 - 1.02]
Women	N/A		N/A	

FG= First generation, SG= Second generation; Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; N/A= not available because the number of deaths is below 20

Table S3.2b Tobacco-related cancer mortality rate ratios excluding lung cancer for the product terms between same-group presence and educational level as well as their basic effects, by migrant origin with 95% confidence intervals

	French		Dutch		Italian	
Men	Model1	Model2	Model1	Model2	Model1	Model2
C	0.87 [0.71 - 1.06]	0.88 [0.72 - 1.08]	1.03 [0.98 - 1.08]	1.04 [0.99 - 1.09]	1.03 [0.98 - 1.09]	1.02 [0.97 - 1.08]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	0.95 [0.26 - 3.46]	0.87 [0.24 - 3.25]	1.63 [0.70 - 3.82]	1.58 [0.68 - 3.66]	4.63 [1.39 - 15.46]	4.32 [1.25 - 14.98]
Lower secondary	0.94 [0.29 - 3.05]	0.82 [0.25 - 2.67]	3.35 [1.46 - 7.68]	2.98 [1.30 - 6.82]	2.58 [0.78 - 8.46]	2.19 [0.64 - 7.50]
(Pre)primary	2.26 [0.74 - 6.95]	1.90 [0.60 - 6.00]	4.03 [1.78 - 9.15]	3.41 [1.49 - 7.79]	2.83 [0.91 - 8.77]	2.10 [0.65 - 6.84]
Unknown	3.03 [0.96 - 9.59]	2.37 [0.74 - 7.57]	5.61 [2.10 - 14.99]	4.73 [1.77 - 12.67]	4.25 [1.23 - 14.71]	3.37 [0.93 - 12.19]
C x Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	1.14 [0.88 - 1.49]	1.14 [0.87 - 1.49]	0.99 [0.93 - 1.06]	0.99 [0.93 - 1.06]	0.95 [0.89 - 1.01]	0.95 [0.88 - 1.01]
C x Lower secondary	1.24 [0.98 - 1.56]	1.23 [0.98 - 1.56]	0.90 [0.81 - 1.00]	0.91 [0.82 - 1.00]	0.97 [0.91 - 1.03]	0.97 [0.91 - 1.03]
C x (Pre)primary	1.13 [0.89 - 1.43]	1.11 [0.87 - 1.41]	0.92 [0.83 - 1.01]	0.93 [0.84 - 1.02]	0.98 [0.93 - 1.04]	0.99 [0.93 - 1.05]
C x Unknown	1.08 [0.86 - 1.35]	1.09 [0.87 - 1.36]	0.88 [0.73 - 1.05]	0.89 [0.75 - 1.05]	0.94 [0.88 - 1.00]	0.94 [0.88 - 1.01]
LQ	0.58 [0.30 - 1.13]	0.60 [0.30 - 1.18]	1.04 [0.96 - 1.12]	1.05 [0.98 - 1.12]	1.45 [1.09 - 1.93]	1.44 [1.07 - 1.93]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	0.72 [0.19 - 2.81]	0.67 [0.17 - 2.59]	1.54 [0.71 - 3.33]	1.51 [0.71 - 3.21]	4.01 [1.29 - 12.48]	3.76 [1.18 - 11.99]
Lower secondary	0.91 [0.26 - 3.17]	0.81 [0.23 - 2.83]	2.54 [1.16 - 5.58]	2.27 [1.05 - 4.91]	3.54 [1.17 - 10.74]	3.15 [1.02 - 9.76]
(Pre)primary	1.71 [0.53 - 5.46]	1.42 [0.44 - 4.61]	4.09 [1.81 - 9.24]	3.36 [1.48 - 7.61]	4.25 [1.52 - 11.92]	3.39 [1.18 - 8.71]
Unknown	2.32 [0.67 - 8.02]	1.83 [0.53 - 6.34]	4.55 [1.73 - 11.97]	3.73 [1.45 - 9.59]	6.35 [1.77 - 22.77]	5.43 [1.47 - 20.01]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	1.76 [0.80 - 3.87]	1.72 [0.79 - 3.78]	1.00 [0.91 - 1.10]	1.00 [0.91 - 1.09]	0.72 [0.48 - 1.09]	0.70 [0.46 - 1.08]
LQ x Lower secondary	1.82 [0.88 - 3.78]	1.77 [0.85 - 3.69]	0.92 [0.79 - 1.06]	0.92 [0.81 - 1.05]	0.66 [0.44 - 0.98]	0.65 [0.43 - 0.99]
LQ x (Pre)primary	1.72 [0.86 - 3.43]	1.66 [0.82 - 3.33]	0.81 [0.63 - 1.05]	0.84 [0.65 - 1.07]	0.70 [0.51 - 0.96]	0.71 [0.51 - 0.98]
LQ x Unknown	1.50 [0.73 - 3.09]	1.52 [0.74 - 3.12]	0.86 [0.65 - 1.15]	0.89 [0.69 - 1.15]	0.46 [0.25 - 0.82]	0.44 [0.24 - 0.82]
Lis	0.88 [0.71 - 1.09]	0.89 [0.71 - 1.12]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	1.03 [1.00 - 1.05]	1.03 [1.00 - 1.05]
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.12 [0.44 - 2.87]	1.05 [0.40 - 2.76]	1.51 [0.78 - 2.92]	1.47 [0.76 - 2.84]	2.54 [1.11 - 5.82]	2.98 [1.00 - 5.29]
Lower secondary	1.52 [0.61 - 3.75]	1.34 [0.53 - 3.39]	1.98 [1.03 - 3.81]	1.81 [0.94 - 3.50]	1.96 [0.87 - 4.38]	1.69 [0.75 - 3.81]
(Pre)primary	2.64 [1.12 - 6.26]	2.15 [0.88 - 5.26]	3.11 [1.60 - 6.04]	2.62 [1.32 - 5.19]	2.56 [1.18 - 5.55]	2.05 [0.93 - 4.48]
Unknown	2.94 [1.20 - 7.19]	2.43 [0.96 - 6.13]	3.65 [1.66 - 8.03]	3.09 [1.39 - 6.89]	2.58 [1.04 - 6.40]	2.12 [0.84 - 5.33]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.	Re.	Ref.
Lis x Upper secondary	1.14 [0.92 - 1.42]	1.13 [0.90 - 1.42]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	0.98 [0.94 - 1.02]	0.97 [0.93 - 1.02]
Lis x Lower secondary	1.14 [0.91 - 1.42]	1.13 [0.89 - 1.42]	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.00]	0.97 [0.94 - 1.01]	0.98 [0.94 - 1.01]
Lis x (Pre)primary	1.13 [0.91 - 1.41]	1.12 [0.89 - 1.41]	0.98 [0.94 - 1.01]	0.98 [0.95 - 1.02]	0.98 [0.95 - 1.00]	0.98 [0.95 - 1.00]
Lis x Unknown	1.13 [091 - 1.40]	1.12 [0.89 - 1.41]	0.98 [0.95 - 1.02]	0.99 [0.95 - 1.03]	0.90 [0.79 - 1.03]	0.90 [0.79 - 1.03]

CI: confidence interval; Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; Dutch, Turkish, and Moroccan women are not included because their case counts were below 20

Table S3.2b (Continued)

	Turkish		Moroccan	
Men	Model1	Model2	Model1	Model2
C	1.05 [0.95 - 1.17]	1.03 [0.91 - 1.17]	1.01 [0.97 - 1.06]	1.01 [0.96 - 1.06]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.41 [0.07 - 81.81]	2.17 [0.05 - 102.33]	1.39 [0.28 -6.86]	1.36 [0.27 - 6.81]
Lower secondary	6.21 [0.23 - 167.49]	5.13 [0.14 - 188.54]	1.14 [0.24 - 5.35]	1.10 [0.23 - 5.25]
(Pre)primary	1.46 [0.06 - 34.79]	2.38 [0.07 - 80.57]	0.57 [0.14 - 2.42]	0.54[0.13 - 2.34]
Unknown	1.63 [0.06 - 47.56]	1.48 [0.04 - 59.51]	1.27 [0.28 - 5.88]	1.22 [0.26 - 5.72]
C x Tertiary	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	0.99 [0.88 - 1.11]	1.00 [0.88 - 1.15]	0.99 [0.93 - 1.04]	0.99 [0.93 - 1.05]
C x Lower secondary	0.92 [0.80 - 1.05]	0.94 [0.81 - 1.10]	0.99 [0.94 - 1.04]	0.99 [0.94 - 1.05]
C x (Pre)primary	0.97 [0.88 - 1.08]	0.99 [0.88 - 1.13]	0.99 [0.94 - 1.03]	0.99 [0.94 - 1.04]
C x Unknown	0.99 [0.89 - 1.10]	1.02 [0.90 - 1.16]	0.97 [0.92 - 1.02]	0.97 [0.92 - 1.02]
LQ	1.12 [0.96 - 1.31]	1.09 [0.89 - 1.33]	1.14 [0.92 - 1.40]	1.10 [0.88 - 1.39]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	3.57 [0.08 - 158.60]	3.79 [0.05 - 280.59]	1.73 [0.32 - 9.29]	1.75 [0.31 - 10.00]
Lower secondary	10.72 [0.29 - 393.85]	10.46 [0.17 - 629.79]	1.53 [0.31 - 7.68]	1.52 [0.28 - 8.11]
(Pre)primary	2.38 [0.07 - 77.92]	4.53 [0.08 - 252.47]	0.84 [0.18 - 3.81]	0.81 [0.17 - 3.92]
Unknown	2.70 [0.07 - 103.06]	2.92 [0.05 - 183.63]	2.07 [0.41 - 10.37]	2.10 [0.40 - 11.14]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	0.96 [0.80 - 1.16]	0.97 [0.78 - 1.21]	0.89 [0.68 - 1.17]	0.89 [0.66 - 1.19]
LQ x Lower secondary	0.81 [0.63 - 1.05]	0.84 [0.64 - 1.11]	0.89 [0.69 - 1.15]	0.89 [0.67 - 1.16]
LQ x (Pre)primary	0.93 [0.79 - 1.10]	0.95 [0.77 - 1.16]	0.86 [0.68 - 1.08]	0.86 [0.67 - 1.10]
LQ x Unknown	0.95 [0.80 - 1.13]	0.99 [0.80 - 1.22]	0.76 [0.58 - 1.00]	0.75 [0.56 - 1.01]
Lis	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	1.01 [1.00 - 1.02]	1.01 [1.00 - 1.02]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.25 [0.17 - 30.44]	3.08 [0.12 - 36.15]	1.61 [0.45 - 5.83]	1.63 [0.44 - 6.02]
Lower secondary	3.78 [0.31 - 46.14]	3.81 [0.25 - 57.90]	1.41 [0.41 - 4.85]	1.41 [0.40 - 4.93]
(Pre)primary	1.12 [0.11 - 11.74]	2.05 [0.15 - 28.53]	0.68 [0.21 - 2.17]	0.66 [0.20 - 2.15]
Unknown	1.83 [0.16 - 21.01]	2.06 [0.14 - 30.13]	1.22 [0.35 - 4.26]	1.22 [0.34 - 4.31]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	0.99 [0.98 - 1.01]	0.99 [0.98 - 1.01]
Lis x Lower secondary	0.99 [0.98 - 1.01]	0.99 [0.98 - 1.01]	0.99 [0.98 - 1.00]	0.99 [0.98 - 1.00]
Lis x (Pre)primary	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	0.99 [0.98 - 1.00]	0.99 [0.98 - 1.00]
Lis x Unknown	1.00 [1.00 - 1.00]	1.00 [1.00 - 1.01]	0.99 [0.97 - 1.00]	0.98 [0.97 - 1.00]

Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index;

Table S3.2b (Continued)

	French		Italian	
Women	Model 1	Model 2	Model 1	Model 2
C	1.07 [0.83 - 1.39]	1.08 [0.85 - 1.38]	1.06 [0.94 - 1.21]	1.07 [0.94 - 1.21]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.10 [0.19 - 23.61]	1.98 [0.19 - 20.63]	7.20 [0.21 - 240.93]	7.29 [0.23 - 235.99]
Lower secondary	12.25 [0.86 - 175.23]	12.55 [0.91 - 173.48]	4.85 [0.14 - 171.69]	5.02 [0.15 - 172.14]
(Pre)primary	7.55 [0.77 - 73.54]	6.59 [0.70 - 62.13]	5.96 [0.20 - 179.02]	6.46 [0.22 - 190.24]
Unknown	11.82 [1.02 - 136.41]	10.06 [0.89 - 114.08]	27.34 [0.88 - 845.18]	28.78 [0.96 - 865.90]
C x Tertiary	Ref.	Ref.	Ref.	Ref.
C x Upper secondary	1.00 [0.72 - 1.39]	1.00 [0.73 - 1.37]	0.95 [0.82 - 1.09]	0.95 [0.82 - 1.09]
C x Lower secondary	0.43 [0.18 - 1.03]	0.41 [0.17 - 1.00]	0.93 [0.80 - 1.07]	0.93 [0.80 - 1.07]
C x (Pre)primary	0.87 [0.59 - 1.27]	0.86 [0.58 - 1.26]	0.95 [0.83 - 1.08]	0.95 [0.83 - 1.08]
C x Unknown	0.77 [0.50 - 1.19]	0.77 [0.50 - 1.20]	0.88 [0.76 - 1.02]	0.88 [0.77 - 1.02]
LQ	1.16 [0.48 - 2.78]	1.19 [0.51 - 2.77]	1.15 [0.23 - 5.71]	1.16 [0.24 - 5.61]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	2.47 [0.20 - 30.92]	2.41 [0.21 - 28.05]	3.35 [0.10 - 107.58]	3.47 [0.11 - 107.20]
Lower secondary	11.08 [0.52 - 235.79]	11.24 [0.52 - 241.11]	2.11 [0.06 - 70.74]	2.22 [0.07 - 72.06]
(Pre)primary	6.94 [0.60 - 79.65]	6.04 [0.54 - 67.87]	3.00 [0.11 - 81.58]	3.30 [0.12 - 88.25]
Unknown	6.75 [0.52 - 87.84]	5.70 [0.46 - 70.66]	22.62 [0.69 - 740.36]	23.83 [0.75 -755.89]
LQ x Tertiary	Ref.	Ref.	Ref.	Ref.
LQ x Upper secondary	0.88 [0.31 - 2.53]	0.87 [0.32 - 2.38]	0.96 [0.17 - 5.50]	0.97 [0.17 - 5.34]
LQ x Lower secondary	0.14 [0.01 - 1.62]	0.12 [0.01 - 1.55]	0.81 [0.14 - 4.82]	0.81 [0.14 - 4.66]
LQ x (Pre)primary	0.69 [0.21 - 2.25]	0.68 [0.21 - 2.20]	0.95 [0.19 - 4.86]	0.94 [0.19 - 4.68]
LQ x Unknown	0.72 [0.23 - 2.28]	0.73 [0.24 - 2.23]	0.33 [0.05 - 2.23]	0.34 [0.05 - 2.20]
Lis	1.01 [0.90 - 1.12]	1.01 [0.92 - 1.11]	0.98 [0.60 - 1.61]	0.99 [0.62 - 1.57]
Tertiary	Ref.	Ref.	Ref.	Ref.
Upper secondary	1.95 [0.43 - 8.89]	1.86 [0.42 - 8.29]	3.13 [0.26 - 37.37]	3.25 [0.28 - 37.75]
Lower secondary	5.25 [0.69 - 40.06]	4.96 [0.64 - 38.22]	1.57 [0.13 - 19.29]	1.66 [0.14 - 20.00]
(Pre)primary	4.59 [1.07 - 19.74]	3.86 [0.89 - 16.77]	2.66 [0.24 - 29.42]	2.90 [0.26 - 31.79]
Unknown	4.38 [0.90 - 21.41]	3.70 [0.76 - 17.92]	10.28 [0.82 - 128.59]	10.96 [0.89 - 134.61]
Lis x Tertiary	Ref.	Ref.	Ref.	Ref.
Lis x Upper secondary	1.00 [0.89 - 1.12]	0.99 [0.90 - 1.10]	1.01 [0.61 - 1.68]	1.01 [0.62 - 1.64]
Lis x Lower secondary	0.28 [0.05 - 1.58]	0.26 [0.04 - 1.58]	1.00 [0.60 - 1.66]	1.00 [0.61 - 1.62]
Lis x (Pre)primary	0.93 [0.70 - 1.23]	0.93 [0.71 - 1.23]	1.02 [0.63 - 1.67]	1.02 [0.64 - 1.63]
Lis x Unknown	0.96 [0.77 - 1.20]	0.97 [0.79 - 1.19]	0.73 [0.38 - 1.38]	0.73 [0.39 - 1.36]

Model 1 : age at baseline; Model 2 : age at baseline, individual level of education, and neighbourhood deprivation; C=Concentration, LQ=Location quotient, Lis=Localised isolation index; Dutch, Turkish, and Moroccan women are not included because their case counts were below 2