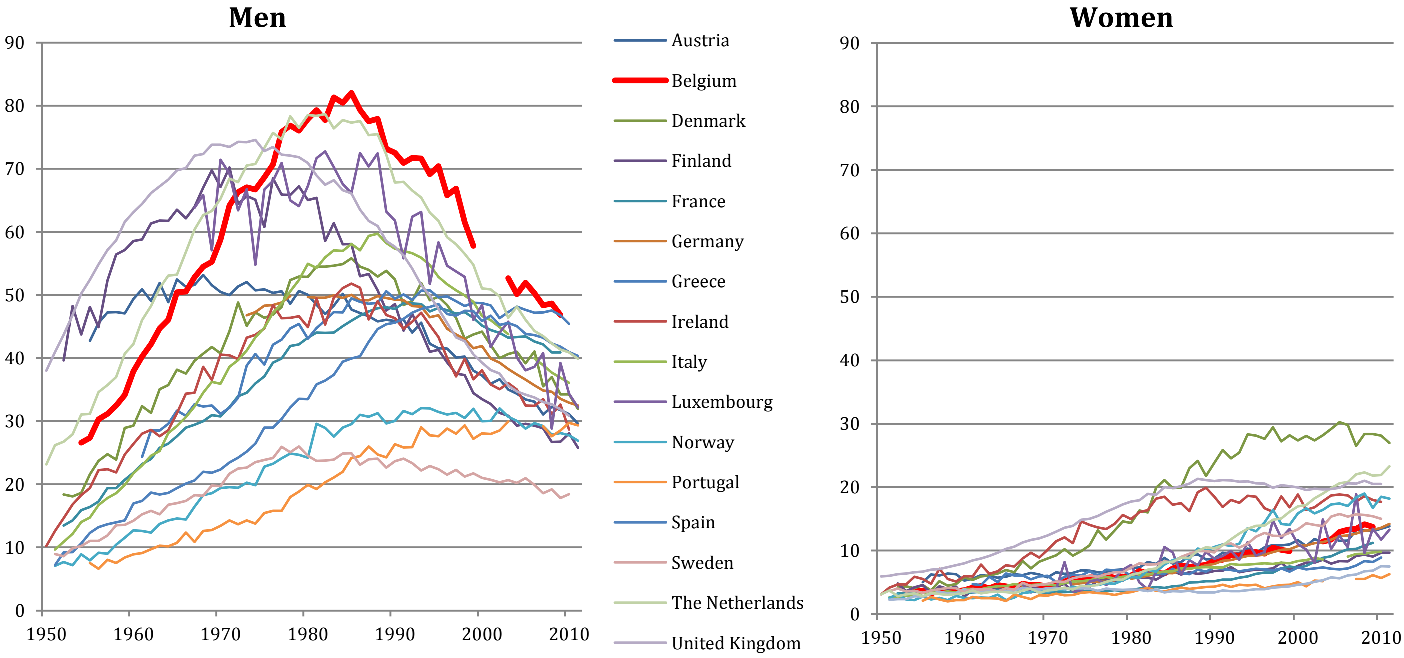
Regional and socioeconomic inequalities in lung cancer mortality in Belgium, 2001-2009

INTRODUCTION

Although lung cancer mortality for men has been declining since the late 1980s, it is still one of the most common cancers (Menvielle et al., 2008; Van der Heyden et al., 2009). Several studies have shown higher levels of lung cancer mortality among persons with lower socioeconomic status (Van der Heyden et al., 2009; Woods, Rachet, & Coleman, 2006). Several factors are likely to be responsible for socioeconomic inequalities in lung cancer mortality. The most important factor is risk behavior (especially smoking) (Woods et al., 2006), but also occupational factors, stage at diagnosis and access to healthcare play a role (Van der Heyden et al., 2009). Although individual SES is a major predictor of differences in lung cancer mortality, it is not the only explaining factor. Area disadvantage, regional cultural and behavioral differences and other environmental factors such as exposure to toxins and pollution can negatively affect lung cancer mortality as well (Bentley, Kavanagh, Subramanian, & Turrell, 2008; Steenland, Henley, Calle, & Thun, 2004).

In Belgium, lung cancer is one of the most common cancers. When comparing the mortality rate to the rest of Europe, Belgian men have the highest levels of lung cancer mortality in Europe. For women the levels are average (figure 1). Previous research has shown that regional mortality differences exist between the Flemish and the Walloon region (Van Oyen, Bossuyt, Deboosere, Gadeyne, & Tafforeau, 2002), which could partly be explained by differences in SES (Deboosere & Gadeyne, 2002). However, not much research has been dedicated to regional differences in (lung) cancer mortality. Therefore the aim of this study is to investigate the geographical pattern in lung cancer mortality in Belgium and to see to what extent this can be explained by individual socioeconomic status.

Figure 1. Lung cancer mortality[*] by men and women for selected European countries, 1950-2011.



Source: WHO Mortality Database

[*] Directly standardized per 100,000 using the world standard population 1960

MATERIAL AND METHODS

Data on lung cancer mortality (ICD10 C33-C34) from 2001 till 2009 for men and women aged 40+ is used. The data comes from the National Mortality Database, a linkage between the 1991 and 2001 census data, information on emigration and all-cause mortality from register data, and causes-of-death data derived from death certificates. This results in a dataset with cause-specific mortality data and extensive information about social indicators. The data for 2001-2009 are only available for Flanders and Brussels, and exclude Wallonia.

Regional mortality is measured at district (arrondissement) level. Mortality is calculated by the directly age-standardized mortality rate (ASMR), using the 2001 population for Belgium as the standard population. The confidence intervals for the ASMR are calculated following the approach of Fay and Feuer (1997). Their method calculates confidence intervals based on a gamma distribution and is more reliable when counts are small and variable (Fay & Feuer, 1997). The relation between lung cancer and socioeconomic status is investigated using Poisson regression. First, the null model is estimated, which compares age-standardized mortality by district relative to the average mortality level of Flanders and Brussels. This model is compared to the final model, estimating the relative age-standardized mortality by district when controlling for individual socioeconomic status. Individual socioeconomic status is measured by educational level, employment status, housing ownership and comfort level. Age in years, marital status and individual health status are included as control variables. Education is measured by four categories based on the International Standard Classification of Education (ISCED) classification: primary education or less (ISCED 0-1); lower secondary education (ISCED 2); upper secondary and post-secondary education (ISCED 3-4); and tertiary education (ISCED 5-6). Employment status is classified into employed, unemployed, retired and non-working. Housing ownership is a dummy variable indicating whether an individual is the owner of a house or not. Housing quality is a composed variable of various weighted housing indicators from the census such as number of large repairs needed, living space, number of bedrooms and amenities.

RESULTS

In the period 2001-2009 26,937 men and 7,069 women died of lung cancer in Flanders and Brussels, making it the most common cancer-related cause of death for men and the 4th most common for women. The maps in figure 2 shows the regional mortality patterns for lung cancer in Flanders and Brussels. As the maps reveal, ASMRs for lung cancer in men and women aged 40+ show a general east-west pattern, with the highest mortality levels in the east of Flanders. While male lung cancer mortality is low in Brussels, it is high for women. Next to Brussels, Antwerp also has significantly higher lung cancer rates for women compared to Belgium (Table 1). For men, it are predominantly the districts in the east of Flanders with significantly higher mortality due to lung cancer. When looking more specifically at the age categories 40-64 and 65+, the pattern for women remains largely unchanged. For both age categories, mortality is relatively high in Antwerp and Brussels, while relatively low in the southwest of Flanders. The regional pattern for men aged 65+ resembles that of men aged 40+, but is different from that of men aged 40-64. In 40-64-year-old men, mortality is relatively high in the southwest and east of Flanders, while it is relatively low in the north of Flanders.

Figure 3 and 4 show the influence of socioeconomic status on the relative mortality differences by district for men and women respectively. The figures compare the relative mortality of the null model to the final model (controlling for individual socioeconomic status). Generally, the differences between both models are small, indicating socioeconomic status plays a minor role in regional mortality inequalities. There are however, a few districts with a clear gap in outcomes for both models. For men 40+ the districts of Halle-Vilvoorde, Oostende, Hasselt and Diksmuide show the largest gap between both models. For women 40+ these are Brussels, Antwerp, Oostende and Diksmuide. After controlling for individual socioeconomic status, the relative risk of lung cancer mortality for these districts becomes considerably closer to the Belgian mean. Several districts, however, show the opposite pattern as their relative mortality shifts further from the Belgian mean when controlling for socioeconomic status. The role of socioeconomic status on regional mortality differences is especially of influence for the 40-64 age-category for both sexes, as the largest differences between the models are found in this age category. Brussels has the largest gap between the null and final model for both men and women aged 40-64, but a contrasting effect can be seen. Brussels has the highest relative risk of cancer mortality for women but controlling for socioeconomic status brings the relative mortality level down and closer to that of Belgium. Men, on the other hand, have a relatively lower risk of lung cancer in Brussels compared to Belgium, and controlling for socioeconomic status lowers the mortality risk even further.

Socioeconomic status has little effect on the relative risk for men aged 65+, as the outcomes of both models show only small differences for most districts. For women aged 65+ there are a few districts were socioeconomic status does affect lung cancer mortality. For Brussels and Antwerp, the relative mortality risk is closer to the Belgian mean once socioeconomic status is taken into account, while the relative low relative risk for Diksmuide disappears completely in the final model.

CONCLUSION

Both regional and socioeconomic inequalities exist within Flanders and Brussels. Geographically, lung cancer mortality for men and women aged 40+ is highest in the east of Flanders, and is relatively low in the southwest. A contrasting pattern is visible for the cities of Brussels and Antwerp, where lung cancer mortality is relatively low for men but high for women. A similar pattern is visible for the age categories 40-64 and 65+, with the exception of men aged 40-64. For men aged 40-64, lung cancer mortality is relatively high in the southwest of Flanders, and mortality is relatively low in the northeast. Regional mortality differences can only partly be explained by compositional differences due to individual socioeconomic status. The relative risk remains unchanged for several districts after socioeconomic status is taken into account. When socioeconomic status does affect the relative risk, it usually has a smoothing effect towards the Belgian mean. Overall, the effect of socioeconomic status is larger for women compared to men, and the largest effects are observed for the 40-64-age category. Based on these results, individual socioeconomic status can only explain part of the regional differences in lung cancer mortality at a district level. As indicated by previous research, it might be possible that area-level socioeconomic status and environmental factors are also of influence. Future research should thus explore the potential influence of these factors as well.

Figure 2. Directly standardized lung cancer mortality rate 2001-2009 for Flanders and Brussels, for men and women aged 40+, 40-64, and 65+.

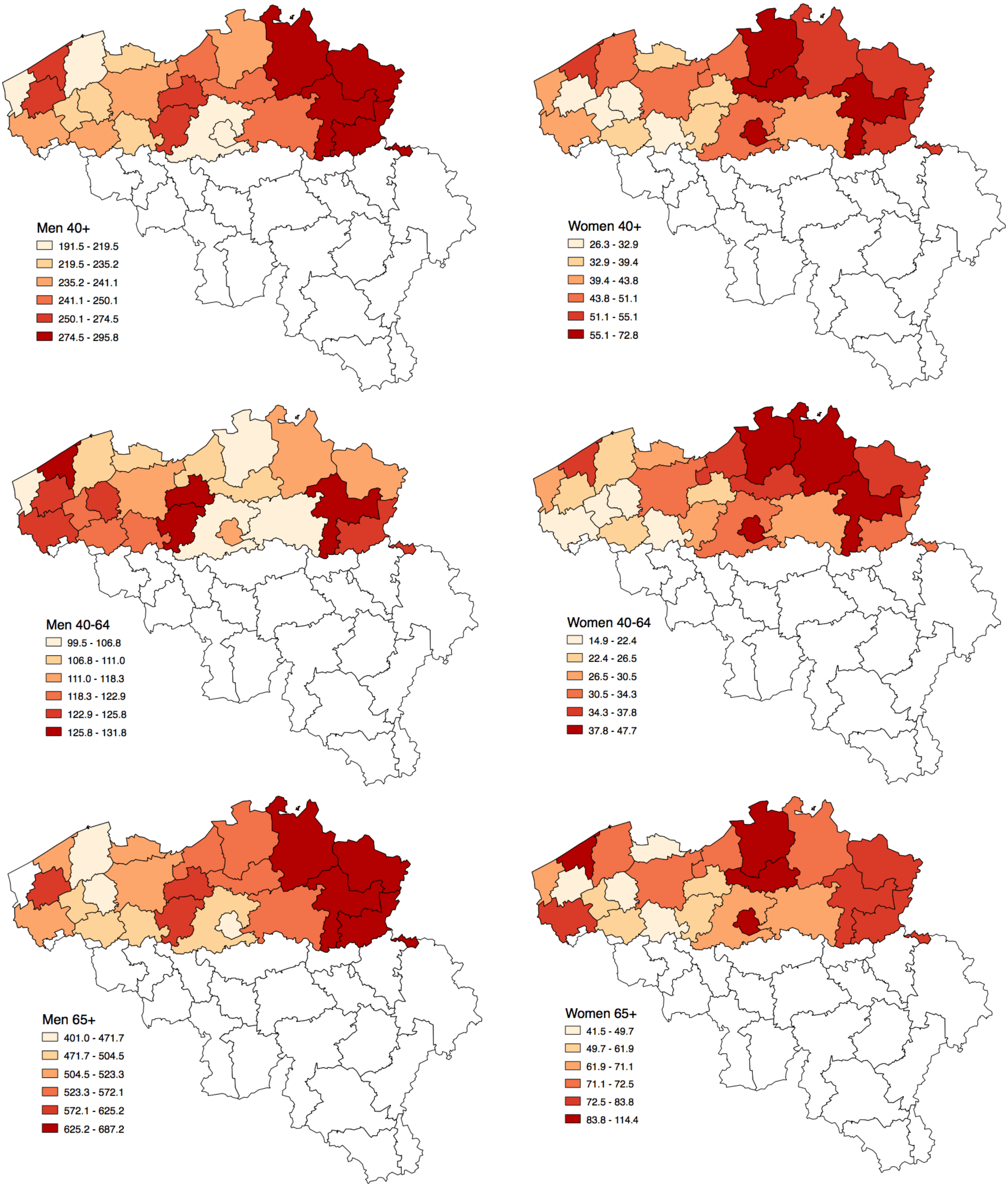


Table 1. ASMR for lung cancer (per 100,000) (95% CI) by sex, age category and district

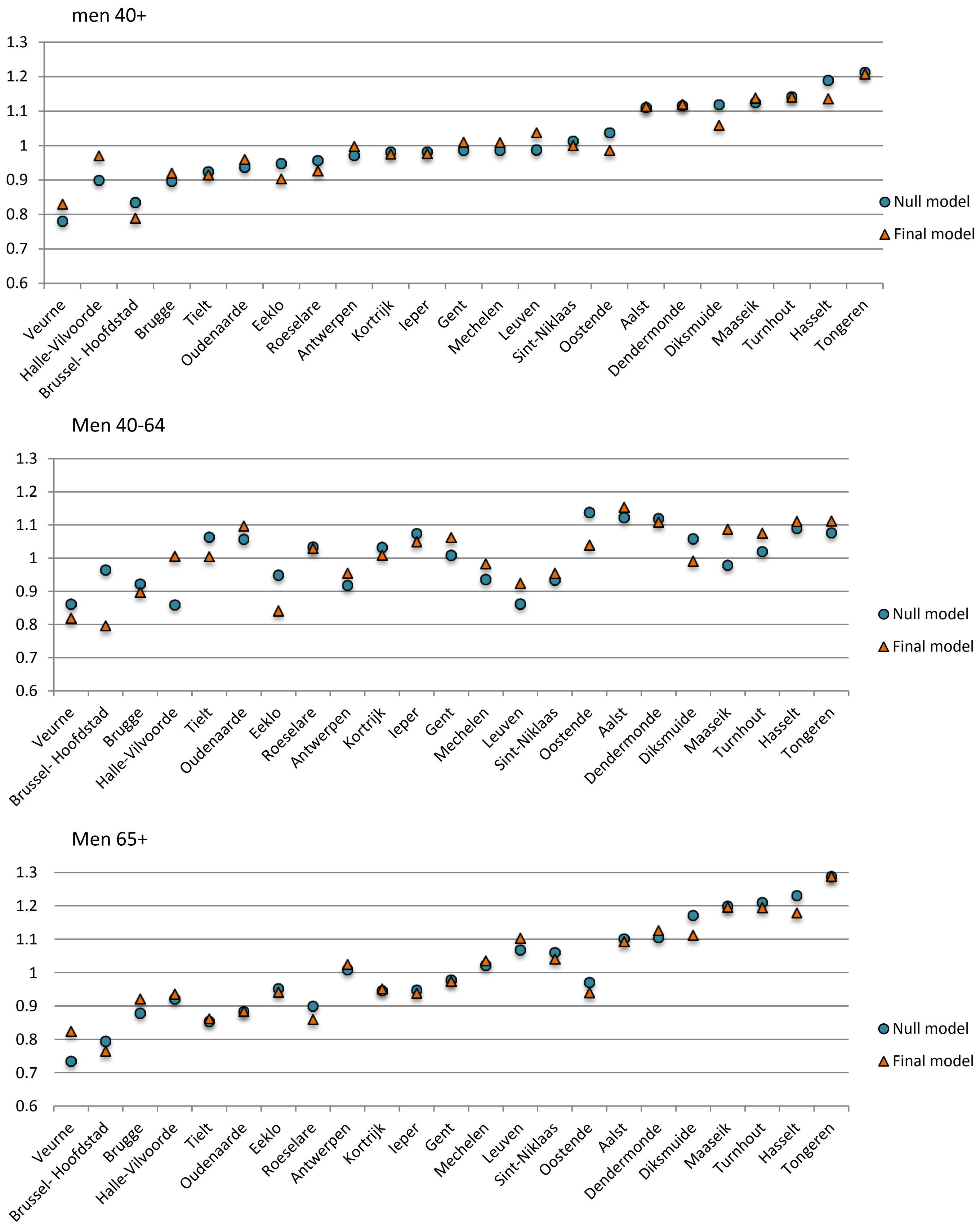
ASMR by 100,000 men

	40+		40-64		65+	
Belgium	**40+**	**95% CI**	**40-64**	**95% CI**	**65+**	**95% CI**
Belgium	240.82	(237.9-243.8)	113.47	(111.3-115.7)	533.06	(524.9-541.4)
District	**40+**	**95% CI**	**40-64**	**95% CI**	**65+**	**95% CI**
Antwerpen	236.55	(228.9-244.4)	106.24	(100.5-112.2)	535.61	(514.2-557.8)
Mechelen	242.11	(228.7-256.2)	108.65	(98.7-119.3)	548.39	(510.6-588.5)
Turnhout	278.29	(264.8-292.3)	118.28	(109.4-127.7)	645.49	(606.3-687)
Brussel-	206.39	(198.6-214.4)	111.61	(105.2-118.4)	423.88	(403.2-445.4)
Halle-Vilvoorde	217.64	(207.9-227.8)	99.58	(92.3-107.2)	488.57	(461.2-517.5)
Leuven	242.93	(231.7-254.6)	99.49	(91.7-107.7)	572.07	(539.9-605.9)
Brugge	217.65	(204.4-231.6)	107.09	(96.8-118.2)	471.37	(435-510.2)
Diksmuide	272.57	(238.4-310.4)	123.32	(97-154.6)	615.05	(521.9-721.1)
Ieper	241.1	(218.5-265.6)	125.29	(106.8-146.1)	506.87	(446.4-574)
Kortrijk	236.28	(222.1-251.2)	119.94	(108.9-131.8)	503.27	(464.5-544.8)
Oostende	250.63	(231.7-270.8)	131.8	(116.4-148.7)	523.33	(472.7-578.7)
Roeselare	226.74	(208-246.9)	119.96	(104.8-136.8)	471.8	(421.3-527.4)
Tielt	220.41	(197.3-245.5)	123.08	(103.5-145.3)	443.77	(383.5-511.5)
Veurne	191.53	(166.5-219.7)	100.27	(79.5-124.9)	400.97	(335.1-478.9)
Aalst	270.23	(254.6-286.7)	130.42	(118.6-143.1)	591.07	(547.6-637.5)
Dendermonde	269.52	(250.6-289.7)	129.81	(116-144.9)	590.13	(537-648.2)
Eeklo	234.61	(209.5-262)	110.68	(91.7-132.4)	519.02	(449.8-596.5)
Gent	240.01	(229.3-251.2)	116.78	(108.5-125.5)	522.8	(493.1-554)
Oudenaarde	228.96	(207.9-251.7)	122.45	(105.1-141.9)	473.41	(417.4-535.6)
Sint-Niklaas	249.23	(232.6-266.8)	108.51	(97-121)	572.14	(524.7-623.4)
Hasselt	289.11	(274.5-304.4)	126.81	(117.2-137)	661.58	(619-707.1)
Maaseik	280.35	(259.7-302.5)	114.24	(102.3-127.2)	661.53	(599.7-730.1)
Tongeren	295.84	(275.5-317.5)	125.28	(112-139.7)	687.25	(627.9-752)

ASMR by 100,000 women

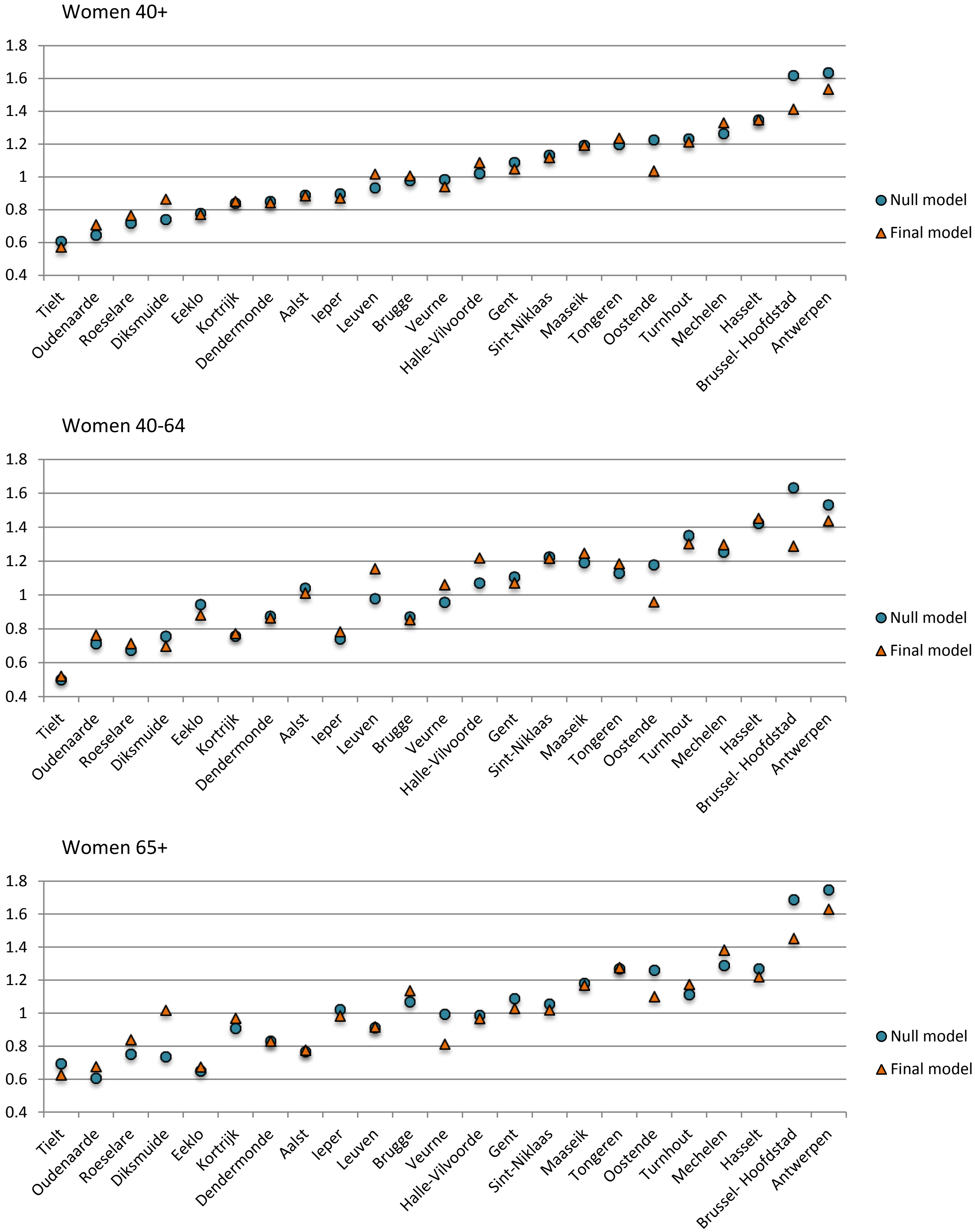
	40+		40-64		65+	
Belgium	**40+**	**95% CI**	**40-64**	**95% CI**	**65+**	**95% CI**
Belgium	52.93	(51.7-54.2)	35.23	(34-36.5)	81.05	(78.4-83.7)
District	**40+**	**95% CI**	**40-64**	**95% CI**	**65+**	**95% CI**
Antwerpen	71.9	(68-75.9)	45.1	(41.4-49.1)	114.45	(106.4-123)
Mechelen	55.64	(49.7-62.1)	36.79	(31.1-43.2)	85.56	(73.5-99.4)
Turnhout	52.24	(47-58.1)	39.79	(34.6-45.6)	72.01	(61.3-84.5)
Brussel	72.8	(68.8-76.9)	47.7	(43.7-52)	112.64	(104.6-121.1)
Halle-Vilvoorde	44.78	(40.7-49.2)	31.51	(27.6-35.8)	65.84	(57.5-75.2)
Leuven	41.72	(37.4-46.4)	28.69	(24.6-33.3)	62.4	(53.5-72.5)
Brugge	43.84	(38.4-49.9)	25.91	(21-31.7)	72.3	(60.7-85.7)
Diksmuide	32.59	(21.9-47.3)	22.98	(12.2-39.3)	47.85	(27.7-80.2)
Ieper	41.65	(32.8-52.3)	22.19	(14.7-32.1)	72.56	(53.5-96.7)
Kortrijk	37.63	(32.5-43.5)	22.51	(17.8-28)	61.64	(50.7-74.6)
Oostende	54.76	(46.8-63.8)	35.76	(27.8-45.2)	84.92	(68.9-103.9)
Roeselare	31.89	(25.3-39.7)	19.87	(13.9-27.5)	50.99	(37.4-68.5)
Tielt	26.29	(19-35.6)	14.88	(8.5-24.2)	44.4	(29.3-65.7)
Veurne	42.43	(31.9-55.6)	27.59	(17.4-41.7)	66	(45.1-94.5)
Aalst	38.24	(33.1-44.1)	30.52	(25-36.9)	50.5	(40.6-62.5)
Dendermonde	37.27	(31-44.6)	25.74	(19.8-32.9)	55.57	(42.9-71.7)
Eeklo	33.08	(24.8-43.5)	27.71	(18.5-39.8)	41.6	(26.7-62.7)
Gent	47.83	(43.5-52.5)	32.52	(28.2-37.3)	72.15	(63.4-81.9)
Oudenaarde	28.92	(22.3-37.1)	20.98	(14.1-30)	41.52	(28.7-58.5)
Sint-Niklaas	49.31	(42.6-56.8)	35.59	(29.1-43.1)	71.1	(57.5-87.3)
Hasselt	57.69	(51.9-64)	41.64	(36.2-47.6)	83.18	(71.3-97)
Maaseik	52.69	(44.6-62.1)	34.95	(28.4-42.6)	80.86	(63-103.4)
Tongeren	52.03	(44.4-60.7)	33.05	(26.4-40.9)	82.18	(66-102)

Figure 3. Lung cancer relative risk for the null model and the final model* by district, men aged 40+, 40-64 and 65+



*Both models are controlled for age, marital status and individual health status

Figure 4. Lung cancer relative risk for the null model and the final model* by district, women aged 40+, 40-64 and 65+



*Both models are controlled for age, marital status and individual health status

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