Cause-specific mortality in the Belgian cleaning industry (1991-2011)

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Introduction

Cleaning has long been perceived as a way to improve living conditions and control the spread of diseases (Curtis, 2007). However, recent research has drawn attention to a number of adverse health effects associated with professional cleaning. High prevalence of asthma, musculoskeletal disorders and bad mental health has been reported repeatedly among cleaning personnel (Gamperiene *et al*, 2006; Jaakkola & Jaakkola, 2006; Kumar & Kumar, 2008).
Cleaning is a generic profession as it entails a variety of tasks in numerous workplaces from the household to the factory floor. Depending on the specific tasks and work environment, cleaners may be exposed to chemical products, biological hazards, difficult physical working conditions, and psychosocial risk factors (European Agency for Safety and Health at Work, 2009).

Approximately 3.3 millions Europeans were employed by cleaning contractors in 2012, according to a survey among national cleaning associations in 20 countries (European Federation of Cleaning Industries, 2014). The large number of professional cleaners and the continuous growth in terms of employment stress the importance of healthy and safe working environments in this industry.

Previous research is fragmented and focuses mainly on morbidity. Few studies on cleaning workers consider the ultimate health outcome: mortality. A comprehensive assessment is needed to understand in what way the variety of exposures influences the end of life. This study examines if cleaners experience higher cause-specific mortality than the general population. Furthermore, the mortality pattern among specific groups of cleaners is assessed to identify potential health improvement opportunities in this growing industry.

Materials and methods

Data are derived from an anonymous record linkage between the 1991 Belgian Census, migration and mortality information from the Population Register (1991-2011) and cause-specific mortality information from death certificates (1991-1997/2001-2011).

The Belgian population between the ages 30 and 60 has been selected from the 1991 census. As shown in table 1, the working population consists of 1,562,551 men and 953,443 women. Between 1 March 1991 and 31 December 2011, a total of 171,529 male and 58,599 female deaths are recorded in the Population register.

Cleaners are first identified using the International Statistical Classification of Occupations (ISCO), selecting domestic cleaners; labourers and cleaners; and office cleaners. Eight types of cleaners are further demarcated using the Statistical Classification of Economic Activities in the European Community (NACE). Two types of male cleaners could not be analysed separately due to the small number of deaths, i.e. domestic cleaners and cleaners in hotels and restaurants. A total of 48,290 men and 96,777 women are identified as cleaners in the 1991 Census.

The all-cause mortality data from the population register is complete for the entire period under investigation, but the follow-up period for the cause-specific mortality information is interrupted. The responsibility to collect and report mortality statistics was shifted from the national level to the regional level in 1998. Due to problems in this regionalization process, cause-specific mortality data

for Wallonia in the period between 1 January 1998 and 1 October 2001 could not be linked to the 1991 Census. Because of the specific mortality patterns in the three Belgian regions, the lack of Walloon cause-of death data would violate the proportionality assumption, as hazards would not be proportional constantly over time. In order to maintain comparability between regions, the cause-specific mortality data for Flanders and the Brussels Capital Region are omitted for this period as well. Approximately 15% of all deaths occurred between 1/1/1998 and 1/10/2001 for men and women alike. Table 2 provides an overview of the number of deaths included in the analyses of cause-specific mortality.

Multivariable-adjusted hazard ratios (HR) and corresponding 95% confidence levels (CL) are calculated using Cox proportional hazards models. Controls include age at baseline, region, Belgian nationality, educational level, part-time employment and manual labour. Hazard ratios are calculated with reference to the sex-specific working population, as well as to secondary school teachers. Because educators have relatively low mortality, this group represents the best-case scenario on the Belgian labour market and contextualizes our findings for cleaners.
Failure time was calculated continuously from 1 March 1991 until time of death. Censorship occurred at emigration or at the end of the follow-up period on 31 December 2011.
Sensitivity analyses are performed in order to account for the gap in the data. Cox models are computed assuming that deaths in the period 1998-2001 occurred (1) in the beginning at 1 January 1998, (2) in the middle at 15 November 1999 and (3) in the end at 30 September 2001. Results were almost identical.

Because of the cross-sectional nature of the census data, misclassification and selection biases must be considered. Information on changes in occupation, industry of employment, working conditions, exposure circumstances, etc. is not available for analysis. In addition, the research design cannot discern the impact of non-professional cleaning on mortality.

Table 1 Belgian population (30-60 years) on 1 March 1991

	Women	% of active	Men	% of active
Cleaner in all other industries	25046	2.6%	15774	1.0%
Cleaner in public administration and general services	17526	1.8%	9549	0.6%
Cleaner in educational institutions	15268	1.6%	3054	0.2%
Cleaner in health care and social services	17786	1.9%	3819	0.2%
Domestic cleaners	2061	0.2%	-	-
Cleaner-undefined	11741	1.2%	11300	0.7%
Industrial cleaners	4577	0.5%	4794	0.3%
Cleaners in hotels and restaurants	2772	0.3%	-	-
Secondary school teacher	49493	5.2%	44917	2.9%
All other occupations	807173	84.7%	1469344	94.0%
Total active population	953443	100.0%	1562551	100.0%
Total non-active population	988627		405914	

Table 2 Absolute numbers of deaths by occupation (1991-1997/2001-2011)

	Women		Men	
	Number of deaths	% of population in 1991	Number of deaths	% of population in 1991
Cleaner in health care and social services	1025	5.8%	567	14.8%
Cleaner in public administration and general services	1193	6.8%	1684	17.6%
Cleaner in educational institutions	1074	7.0%	540	17.7%
Industrial cleaners	252	5.5%	559	11.7%
Domestic cleaners	142	6.9%	-	-
Cleaners in hotels and restaurants	152	5.5%	-	-
Cleaner-undefined	730	6.2%	1494	13.2%
Cleaner in all other industries	1521	6.1%	2016	12.8%
Secondary school teacher	2150	4.3%	3826	8.5%
All other occupations	41846	5.2%	160843	10.9%
Total active population	50085	5.3%	171529	11.0%
Total non-active population	114763	11.6%	111775	27.5%

Table 3 Hazard ratios and 95% confidence levels for all-cause mortality by sex and activity status in 1991-2011[12]

	Women					Men				
	D	N	HR	LL	UL	D	N	HR	LL	UL
Active population										
Cleaners	7108	96777	1.4	1.3	1.6	8040	48290	1.2	1.1	1.2
Secondary school teachers	2527	49493	0.9	0.8	0.9	4525	44917	0.8	0.8	0.8
All other working	48964	807173	1.0	-	-	189777	1469344	1.0	-	-
Non-active population										
Disabled	8055	27492	2.7	2.5	3.0	17736	38386	2.2	2.1	2.3
Unemployed-looking	15506	173654	1.1	1.0	1.2	27789	101648	1.5	1.4	1.6
Unemployed-not looking	58556	377445	1.1	1.1	1.2	70549	173088	1.2	1.2	1.3
Never employed-not looking	44570	336744	1.0	1.0	1.1	2913	9606	1.7	1.6	1.8
Other (student, indep. means...)	3601	31368	1.2	1.1	1.3	4250	21676	1.2	1.1	1.3
Missing information										
	4573	41924	1.4	1.3	1.6	11498	61510	1.4	1.4	1.5
Total	193460	1942070				337077	1968465			

[1] Controlled for age, region, Belgian nationality, Educational level, part-time employment and manual labour.

[2] Abbreviations: D= Absolute number of deaths; N = Absolute number of Belgians on 1 March 1991; HR= Hazard Ratio; LL= lower bound of 95% confidence interval; UL= upper bound of 95% confidence interval

Results

All-cause mortality (1991-2011)

Table 3 shows hazard ratios and 95% confidence levels for all-cause mortality in the Belgian population between the census date and 31 December 2011. Both male and female cleaners seem to experience significantly higher mortality compared to other occupational groups. All-cause mortality is respectively 20% (CL 1.1-1.2) and 40% (CL 1.3-1.6) higher among male and female cleaners than in other job categories. All-cause mortality among secondary school teachers is 10% (CL 0.8-0.9) lower among men and 20% lower among women compared to all other workers.
For women, the comparison with the non-active population is striking as only disabled women have a higher hazard ratio of 2.7 (CL 2.5-3.0). Hazard ratios among men are higher in the categories disabled (HR 2.2 CL 2.1-2.3), never employed and not looking for a job (HR 1.7 CL 1.6-1.8); unemployed and looking (HR 1.5 CL 1.4-1.6); and missing information (HR 1.4 CL 1.4-1.5).

Cause-specific mortality (1991-1997/2001-2011)

Respiratory mortality

Table 4 shows the hazard ratios and 95% confidence levels for respiratory mortality with reference to secondary school teachers. Results show that both sexes experience elevated mortality due to respiratory cancers and due to respiratory diseases.

Compared to secondary school teachers, mortality due to respiratory malignancies is significantly higher among cleaners in public administration and general services; educational services; industrial activities; hotels and restaurants; undefined industries; and all others industries.
Deaths due to respiratory cancers are twice as high among female cleaners in hotels and restaurants (HR 2.0 CL 1.3-3.2) than among secondary school teachers. Respiratory cancer deaths are 30% to 70% higher among women cleaning in undefined industries (HR 1.3 CL 1.0-1.8); public administration and general services (HR 1.4 CL 1.1-1.8); all other industries (HR 1.5 CL 1.1-1.9); educational services (HR 1.6 CL 1.2-2.0); and industrial activities (HR 1.7 CL 1.1-2.6) in 1991. Results show less variation for male cleaners in these industries, as hazard ratios range from 1.4 to 1.5. Hazard ratios for domestic cleaners (women HR 0.8 CL 0.4-1.7) and cleaners in the health care and social services sector (women HR 1.2 CL 0.9-1.6; men HR 1.0 CL 0.8-1.3) approximate the hazard ratios for secondary school teachers.

In comparison with the total working population, mortality due to respiratory malignancies is significantly higher for female and male cleaners in educational institutions (women HR 1.2 CL 1.0-1.4; men HR 1.1 CL 1.1-1.4). For women, we also found significant excess in mortality among cleaners in hotels and restaurants (HR 1.5 CL 1.0-2.2). Mortality due to respiratory cancers is significantly higher among male cleaners in industrial activities (HR 1.2 CL 1.0-1.4), undefined industries (HR 1.1 CL 1.0-1.2) and in all other industries (HR 1.1 CL 1.0-1.2).
After further investigation of the specific types of respiratory cancers, we find the excess in respiratory cancer deaths is mainly due to the higher lung cancer mortality. Female and male cleaners experience respectively 40% (HR 1.4 CL 1.2-1.5) and 20% (HR 1.2 CL 1.1-1.2) higher lung cancer mortality compared to the total working population.

The results for mortality due to respiratory diseases show significant excess among male and female cleaners in health care and social services, undefined industries and all other industries compared to secondary school teachers. Male cleaners in public administration and general services, educational institutions and industrial activities also experiences significant excess mortality.

Respiratory diseases cause 150% more deaths among male cleaners in health care and social services (HR 2.5 CL 1.1-2.2) than among secondary school teachers. For men working in public administration and general services and in educational institutions, we find 70% (HR 1.7 CL 1.4-2.2) and 80% (HR 1.8 CL 1.3-2.4) higher mortality, respectively. Female cleaners in health care and social services (HR 1.5 CL 1.1-2.2); undefined industries (HR 1.5 CL 1.0-2.1); and all other industries (HR 1.5 CL 1.1-2.1) have 50% higher mortality due to respiratory diseases than secondary school teachers.

The findings for cleaners in health care and social services remain significant for both sexes in comparison with the total working population (women HR 1.3 CL 1.0-1.6; men HR 1.6 CL 1.3-2.0). Female cleaners in all other industries (HR 1.2 CL 1.0-1.5) and male cleaners in public administration and general services (HR 1.1 CL 1.0-1.3) also show significant excess mortality due to respiratory diseases compared to the working population

When reviewing the specific causes of deaths due to respiratory diseases, we find significant excess in mortality due to chronic obstructive pulmonary disease compared to the working population. Female and male cleaners experience respectively 70% (HR 1.7 CL 1.4-2.0) and 40% (HR 1.4 CL 1.3-21.6) higher mortality due to chronic obstructive pulmonary disease. For men, we also found significant excess in mortality due to pneumonia (HR 1.2 CL 1.0-1.4). Unexpectedly, we found no significant excess for asthma.

Table 4 Hazard ratios and 95% confidence levels for respiratory mortality by sex and occupation (1991-1997/2001-2011)[‡]

	Malignant neoplasms of the respiratory system[§]						Diseases of the respiratory system[**]					
	Women			Men			Women			Men		
	HR	LL	UL	**HR**	LL	UL	**HR**	LL	UL	**HR**	LL	UL
Cleaners												
Health care and social	1.2	0.9	1.6	1.0	0.8	1.3	1.5	1.1	2.2	2.5	1.8	3.3
Public adm. and general	1.4	1.1	1.8	1.4	1.2	1.6	1.3	0.9	1.9	1.7	1.4	2.2
Educational institutions	1.6	1.2	2.0	1.5	1.2	1.8	1.3	0.9	1.8	1.8	1.3	2.4
Industrial cleaners	1.7	1.1	2.6	1.5	1.2	1.9	0.9	0.4	1.8	1.4	1.0	2.0
Domestic cleaners	0.8	0.4	1.7	-	-	-	1.0	0.5	2.2	-	-	-
Hotels and restaurants	2.0	1.3	3.2	-	-	-	1.3	0.6	2.7	-	-	-
Undefined	1.3	1.0	1.8	1.4	1.2	1.6	1.5	1.0	2.2	1.5	1.2	1.9
All other	1.5	1.1	1.9	1.4	1.3	1.7	1.5	1.1	2.1	1.6	1.3	1.9
Secondary school teacher	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
All other occupations	1.3	1.1	1.5	1.2	1.1	1.4	1.2	0.9	1.5	1.2	1.0	1.4

[‡] Controlled for age, region, Belgian nationality, Educational level, part-time employment and manual labour.

Abbreviations: HR= Hazard Ratio; LL= lower bound of 95% confidence interval; UL= upper bound of 95% confidence interval

[§] International Classification of Diseases revision 9: 162-165; revision 10: C33-C39. Results based on 3,987 deaths among 953,443 women and 24,409 deaths among 1,562,551 men.

[**] International Classification of Diseases revision 9: 460-519; revision 10: J00-J99. Results based on 2,017 deaths among 953,443 women and 9,731 deaths among 1,562,551 men.

Other causes of death

Table 5 presents the hazard ratios and 95% confidence intervals for the other categories of cause-specific mortality with reference to secondary school teachers.

The comparison with the group of educators paints a somber picture for male cleaners especially. Mortality due to cardiovascular mortality is significantly higher for almost all types of male cleaners. Hazard ratios for ischemic and other heart-related diseases range between 1.4 (all other industries CL 1.2-1.6) and 1.9 (public administration and general services CL 1.7-2.2). Cerebrovascular and other circulatory diseases cause between 20% (all other industries HR 1.2 CL 1.0-1.6) and 80% (Health care and social services HR 1.6-2.6).

In addition, we find significantly higher mortality among all groups of cleaners for alcohol-related diseases, with the exception of industrial cleaners (HR 0.4 CL 0.1-1.1). Hazard ratios for cleaners in public health care and social services are twice as high as for secondary school teachers (HR 2.1 CL 1.3-3.4). Cleaners in public administration and general services have a hazard ratio of 2.5 (CL 1.8-3.5).

Furthermore, deaths due to all other natural causes are significantly higher for all male cleaners. Hazard ratios range between 1.4 (industrial cleaners CL 1.1-1.9) and 2.3 (health care and social services CL 1.8-2.9).

When we compare mortality patterns between groups of cleaners, it seems that male cleaners in the health care and social services and in the public administration and general services are worst off. Mortality in these groups is consistently higher for all investigated causes of death, both in comparison with secondary school teachers and with the total working population.

Discussion

Working in the cleaning industry in 1991 is associated with significant excess in mortality during the subsequent 20-year period. Both male and female cleaners experience significantly higher respiratory mortality. Not only deaths due to respiratory diseases are elevated, we also find excess respiratory cancer mortality for all types of cleaners. When reviewing the specific causes of respiratory cancer deaths, we find significant excess in lung cancer mortality for female and male cleaners. Results for respiratory diseases show significant excess mortality due to chronic obstructive pulmonary diseases (COPD) for both sexes. Male cleaners also seem to experience significantly higher pneumonia deaths.

Smoking is a major risk factor for lung cancer and COPD (Zaher *et al*, 2004). Information on smoking is not available in the census data. However, data from the Belgian Health Interview survey suggests little variation in smoking habits between cleaners and other occupational groups. Pooled data for four waves (1997, 2001, 2004 and 2008) show 60.3% of male cleaners have ever smoked versus 53.8% in all other occupational types. Among women, 39.4% of cleaners have ever smoked versus 36.9% in all other occupations (WIV-ISP, 2015).

The elevated respiratory mortality can also be explained by exposure to chemicals in cleaning agents. A potential carcinogenic effect of chlorinated solvents on lung cancer has been reported in recent research (Vizcaya *et al*, 2012; Mattei *et al*, 2014). COPD has been associated with an abnormal response of the lungs to noxious particles and gases (Salvi & Barnes, 2009). Chronic respiratory symptoms have been associated with the use of disinfectants among pig farmers (Preller *et al*, 1995). Contrary to previous studies, we did not find an association with asthma-related mortality (Jaakkola & Jaakkola, 2006; Vizcaya *et al*, 2015).

The excess in pneumonia mortality among males may be an indication of biological risk factors in cleaning work, such as exposure to aspergillus fumigatus (European Agency for Safety and Health at Work, 2009).

A second major finding is the excess in mortality among male cleaners. Although a female workforce dominates the cleaning industry, our results show a sombre health outlook for male cleaners in particular. Men cleaning in health care and in the public administration have higher mortality for every category of cause of death. Further research should look into sex-differences in morbidity, as well as possible co-exposures or selection effects.

The census-linked mortality register data provides a snapshot of the occupational distribution for the total Belgian population in 1991. This large, exhaustive dataset allows the study of differential mortality by individual socio-economic characteristics over a period of 20 years. The main advantage of this study is the availability of census-linked cause-specific mortality data. The anonymous linkage at individual level minimizes the nominator-denominator bias. Furthermore, even groups of cleaners with relatively small working populations could be included in this study due to the large number of persons in the dataset.
The study design has some limitations. Occupational information is only available for one point in time. Our findings may be confounded by exposures during previous jobs. Persons who have already quit the cleaning industry at the time of the 1991 census cannot be identified. Workers who were experiencing health problems, may have already left the workforce due to health reasons. As only actively employed workers are studied, healthy worker effects may bias our results. Because of the considerable staff turnover and the importance of undeclared work in the sector, our results are possibly an underestimation of the true health situation of cleaning workers. Because of the variety in tasks, cleaners regularly use different products complicating their exposure profiles. Also, exposure to cleaning products may have changed over time as a result of the development of environmentally preferable cleaning products and new technologies, such as micro fiber and steam technology (Garza *et al*, 2015).

The comparison with secondary school teachers is a good indication of the distance that needs to be covered in the pursuit of a healthy and safe work environment for cleaners. Because of the strong association with respiratory health effects, we propose to improve work area ventilation and encourage the use of personal protective equipment. Future studies should examine the effect of cleaning products on the development of lung cancer, as well as investigate the causal relation with chronic respiratory effects.

In conclusion, this study provides a strong indication of the adverse health effects of professional cleaning on population level. Male and female cleaners seem to experience high mortality due to respiratory cancer and respiratory diseases, which is potentially associated with exposure to chemicals in cleaning products. In light of elevated mortality risks for every investigated cause of death, health among male cleaners deserves additional attention.

Table 5 Hazard ratios and 95% confidence intervals for cause-specific mortality by sex and occupation (1991-1997/2001-2011)[††]

			Infect. And Paras. Diseases			Malignant neoplasms											Ischemic heart diseases and other heart			Cerebrovascular and other circulatory		
						Head and Neck			Digestive system			Urogen. System			Other								
Women	N	D	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL
Cleaners																							
Health care and social services	17786	1025	1.4	0.8	2.6	1.4	0.6	3.5	0.7	0.5	0.9	0.8	0.6	1.1	0.7	0.6	0.9	1.1	0.9	1.4	1.1	0.8	1.5
Public adm. and general services	17526	1193	1.0	0.5	1.8	1.2	0.5	2.9	0.7	0.6	0.9	0.8	0.6	1.1	0.6	0.5	0.7	1.1	0.9	1.4	1.0	0.7	1.4
Educational institutions	15268	1074	1.0	0.5	1.8	2.1	0.9	4.8	0.9	0.7	1.1	0.7	0.5	0.9	0.8	0.6	0.9	1.1	0.8	1.4	1.1	0.8	1.4
Industrial cleaners	4577	252	1.5	0.6	4.0	0.7	0.1	5.8	0.8	0.5	1.2	1.0	0.7	1.6	0.8	0.6	1.1	1.1	0.7	1.7	1.0	0.5	1.7
Domestic cleaners	2061	142	1.8	0.6	5.3	1.3	0.2	10.1	0.5	0.3	1.0	1.2	0.7	2.1	0.5	0.4	0.8	1.6	1.0	2.4	1.1	0.6	2.1
Hotels and restaurants	2772	152	-	-	-	1.2	0.2	9.6	0.6	0.3	1.1	1.2	0.7	2.1	0.9	0.7	1.3	1.0	0.6	1.7	0.9	0.4	1.9
Undefined	11741	730	1.2	0.6	2.4	1.5	0.6	4.2	0.7	0.5	0.9	0.6	0.4	0.9	0.7	0.6	0.9	1.2	1.0	1.6	1.2	0.8	1.7
All other	25046	1521	0.9	0.5	1.7	2.5	1.2	5.1	0.8	0.6	1.0	0.8	0.7	1.1	0.8	0.7	0.9	1.4	1.1	1.7	1.1	0.8	1.4
Secondary school teacher	49493	2150	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
All other occupations	807173	41846	1.1	0.8	1.7	1.4	0.8	2.4	0.8	0.7	0.9	0.9	0.8	1.1	0.9	0.8	0.9	1.1	0.9	1.3	1.0	0.8	1.2
Men	N	D	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL
Cleaners																							
Health care and social services	3819	567	2.2	1.1	4.4	1.0	0.5	2.0	1.0	0.7	1.4	1.3	0.8	2.0	1.3	1.0	1.8	1.8	1.5	2.2	1.8	1.3	2.6
Public adm. and general services	9549	1684	2.4	1.5	3.8	2.2	1.5	3.1	1.3	1.1	1.6	1.7	1.3	2.2	1.1	0.9	1.4	1.9	1.7	2.2	1.7	1.3	2.1
Educational institutions	3054	540	2.3	1.2	4.5	1.5	0.8	2.6	1.2	0.9	1.6	1.2	0.8	1.9	1.0	0.7	1.4	1.5	1.2	1.9	1.3	0.9	1.9
Industrial cleaners	4794	559	2.7	1.5	5.2	0.8	0.4	1.6	1.2	0.9	1.6	1.1	0.7	1.7	1.1	0.8	1.5	1.5	1.2	1.8	1.7	1.2	2.4
Domestic cleaners	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hotels and restaurants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Undefined	11300	1494	2.4	1.5	3.7	1.7	1.2	2.4	1.4	1.2	1.7	1.2	0.9	1.6	1.2	1.0	1.5	1.7	1.5	2.0	1.3	1.0	1.7
All other	14914	2016	1.4	0.9	2.3	1.5	1.1	2.1	1.3	1.1	1.5	1.4	1.1	1.8	1.1	0.9	1.4	1.4	1.2	1.6	1.2	1.0	1.6
Secondary school teacher	44917	3826	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
All other occupations	1469344	160843	1.7	1.3	2.2	1.2	1.0	1.5	1.2	1.1	1.3	1.1	1.0	1.3	1.1	1.0	1.2	1.4	1.3	1.5	1.2	1.1	1.4

[††] Controlled for age, region, Belgian nationality, Educational level, part-time employment and manual labour.

Table 7 Hazard ratios and 95% confidence intervals for cause-specific mortality by sex and occupation (1991-1997/2001-2011) (continued)[‡‡]

			Alcohol-related diseases			All other natural causes			Accidents, including traffic and falls			Suicide			All other external causes		
Women	N	D	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL
Cleaners																	
Health care and social services	17786	1025	1.1	0.7	1.8	1.4	1.1	1.7	0.9	0.6	1.4	0.7	0.5	1.1	1.3	0.7	2.4
Public adm. and general services	17526	1193	1.4	0.9	2.2	1.2	0.9	1.5	1.0	0.6	1.5	0.9	0.6	1.2	1.5	0.9	2.6
Educational institutions	15268	1074	1.2	0.7	2.0	1.3	1.1	1.7	0.9	0.6	1.5	0.6	0.4	0.9	1.4	0.8	2.5
Industrial cleaners	4577	252	0.4	0.1	1.7	1.5	1.0	2.2	0.1	0.0	1.0	0.8	0.4	1.6	2.1	0.9	4.7
Domestic cleaners	2061	142	1.3	0.5	3.5	1.9	1.3	2.8	0.5	0.1	2.0	0.2	0.0	1.2	1.1	0.3	4.5
Hotels and restaurants	2772	152	1.9	0.8	4.5	0.9	0.5	1.7	0.5	0.1	1.9	0.8	0.4	2.0	1.0	0.2	4.1
Undefined	11741	730	1.2	0.7	2.2	1.2	0.9	1.6	1.4	0.8	2.2	0.8	0.5	1.3	1.3	0.7	2.5
All other	25046	1521	1.1	0.7	1.7	1.2	0.9	1.4	0.9	0.6	1.3	0.7	0.5	1.0	1.5	0.9	2.5
Secondary school teacher	49493	2150	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
All other occupations	807173	41846	1.2	0.9	1.6	1.3	1.1	1.5	1.0	0.8	1.3	1.0	0.8	1.2	1.4	1.0	2.1
Men	N	D	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL	HR	LL	UL
Cleaners																	
Health care and social services	3819	567	2.1	1.3	3.4	2.3	1.8	2.9	1.7	1.1	2.8	1.8	1.2	2.7	2.0	1.1	3.5
Public adm. and general services	9549	1684	2.5	1.8	3.5	1.8	1.5	2.2	1.7	1.2	2.4	1.5	1.1	2.0	1.3	0.8	2.1
Educational institutions	3054	540	1.3	0.7	2.4	1.7	1.4	2.2	1.3	0.7	2.4	1.2	0.7	2.0	0.7	0.2	1.8
Industrial cleaners	4794	559	0.4	0.1	1.1	1.4	1.1	1.9	1.3	0.7	2.2	1.6	1.1	2.4	1.6	0.9	3.0
Domestic cleaners	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hotels and restaurants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Undefined	11300	1494	1.7	1.2	2.4	1.4	1.2	1.7	1.7	1.2	2.3	1.4	1.0	1.9	1.3	0.8	2.0
All other	14914	2016	1.7	1.2	2.3	1.5	1.3	1.7	1.7	1.3	2.3	1.4	1.0	1.8	1.6	1.1	2.4
Secondary school teacher	44917	3826	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
All other occupations	1469344	160843	1.5	1.2	1.8	1.2	1.1	1.4	1.6	1.3	1.9	1.4	1.2	1.7	1.4	1.1	1.8

[‡‡] Controlled for age, region, Belgian nationality, Educational level, part-time employment and manual labour.

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