

# Inequalities in mortality associated with housing conditions in Belgium between 1991 and 2015

Martina Otavova <sup>1,2,3,4</sup>, Christel Faes <sup>2</sup>, Brecht Devleesschauwer <sup>4,5</sup>, Bruno Masquelier <sup>1</sup>

<sup>1</sup> Center for Demographic Research, UCLouvain, Louvain-la-Neuve, Belgium

<sup>2</sup> Data Science Institute, I-BioStat, Hasselt University, Belgium

<sup>3</sup> Department of Epidemiology and Public Health, Sciensano, Brussels, Belgium

<sup>4</sup> Department of Veterinary Public Health and Food Safety, Ghent University, Merelbeke, Belgium

## Background

Inequalities in health and well-being between socio-economic (SE) groups are one of the major challenges for public health sectors worldwide[1-4]. In Belgium, previous studies on SE inequality defined people with low SE status by their income, education, occupation or where they live [5-7]. Housing is one of the environmental factors that play a central role in individual's health, and it is also a reflection of SE status that can carry physical, psychological and social risk for impaired well-being[8]. Yet, its impact on mortality has been less considered. Studies that examined the socioeconomic determinants of mortality and included housing aspect have, however, shown that sparse housing conditions are associated with poor health and increased mortality [9-12]. The objective of this research is thus to measure inequality in mortality attributable to housing deprivation in Belgium from 1991 to 2015.

## Methods

### Mortality data

We utilized individual-level mortality data at ages 0-100+ from the National Register in Belgium between Jan 1, 1991 and Dec 31, 2015. Data included the decedent's age, sex, and place of residence at time of death. The residence identification number was used to derive the decedent's statistical sector, which is the smallest geographical unit in Belgium, hosting around 550 inhabitants on average. Belgium has around 19,500 statistical sectors (with small changes over time).

### Housing Deprivation Score

We utilized data on housing characteristics from the 1991, 2001, and 2011 Belgian population censuses to develop area-level housing deprivation indices at the level of statistical sector for every respective year. Each index was based on a group of indicators encompassing multiple

deprivation dimensions, e.g. occupancy status and its density, absence of central heating, bathroom, toilet, kitchen, double glazing, internet, etc. First, for each indicator, proportion of deprived population in a statistical sector was calculated. Maximum likelihood factor analysis (FA) was used to combine these indicators into a single score, at the level of statistical sector, based on inter-correlation between the indicators. Then, statistical sectors were ranked based on the FA scores and assigned to deciles. Similar methodology was followed for 1991, 2001, and 2011 indices.

### Statistical Analysis

First, we stratified the mortality and population data according to 5-year age group, sex, deprivation decile and 5-year period (1991-1995, 1996-2000, 2001-2005, 2006-2010, 2010-2015). Within each age group, sex, and period, the mortality rate for the least deprived decile was used as a reference group and applied to the other deciles to produce a number of expected deaths. The mortality attributable to housing deprivation inequality was calculated as the difference between the observed and expected deaths, expressed as a population attributable fraction (PAF).

Second, we computed age-standardized mortality rates (ASMR) per 100,000 person-years by decile, sex, and time period using the sex and age structure of the Belgian population structure in 2018.

### **Preliminary results**

Our study covered 262 million person-years in people aged from 0 to 100+, with 2,603,954 deaths. During the study period, mortality rates decreased for men and women in all deciles.

Reductions in absolute mortality rates were greater for males in the most deprived decile (931 per 100,000 person-years) and females in the least deprived deciles (824 per 100,000 person-years), whereas relative reductions were greater for males (51%) and females (48%) in the least deprived deciles (Table 1).

Table 1: Standardized mortality rates per 100,000 person-years.

Male		1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	Change <sup>4</sup> (%)
	Most deprived <sup>1,2</sup>	2179	2085	1571	1412	1248	-43
	Least deprived <sup>3</sup>	1805	1695	992	875	887	-51
	Difference	374	390	579	537	361	3.5
Female							
	Most deprived	1886	1825	1317	1226	1139	-40
	Least deprived	1739	1641	1112	968	915	-48
	Difference	147	184	205	258	224	-52

Mortality is adjusted to the Belgian population structure in 2018.

<sup>1</sup> Housing deprivation index 1991 applied for years 1991-2000, index 2001 for 2001-2010, and index 2011 for 2011-2015

<sup>2</sup> Most deprived refers to the most deprived decile of the housing deprivation index.

<sup>3</sup> Least deprived refers to the least deprived decile of the housing deprivation index.

<sup>4</sup> Change in mortality between 1991-1995 and 2011-2015.

The proportion of mortality attributable to housing inequality varied by sex and time period. Between 1991 and 2015, the proportion of mortality attributable to housing inequality was much higher for men (24%) than women (13%) (Table 2).

Table 2: Mortality attributable to housing deprivation inequality (PAF)

	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	All years
Male	14.5%	15.11%	26.45%	25.31%	15.47%	24.21%
Female	6.67%	9.24%	10.45%	13.38%	11.94%	12.92%

If Belgium had the same risk of mortality as the least deprived group in 2001, 468,712 fewer deaths would have occurred between 1991 and 2015. It represents about 18% of all deaths that can be attributable to housing inequality (Figure 1).

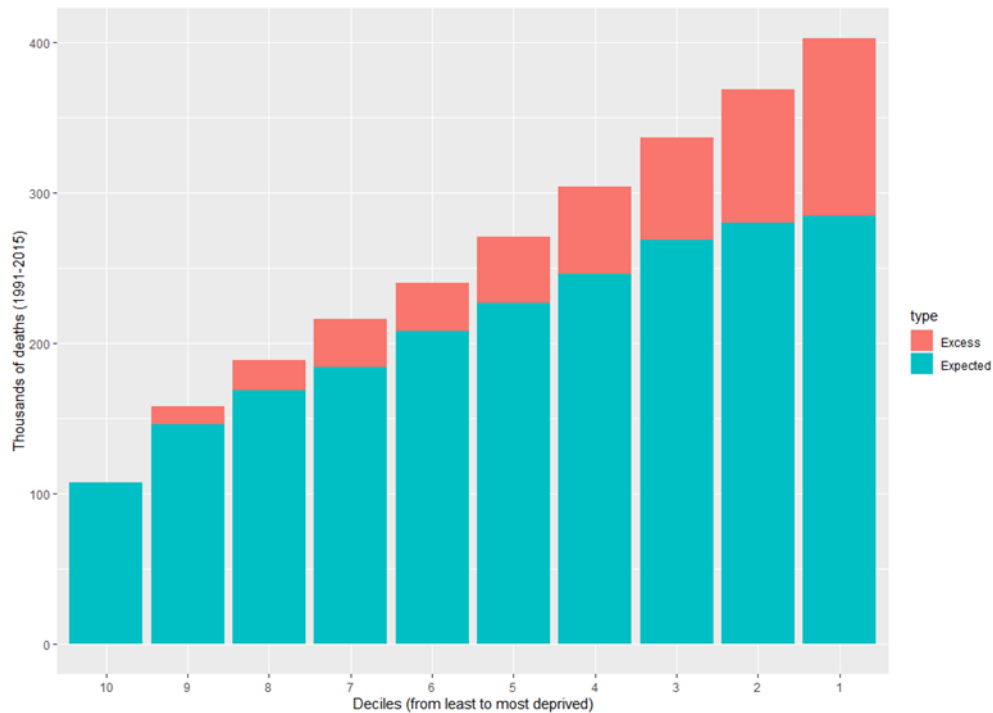


Figure 1: Mortality attributable to housing deprivation inequality with excess and expected deaths. Expected deaths are based on mortality in least deprived decile measured by housing index 2001.

## Conclusion

Previous research has shown that housing conditions play an important role in mortality inequalities and ensuring good housing conditions can help in reducing avoidable mortality. Our results provide insight into changing housing inequality over time and shed more light on impact of poor housing conditions and with that associated low socio-economic status on overall mortality in Belgium.

In our next step, we will construct similar deprivation indices on education and employment, and estimate the overall PAF. We will further investigate cause-specific mortality and the reduction in life expectancy due to inequalities in housing, education and employment.

## References

1. Mackenbach, J., *Health inequalities: Europe in profile* 2006, Expert Report commissioned by the EU
2. Mackenbach, J.P., *The persistence of health inequalities in modern welfare states: the explanation of a paradox*. Soc Sci Med, 2012. **75**(4): p. 761-9.
3. Humanities, D.-G.f.R.S.S.a., *Why socio-economic inequalities increase?* . 2010, European Commission.
4. WHO, *Closing the gap in a generation: health equity through action on the social determinants of health*. 2008, WHO: Geneva.
5. Renard, F., et al., *Educational inequalities in premature mortality by region in the Belgian population in the 2000s*. Arch Public Health, 2017. **75**: p. 44.
6. Renard, F., et al., *Evolution of educational inequalities in life and health expectancies at 25 years in Belgium between 2001 and 2011: a census-based study*. Archives of public health = Archives belges de santé publique, 2019. **77**(1): p. 6-6.
7. Renard, F., et al., *Trends in educational inequalities in premature mortality in Belgium between the 1990s and the 2000s: the contribution of specific causes of deaths*. J Epidemiol Community Health, 2017. **71**(4): p. 371-380.
8. Sanford, J., *The Role of Human Factors in Home Health Care: Workshop Summary* N.R.C.U.C.o.t.R.o.H.F.i.H.H. Care., Editor. 2010, National Academies Press (US): Washington (DC).
9. Eggerickx, T., J.-P. Sanderson, and C. Vandeschrick, *Les inégalités sociales et spatiales de mortalité en Belgique : 1991-2016*. Espace populations sociétés, 2018.
10. Gadeyne, S., *The ultimate inequality: Socio-economic differences in all-cause and cause-specific mortality in Belgium in the first part of the 1990s*. Centrum voor Bevolkingsen Gezinsstudie (CBGS), 2006.
11. Dunn, J.R., *Housing and inequalities in health: a study of socioeconomic dimensions of housing and self reported health from a survey of Vancouver residents*. J Epidemiol Community Health, 2002. **56**(9): p. 671-81.
12. Damiens, J., *The impact of housing conditions on mortality in Belgium (1991-2016)*. J Pop Research, 2020. **37**: p. 391-421.