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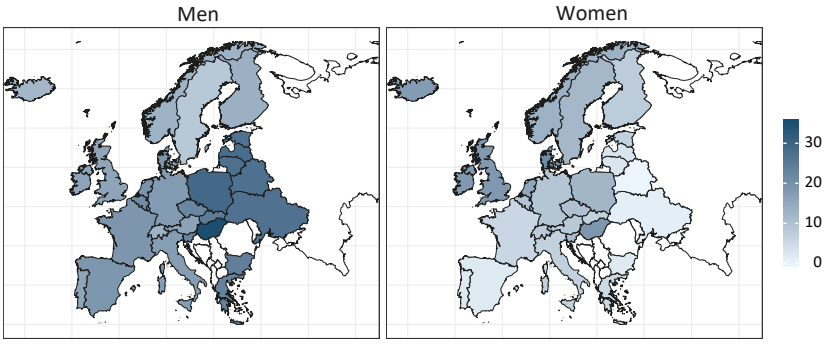
Smoking is the leading preventable risk factor of mortality in Europe, and its share of all-cause mortality is particularly high compared to other world regions. Fanny Janssen analyses the impact of smoking on mortality levels and trends in Europe and examines how variations in smoking and smoking-attributable mortality by sex and between countries explain differences in life expectancy.

More than a billion people, or 22% of the world population aged 15 and older, smoked tobacco in 2016 [1]. In the most developed countries, smokers have mortality rates 2–3 times higher than non-smokers and live on average 6–10 years less [2]. According to the most recent Global Burden of Disease estimates, smoking caused about 6.4 million deaths globally in 2015, or about 11% of all deaths [3]. Smoking thus exacts a heavy toll, particularly among those aged 30–69.

Smoking prevalence, however, differs greatly between countries, between men and women, and over time. Consequently, smoking's impact on mortality levels and trends also varies significantly. The smoking epidemic model [4, 5] describes these differences. Smoking prevalence first increases, then declines, and a similar wave pattern in smoking-attributable mortality follows about 30 years later.

Figure 1. Smoking-attributable mortality fractions in Europe in 2014 (%)



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Coverage: Twenty-nine European countries with long-term data series (see Figure 3).
Year: 2014 except for Bulgaria (2010), Greece (2013), and Ukraine (2012).
Source: Author's calculations based on data from the WHO Mortality Database, the ACS CPS-II, and the Human Mortality Database (see Box 1).

The smoking epidemic started among men in North American, Australasian, and North-Western European countries, followed by men in other European countries, then China, Japan, Southeast Asia, Latin America, North Africa, and, finally, sub-Saharan Africa. It occurred several decades later among women, but their smoking prevalence levels have remained lower than those of men [4].

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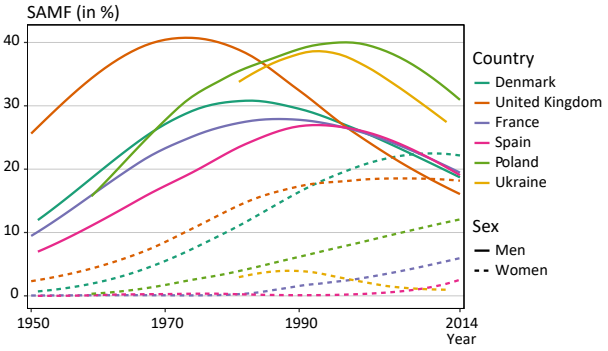
Figure 2. Trends in smoking-attributable mortality fractions in selected European countries, 1950–2014



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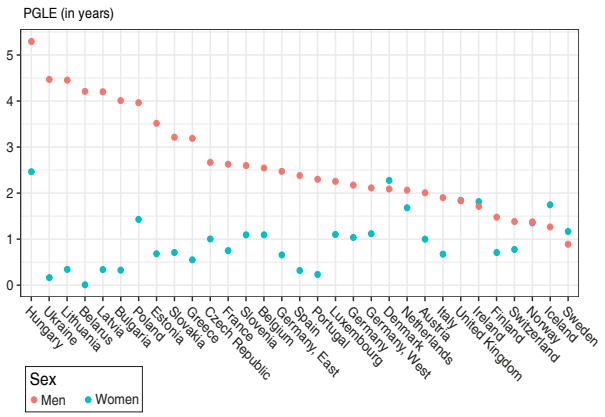
Source: Author's calculations based on data from the WHO Mortality Database, the ACS CPS-II, and the Human Mortality Database (see Box 1).

Figure 3. Potential gain in life expectancy after excluding mortality from smoking, 2014



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Coverage: Twenty-nine European countries with long-term data series.
Year: 2014 except for Bulgaria (2010), Greece (2013), and Ukraine (2012).
Source: Author's calculations based on data from the WHO Mortality Database, the ACS CPS-II, and the Human Mortality Database (see Boxes 1 and 2).

In Europe, smoking is currently the leading preventable risk factor of mortality [6]. At 29%, this global region has the highest tobacco smoking prevalence among adults [1]. The share of all-cause mortality due to smoking among those over age 30 is 16% in Europe [7], which is about 5% higher than the global average.

Sex and country differences

Because the timing of the smoking epidemic in Europe has varied by sex and subregions, clear differences in smoking-attributable mortality levels were observed in 2014 (Figure 1).

For men, the share of mortality due to smoking ranged from 9% (Sweden) to 35% (Hungary) and was 20% on average for the 29 European countries examined here. For women, this share was substantially lower, ranging from 0.1% (Belarus) to 22% (Denmark), with an average level of 8%. For men, it was higher in Eastern European countries than in the rest of Europe (27% vs. 17% on average). Among women, however, it was higher in North-Western European countries (11%) than elsewhere (6%).

The smoking epidemic is therefore most advanced in North-Western Europe, with smoking-attributable mortality already abating among men but still nearing its peak among women (see also Figure 2) [8]. The early onset of the smoking epidemic in North-Western European countries can be explained by the early automation of the cigarette production process in these countries, facilitated by their high income levels [8].

Smoking's effect on life expectancy levels

These substantial levels of smoking-attributable mortality are having a clear impact on levels of life expectancy throughout Europe, and explain important differences therein across countries and between men and women.

Figure 3 shows country- and sex-specific estimates of the potential gain (the added years) in life expectancy at birth (PGLE) if smoking were eliminated (see Box 2). In 2014, PGLEs ranged from 0.9 years (Sweden) to 5.3 years (Hungary) among men, with an average of 2.7 years; and from 0.01 years (Belarus) to 2.5 years (Hungary) among women, with an average of 1.0 years. For France, PGLEs were 2.7 and 0.7 years among men and women, respectively.

In Europe, the difference in PGLEs between men and women is 1.7 years on average. This difference is highest in Eastern European countries, but women exhibit higher PGLEs in the forerunner countries of Denmark, Ireland, Sweden, United Kingdom, and Iceland. On average, the sex difference in life expectancy in the 29 European countries studied was 6.0 years. Thus, on average, smoking contributed 28% (1.7 ÷ 6.0) to the sex difference in life expectancy.

Smoking also contributed to life expectancy differences between countries. Figure 3 shows that in 2014, the ordering of countries by PGLEs for men

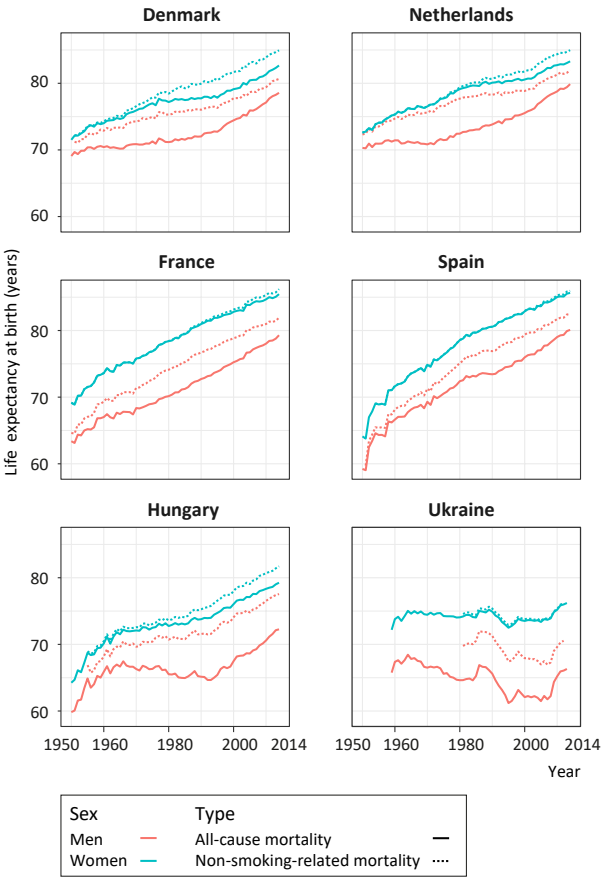
(from high to low) closely resembles the ordering of countries by overall life expectancy levels (from low to high). For men, the difference in life expectancy between Hungary (72.3 years) and Sweden (80.4 years) was 8.1 years. This difference would have been 3.7 years had smoking not occurred. For women, the opposite pattern is observed, as the smoking epidemic currently results in smaller differences between countries due to higher smoking-attributable mortality in Western Europe than in Eastern Europe. In 2014, women's life expectancy was 3.8 years higher in Western Europe than in Eastern Europe. This difference would have been 4.1 years if smoking had not occurred.

Smoking's effect on the evolution of life expectancy

The 2014 levels reflect the current phase of the smoking epidemic for men and women in the countries studied. The smoking epidemic, however, evolves in a wave pattern, first with an increase in smoking-attributable mortality, then a decline (Figure 2). Figure 4 reveals how this wave pattern affects the evolution in PGLEs due to smoking. In this Figure, the PGLE represents the difference between life expectancy for non-smoking-related mortality and life expectancy for all-cause mortality. For men, the PGLE first increased and then declined. For Danish and Dutch men, the peak in PGLEs occurred around 1980 at 4.2 and 5.2 years, respectively. For French men, the PGLE was highest around 1987 at 4.0 years. For men in Spain, Hungary, and Ukraine, the peak occurred in the 1990s, with values over 6.0 years for Hungary and Ukraine. The above reflects the spread of the smoking epidemic from North-Western to Southern Europe and then to Eastern Europe. For women in most countries, the PGLE is still increasing (North-Western European countries), or has begun to do so recently (Southern and Eastern Europe), and PGLE levels are low. In Denmark, however, women's PGLE levels have become higher than men's, and for the Netherlands and other forerunner North-Western European countries, this is expected to occur soon.

Figure 4 also reveals the impact of smoking on trends in life expectancy over time. For men in the Netherlands, Denmark, and other Nordic countries, the increase in life expectancy stagnated in the 1950s and 1960s, but if we exclude smoking-related mortality, the stagnation largely disappears. Similarly, among Danish and Dutch women in the 1980s and 1990s, the stagnation disappears when considering non-smoking-related mortality. Among men in other European countries, and women in other North-Western European countries and selected Eastern European countries, the increase in life expectancy would have been greater if smoking were eliminated. Finally, if we consider only non-smoking-related mortality, the increase in men's life expectancy becomes more similar to that of women.

Figure 4. Life expectancy trends including and excluding mortality from smoking, selected countries, 1950–2014



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Source: Author's calculations based on data from the WHO Mortality Database, the ACS CPS-II, and the Human Mortality Database (see Boxes 1 and 2).

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Box 1. Smoking-attributable mortality

Smoking-attributable mortality fractions (the share of mortality due to smoking) by country, year, sex, and age are estimated using a simplified version of the indirect method developed by Peto et al. (1992) [9, 10]. This method uses observed lung cancer mortality rates, controlled for the part not due to smoking, as a proxy for lifetime smoking prevalence. Smoking-attributable mortality fractions are then obtained by applying to this prevalence relative risks (RRs) of death from all causes combined for a smoker compared to a non-smoker. The method takes into account that smoking affects not just lung cancer mortality but also deaths from other causes. See Janssen (2019) for an appraisal of this method's pros and cons [8].

Age- and sex-specific lung cancer deaths were obtained mainly from the World Health Organization Mortality Database (updated 11 April 2018). The age- and sex-specific RRs as well as the information used to obtain non-smoking-related lung cancer mortality are derived from the American Cancer Society's Cancer Prevention Study II (ACS CPS-II) [9].

To estimate the share of all-cause mortality due to smoking for all ages combined for each country and year, age- and sex-specific smoking-attributable deaths were obtained by multiplying this category's share of mortality due to smoking by its all-cause mortality numbers (downloaded from the Human Mortality Database on 20 July 2018). Then, for each country and year, the smoking-attributable deaths were summed over all ages and divided by the all-cause deaths for all ages combined.

To assess the impact of smoking-attributable mortality on life expectancy levels and trends (see Box 2), non-smoking-attributable mortality rates were estimated by multiplying age- and sex-specific all-cause mortality rates by 1 minus the age- and sex-specific smoking-attributable mortality fractions.

Box 2. Life expectancy levels and trends if smoking were eliminated

The effect of smoking on life expectancy is illustrated by the potential gain in life expectancy (PGLE) if smoking were eliminated. It is estimated by subtracting the normal life expectancy level from the life expectancy level if all deaths due to smoking were avoided. The latter life expectancy levels are obtained by constructing life tables based on non-smoking-attributable mortality rates, rather than all-cause mortality rates.

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Abstract

In Europe, the smoking epidemic has clearly affected mortality levels and trends, as well as differences therein between countries and sexes. In 2014, smoking reduced the life expectancy levels of European countries on average by 2.7 years among men and by 1.0 years among women, and smoking contributed 28% to the sex difference in life expectancy. The smoking epidemic is most advanced in North-Western Europe, where smoking-attributable mortality is abating among men but still nearing its peak among women, resulting in small differences between both sexes. If we eliminate smoking-related mortality, life expectancy would not have stagnated in countries like Denmark and the Netherlands in the 1950s and 1960s among men and in the 1980s and 1990s among women. Generally, without smoking, life expectancy would have increased more strongly and in a more similar manner among men and women.

Keywords

smoking, mortality, sex differences, country differences, time trends, Europe.

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