

# BMJ Open What is the association of smoking and alcohol use with the increase in social inequality in mortality in Denmark? A nationwide register-based study

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## ABSTRACT

**Objectives:** The aim of this paper is to estimate the impact of smoking and alcohol use on the increase in social inequality in mortality in Denmark in the period 1985–2009.

**Design:** A nationwide register-based study.

**Setting:** Denmark.

**Participants:** The whole Danish population aged 30 years or more in the period 1985–2009.

**Primary and secondary outcome measures:** The primary outcome is mortality rates in relation to educational attainments calculated with and without deaths related to smoking and alcohol use. An absolute measure of inequality in mortality is applied along with a result on the direct contribution from smoking and alcohol use on the absolute difference in mortality rates. The secondary outcome is life expectancy in relation to educational attainments.

**Results:** Since 1985, Danish overall mortality rates have decreased. Alongside the improvement in mortality, the absolute difference in the mortality rate (per 100 000 persons) between the lowest and the highest educated quartile grew from 465 to 611 among men and from 250 to 386 among women. Smoking and alcohol use have caused 75% of the increase among men and 97% of the increase among women. Among men the increase was mainly caused by alcohol. In women the increase was mainly caused by smoking.

**Conclusions:** The main explanation for the increase in social inequality in mortality since the mid-1980s is smoking and alcohol use. A significant reduction in the social inequality in mortality can only happen if the prevention of smoking and alcohol use are targeted to the lower educated part of the Danish population.

## INTRODUCTION

Many western countries have experienced an increase in life expectancy with a contemporary marked increase in social inequality in mortality over the last decades, and Denmark is no exception.<sup>1–7</sup> Some environmental and behavioural risk factors have been identified

## Strengths and limitations of this study

- The entire Danish population aged 30 years or more is included for a period of 25 years.
- Mortality due to smoking is estimated using a commonly used indirect method.
- In the beginning of the study period, information on educational attainment is incomplete for 90% of the population above 64 years of age. However, the missing data on education become smaller during the time period of the study.

as mediating the effects of social position on disease incidence and survival, but exactly what drives the growth in this health divide remains to be determined.<sup>8–9</sup> In general, equalities in health are associated with income equality and equal distribution of power in the society, and therefore the question about what drives the health gap is even more intriguing in a Nordic welfare state such as Denmark where income inequality is low and has declined through most of the twentieth century.<sup>10–11</sup> Smoking-related and alcohol-related deaths contribute substantially to inequalities in mortality in several western countries.<sup>6–7–12</sup> Studies of cause-specific mortality in relation to social position have been used to determine what drives the health gap, and large inequalities in lung cancer and chronic obstructive pulmonary disease (COPD) mortality indicate the pervasive role of smoking as a proximal cause of inequality.<sup>12–18</sup> The estimated contribution from risk factors on inequalities in mortality varies in the literature due to different types of data and methodology, but most importantly, it varies due to the fact that the level and the social distribution of smoking and alcohol habits differ between countries. For example, inequalities in mortality in Italy and Spain are smaller than in other European countries and this has proved to