Unravelling the social gradient in cause-specific mortality in the Netherlands, 1811-2024

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In this study, we investigate whether the social gradient in mortality can be primarily attributed to the increase in non-communicable disease deaths. Drawing on novel linked data spanning over two centuries of the Dutch population, initial analyses reveal preliminary support for the hypothesis. If historical evidence undermines the idea that health inequalities are inherent or natural, it can imply that the health gradient is a socially constructed phenomenon and, as such, amenable to social and policy intervention.

Introduction and theoretical framework

Over the past two centuries, the Netherlands has experienced a striking improvement in longevity. The average life expectancy at birth rose from 40 years in 1850 to 82 years in 2023 (OECD, 2014; United Nations, 2024). Nevertheless, these improvements have not been experienced evenly throughout the society. Today, socioeconomic status, a multidimensional measure of educational attainment, occupational status, and income, is a key determinant of mortality, similar to other measures of health (Gadeyne, 2006; M. Marmot, 2020; M. G. Marmot et al., 1978). The wealthiest and highest educated in society tend to live longer lives than the poorest and lowest educated.

This phenomenon is widely described as the *social gradient in mortality* (Marshall et al., 2019). In the Netherlands specifically, people in the top 10% of the income distribution currently live an average of eight years longer than those in the bottom 10% (Social and Economic Council, 2023). This is particularly surprising, as the Netherlands is a wealthy country that has relatively low levels of income inequality and has had a national welfare system in place since the Second World War (Mackenbach, 2012; Mackenbach & Stronks, 2002; World Bank, 2021).

There is also evidence that socioeconomic inequalities in health, particularly mortality, have widened, both in absolute and in relative terms. This has been a trend since at least the past 75 years. In the 1950s and earlier, there were no differences in all-cause mortality based on socioeconomic

status in the Netherlands (Mackenbach, 1992; Mackenbach et al., 2003; Thompson & van Ophem, 2023).

Why health inequalities have widened is not precisely clear. One of the more compelling arguments relates to the changing pattern of mortality (Mackenbach, 2012). The basis of this argument is Omran's (1971) epidemiological transition theory which sets out four phases of mortality: 1) a pre-modern phase, characterized by infectious diseases and famines, with high birth and high death rates; 2) early-modern, in which mortality rates decrease due to improvements in public health, sanitation and nutrition; 3) late-modern, in which 'man-made', non-communicable disease rates increase; and 4) post-modern, when people can live longer with chronic conditions thanks to medical advancements. Others have further elaborated: "social inequalities in cause-specific mortality arise partly because social, economic, and structural factors influence mortality when diseases are preventable" (Clouston et al., 2016). Individuals in more favourable social, economic, and structural positions – those with higher socioeconomic status – draw on their resources, whether intentionally or not, to protect themselves against preventable illness. Thus, in theory, as societies move from the pre-modern to the modern phase, socioeconomic inequalities in health will rise due to the increase in preventable illness (Clouston et al., 2016).

Mackenbach (2012) argued that consumption behaviour is one of the most important predictors of socioeconomic inequities. People with lower socioeconomic status are more likely to consume unhealthily, which appears to be the result of the combination of cultural factors, personal characteristics, and material disadvantage. These include consuming more calorie-dense, nutrient-poor foods, lower rates of physical activity, and higher rates of drug and excessive alcohol consumption (Hulshof et al., 2003; Vinke et al., 2020). These factors, in turn, relate to higher rates of non-communicable chronic diseases that are related to premature death, causing socioeconomic differences in mortality (Grosso, 2019; Lee et al., 2012). If consumption behaviour is a key driver of the observed socioeconomic equities, non-communicable diseases related to lifestyle – including type II diabetes, cardiovascular disease, liver disease, colorectal cancer, and lung cancer – should have a clear social patterning that emerges over the twentieth century, clearer than other causes of death. We thus

hypothesise that the social gradient in mortality will be largely explained by the increase in non-communicable disease deaths.

Despite the importance of studying cause-specific mortality in terms of socioeconomic patterning in health, this has received scant attention in the literature. This is largely because cause-specific mortality is infrequently available over a sufficiently long period and wide geographical scope. The few previous studies have used all-cause mortality over entire countries (Poppel et al., 2009), or over single regions and/or cities (Bengtsson et al., 2020; Debiasi & Dribe, 2020). This study represents a major advance because we employ nationwide data between 1811 to 2024 to study the social gradient in cause-specific mortality in the Netherlands. To our knowledge, this study is the first to use such data to investigate the social gradient in this respect. Understanding when the social gradient in mortality emerged may assist researchers and policymakers.

Data, methods and preliminary findings

This paper utilises a linked sample of the Historical Sample of the Netherlands (HSN), consisting of individuals from the late nineteenth and twentieth centuries, and the Social Statistical Datasets (SSD), with individuals from the late twentieth century (Mandemakers, 2000; van Toor et al., 2022). This sample provides information on the cause of death, socioeconomic factors, residential data, family information, and other individual characteristics. We apply Cox proportional hazard models to examine the survival of individuals. Initial models indicate that socioeconomic differences in mortality can, in part, be attributed to the increase in preventable disease deaths. If historical evidence diminishes the idea that health inequalities are natural, this would imply that the gradient is socially constructed and can thus be changed.

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