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# Socioeconomic Differences in Health over the Life Cycle in an Egalitarian Country

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**Abstract**

A strong relationship between health and socioeconomic status is firmly established. Yet, partly due to the multidimensional and dynamic nature of the variables, the causal mechanisms connecting them are poorly understood. This paper argues that adoption of a life-cycle perspective is essential to uncover these causal pathways. A life-cycle perspective also allows investigation of whether the socioeconomically disadvantaged, on top of a lower health level, experience a sharper deterioration of their health over the life cycle. We show that in the Netherlands, as in the US, the socioeconomic gradient in health widens until late-middle age and narrows thereafter. The analysis and the available evidence suggests that the widening gradient is attributable both to health-related withdrawal from the labor force, resulting in lower incomes, and the cumulative protective effect of education on health outcomes. The less educated suffer a double health penalty in that they begin adult life with a slightly lower health level, which subsequently declines at a faster rate. The observed narrowing of the gradient in old age is partly an artefact stemming from the fact that only the most healthy of the disadvantaged survive into old age. It also reflects that after middle age, withdrawal from the labor force increasingly occurs for non health-related reasons.

***JEL Classification**: D30, D31, I10, I12*

**Keywords**: health, socioeconomic status, life cycle

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## 1 Introduction

Health differs by socioeconomic status. The socially and economically advantaged enjoy better health, irrespective of whether it is measured by morbidity, disability or mortality. This strong socioeconomic gradient in health is firmly established in evidence from many countries (Marmot 1999; Smith 1999; Mackenbach *et al*. 2002; CSDH 2008). The huge international literature on socioeconomic inequalities in health reflects the widespread view that they represent an infringement of social justice. The ethical position that health is a fundamental right, and should not be determined by social and economic circumstances, was vociferously defended recently by the World Health Organisation's Commission on the Social Determinants of Health (CSDH 2008).

Despite the wealth of literature available on the socioeconomic gradient in health, the causal mechanisms and pathways that determine the association are still poorly understood. In part, this stems from the static nature of much of the analysis. Observation of a correlation between health and socioeconomic status (SES) at any given age does not reveal anything about the direction of causality. Both health and socioeconomic status are multidimensional and dynamic, and the relationship between them may reflect different effects and feedbacks over the course of life. Does low economic status in early life lead to the development of health problems in middle and later life? Or, does poor health interfere with the acquisition of education and, subsequently, the chances of securing, or holding onto, a well-paid job? The difficulty of answering such questions led Cutler *et al.* (2008) in a recent review to remark that *"(...) differential patterns of causality make a single theory of socioeconomic gradients in health difficult to imagine. We suspect, though, that the right theory will emphasize the lifecycle."*

The main aim of this paper is to demonstrate the importance of bringing a life-cycle perspective to the examination of socioeconomic differences in health. Most notably, this allows identifying the timing of events that is essential to unraveling the causal mechanisms that generate the socioeconomic gradient in health. This paper does not aim to present evidence on the causal impact of SES on health, or vice versa, but rather to serve as a precursor to such analysis, describing how socioeconomic differences in health evolve over the course of the life cycle. This should help gauge the extent to which data are consistent with various causal mechanisms. The

advantage of bringing a lifecycle perspective on the gradient has proved extremely useful already in the United States, where Smith (1999, 2005a) and Case and Deaton (2005) have challenged the common view that a large part of the socioeconomic gradient in health ensues from the effect of socioeconomic status, in particular income, on health. Rather they show that the gradient derives largely from a feedback effect of health on income through labor force participation (Smith 1999; 2005a; Case and Deaton, 2005). Banks *et al.* (2007) made a first attempt to unravel these mechanisms in the UK and their preliminary conclusion is that the same mechanism is able to explain an important part of the gradient there as well.

This paper investigates whether the stylized facts emerging from the US focused literature are also apparent in Dutch data. The Netherlands differs markedly from the US in relation to social structure, income inequality, health and disability insurance, social protection and health care organization. No doubt as a consequence of these differences, socioeconomic inequality in health is much lower in the Netherlands than it is in the US (van Doorslaer *et al.* 1997). But little or nothing is currently known about whether and how the countries differ in the way in which the socioeconomic gradient in health varies over the life course. If there were no such differences, it would suggest that the observed patterns result from the fundamental relationships between education, occupation, work and health over the life course, and are not responsive to the social, health and economic policy environment.

A life-cycle perspective additionally provides information on how much more rapidly health declines for some groups than others. While it is clear that, at any given age, the socially disadvantaged experience a lower level of health, there is no consensus over whether they can also expect their health to deteriorate more rapidly. On the one hand, proponents of the *cumulative-advantage hypothesis* maintain that differences in health by SES are established early in life and subsequently widen as the economic and health disadvantages of the less privileged interact and accumulate (House *et al.* 1994; Ross and Wu 1996; Lynch 2003; Willson *et al.* 2007). The competing view— the *age-as-leveler hypothesis*— maintains that deterioration in health is an inevitable part of the process of ageing irrespective of economic means or social position, with the result that the SES-health gradient narrows at advanced ages (Beckett 2000; Herd 2006). A sharper deterioration of a lower initial stock of health possessed by the socially disadvantaged would be a double blow likely to intensify concerns about socioeconomic inequalities in health, equity and social cohesion. If

there is cumulative advantage, then interventions that were effective in breaking this process by expanding opportunities to socially disadvantaged groups earlier in life would have large pay-offs in terms of improved health and labor-market prospects over the life cycle.

Our interpretation of the Dutch evidence is that, as in the US, a large part of the socioeconomic gradient in health is governed by labor force participation. Once one controls for the working status of individuals, health differences across income groups disappear almost entirely. Since the largest health differences are between those working and those not, there appears to be a large effect of health on labor force participation and eventually income. Other studies in high-income countries have found that, in adulthood, income does not seem to have any direct causal impact on health outcomes (Adams *et al.,* 2003; Contoyannis *et al.,* 2004; Smith, 2005a; Case and Deaton, 2005; Frijters et al, 2005). However, we cannot rule out important long-term effects of socioeconomic conditions in childhood, neither the direct protective effect of education on health outcomes in adulthood. Additionally, we claim that although socioeconomic differences in health first diverge, reach a peak around retirement age, and then converge in old age, there are clear signs that the socioeconomically disadvantaged in practice suffer a double jeopardy in health. The convergence after retirement partly stems from selective mortality—only the robust group in the lower socioeconomic classes survive, so that health differences seem to converge.

The paper is organized as follows. Section 2 summarizes and discusses existing evidence on the SES health gradient over the life cycle. It is important to emphasize that while we will often refer rather loosely to the 'life cycle', we restrict our attention to the years of adulthood, and thereby do not survey either the ever-expanding literature on socioeconomic differences in the evolution of child health (e.g. Case *et al.* 2002; Currie and Stabile, 2003; Currie *et al.*, 2007; Murasko 2008), or that on the impact of early-life conditions on health in adulthood (Barker, 1995; van den Berg *et al.*, 2006; van den Berg and Lindeboom, 2007). In Section 3, we briefly discuss the data and methods, and in Section 4 evidence on the SES-health gradient over the adult life course in the Netherlands is presented. Section 5 summarizes the evidence and considers its consequences both for discussions of inequalities in health and the extent to which they should provoke social concern, and for policy.

## 2 Existing Evidence on Socioeconomic Differences in Health over the Life Cycle

Case and Deaton (2005), amongst others, examine how socioeconomic differences in self-reported health (SRH) vary with age. They report large differences in average self-reported health in the US by income quartile, excepting the very youngest and oldest. This is the familiar, strong SES-health gradient. More specifically, they show that the income gradient in health is increasing up to age 50-55, before it narrows particularly after age 60, until it eventually seems to disappear by age 80. While there are a large number of potential explanations for this phenomenon, it is at least consistent with lower-income groups experiencing more rapid deterioration in health up to the age at which (early) retirement sets in. These patterns are typical for the ones that emerge in other, including European, studies (e.g. Smith, 2005a; Deboosere and Neels, 2008).

Interpretations of the observed widening and then narrowing of the SES-health gradient with age differ in the extent to which the observed pattern is presumed to reflect substantive changes in the relationship between SES and health over the life course, as opposed to simply being the product of methodological limitations that obscure the true relationship. In the sociological and demographic literature two competing hypotheses have been put forward concerning the strength of the relationship between SES and health over time, as individuals grow old. According to the *cumulative-advantage hypothesis,* the SES-health gradient increases over the life course. This may be due to gestation of some effects of SES on health. For example, the health effects of socioeconomic differences in smoking become apparent only in middle age (Lynch 2003). Alternatively, social advantages in factors that affect health may have accumulated across the life cycle. For example, differences in social capital, networks and information may all increase with age (Lynch 2003). Empirical support of this hypothesis is provided by Ross and Wu (1996), Lynch (2003), Kim and Durden (2007), and Willson *et al.* (2007), among others. The competing view, the *age-as-leveler hypothesis*, proposes that the (mainly biological) dependence of health on age increases at older ages, and so the contribution of socioeconomic determinants necessarily falls (Herd 2006). A large literature documents the fact that at young ages much of the variation in health is associated with SES (see e.g. Case *et al.* 2002). It seems, however, that biology exerts a stronger influence as we age, and there is less

room for SES to play a role. Generally, the evidence is consistent with a cumulative-advantage process operating until middle age, with age indeed acting as a leveler over the years of retirement (Kitagawa and Hauser 1973; Kunst and Mackenbach 1994; House *et al.* 1994; Elo and Preston 1996; Deaton and Paxson 1998; Beckett 2000; Case and Deaton 2005; Smith 2005a; Herd 2006).

It is striking that similar patterns have been observed regardless of the indicators of SES and of health (Smith 2005a; Case and Deaton 2005). Smith (2005a) finds a similar pattern in the health gradient by education, although the gradient is more persistent and is still marked at very old ages. Additionally, he attempts to determine whether differences in income or education drive the US SES-health gradient. It turns out that only the poorest income quartile stands out: within each education level, the poorest have lower health. Repeating this analysis for employment (rather than health), conditional on education: again, only the poorest income quartile has considerably lower employment rates. This suggests that low income is largely due to lower employment rates. To complete the picture, Smith (2005a) plots SRH by employment and finds that those not working, at younger ages, report much lower health. Taken together, this series of analyses suggests that the constraining effect of health on work plays a large role in generating the income-health gradient.

While Case and Deaton (2005) agree that health-related interruptions to work contribute strongly to the income-health gradient and its variation with age, they also emphasize the impact of work on health. Pooling data from the 1986-2001 US National Health Interview Surveys (NHIS), they show that the initial divergence followed by convergence of the age profile in self-reported health is also apparent by labor-force status, even at the same income percentiles. They show that the association of health with income is swamped by the association with employment. They go on to compare rates of change of self-reported health between manual and non-manual occupations, and find that, even when controlling for income and education, the health difference between these two is increasing with age. They claim that, because of health selection, the differential is even biased downward. They find evidence of health selection out of the labor force among manual but not among non-manual workers. The manual workers that remain in employment experience a more rapid deterioration in health than non-manual workers. This all suggests a strong role for the nature of work in explaining adult health trajectories in the US.

Smith (2005b, 2007) used various US panel data sets to probe the SES-health relationship in an effort to unravel the causal mechanisms that may be responsible for it. Very broadly, his argument is that the data appear to support a strong causal impact (which seems to be mediated through work participation) of health on financial indicators of SES, and a causal impact only of education, among the SES indicators, on health. Much of Smith's argument is derived from the timing of the onset of chronic conditions (assumed to correspond to a health shock) in relation to measures of SES. A substantial impact of a health shock on the probability of future work and the income of older Americans is taken as evidence of a strong causal mechanism running from health to SES (Smith 2007). Using the Panel Study of Income Dynamics (PSID), Smith repeats the test for an impact of onset of chronic conditions on employment, income and wealth for different age groups. He finds that the group aged 51-61 consistently experiences the strongest effects. This offers quite a different interpretation of the quadratic relationship of the SES-health gradient with age than that of a cumulative-advantage process eventually being overturned by the leveling effect of age.

In the opposite direction, Smith (2007) consistently finds education to be a strong predictor of the onset of new chronic conditions, having controlled for initial health and a multitude of background factors including employment and smoking behavior, but finds no effect of financial measures of SES (income, wealth and change in wealth) on changes in health. Financial indicators do not predict the onset of health problems at any age, while the effect of education is largest in the group aged 40-60 years, but is not significant at older ages.

## 3 Data and Methodology

We examine socioeconomic differences over the life cycle in both self-reported health and mortality. The data used in the analysis are retrieved from the Central Bureau of Statistics (CBS) *Health Interview Surveys* covering 1983-2000 (*Gezondheidsenquête 1983-1996 and Permanent Onderzoek Leef-Situatie 1997-2000*), and from linked administrative data[1] covering 1998-2005. Compared to previous studies, these data offer clear advantages. First, the CBS *Health Interview Surveys*, which are used for the analysis of self-reported health, cover an 18-year timeframe, which is long enough to disentangle the effect of ageing – the life cycle – from that of cohort differences in

the social, health and economic conditions experienced at a given age. Second, the linked administrative data allow analysis of mortality in relation to actual (not reported) income from tax files at the level of the Dutch population.

We use graphs to illustrate the evolution of socioeconomic differences in self-reported health over the adult life course, paying particular attention to the age bracket coinciding with early retirement that emerged as a 'turning point' in the US studies. Self-reported health is obtained from the question: "How is your health in general?" Responses are on a five-point scale: "very good", "good", "fair", "variable", and "bad". We dichotomize and focus on individuals reporting the bottom two categories, which we refer to as "bad health".[2] Graphs are presented showing the percentage reporting bad health by socioeconomic indicators, separately for males and females. Moving across ages, we compare the health of those found at the bottom and top of the distribution of the given socioeconomic indicator – income, education, work status and occupation. We pool the 18 cross-sectional CBS surveys and compute the percentage of individuals in bad health in two-year age intervals, separately for females and males. A kernel-weighted local polynomial is estimated through the age-specific prevalence rates. Attention is restricted to adults between the ages of 18 and 80, the upper cut-off being chosen to maintain sufficient cell sizes.

To examine whether the life-cycle profile is obscured by cohort effects[3], we define cohorts by five-year birth intervals. Individuals born between 1915 and 1920 belong to the oldest cohort, and those born between 1975 and 1979 form the youngest.[4] We compute the gender-specific prevalence of bad health for each cohort in each of the cross-sections between 1983 and 2000, and do this separately for the bottom and upper income quartiles. Comparison of the prevalence of bad health of consecutive cohorts at the same age and in the same income quartile makes it possible to identify the cohort effect for each income quartile.[5] The life-cycle profile for each income quartile is identified by the within-cohort variation in reported health with age.

Selective attrition through mortality and institutionalization may bias estimation of the socioeconomic gradient. Given that mortality is strongly correlated with SES, at older ages the most robust of the lower socioeconomic groups will have survived. This could explain why socioeconomic differences in health amongst those surviving into old age appear to narrow. To examine whether selective attrition due to mortality

influences the life-cycle profile of self-reported health a similar graph of mortality rates by income quartile over the life-cycle (corrected for cohort effects) is presented.

In addition to self-reported health, we examine disability — a different dimension of health with a potentially distinct life-cycle profile (Crimmins, 2004; Freedman *et al.*, 2007). Some of the apparent effect of health on work, and the peak in the prevalence of reported ill-health in middle-age, may be illusory, given that much of the evidence is derived from self-reported measures of general health. Those not working may report poor health in order to justify their status and/or remain consistent with claims made for disability insurance (Bound, 1991; Kapteyn *et al.*, 2007). We used a disability measure as a more objective health measure to gauge whether reporting differences cloud the actual profiles. Disability is measured using the OECD Long-Term Disability Questions on eight selected domains (McWhinnie 1982; Gudex and Lafortune 2000).[6] We create a binary indicator of whether the individual reports at least one severe disability, defined as only being able to carry out an activity with great effort or not at all, in any domain. While this is still a self-reported measure, it is more specific than an assessment of health in general, referring to ability to undertake defined activities, many of which (hearing, seeing) are anticipated to become more difficult in old age. Older individuals might report their health as good, despite the onset of restricted activities, simply because they expect this to be part of the ageing process.

The CBS Health Interview Surveys measure income as annual net household income, which for the years 1983-96, is recorded in 11 categories with fixed bounds, and for the years 1997-2000 is available in deciles. To allow for variation in living standards within each income category, we rank inversely by household size. The resulting ranks are then used to identify age-gender specific quartiles in the (per capita) income distribution. The educational variable that is used is the highest education degree ever obtained.[7] We use this information to construct a low- and high education group. The low education group includes individuals that finished only primary school (21 percent of the total pooled sample), and the high education group refers to university and college graduates (17 percent of the total pooled sample).

The CBS Health Interview Surveys provide information on whether individuals are currently working (about 41,000 observations) or not (about 39,000 observations) up to the age of 70. In order to compare the health of individuals in the most and least physically demanding jobs, we assign those working in industrial, craft

and transport occupations to a "manual" category, and executives and specialists to a category we label "non-manual".[8] For individuals who are retired, their last occupation is coded, but this is not true for the last four cross-sections, which were excluded for this part of the analysis.

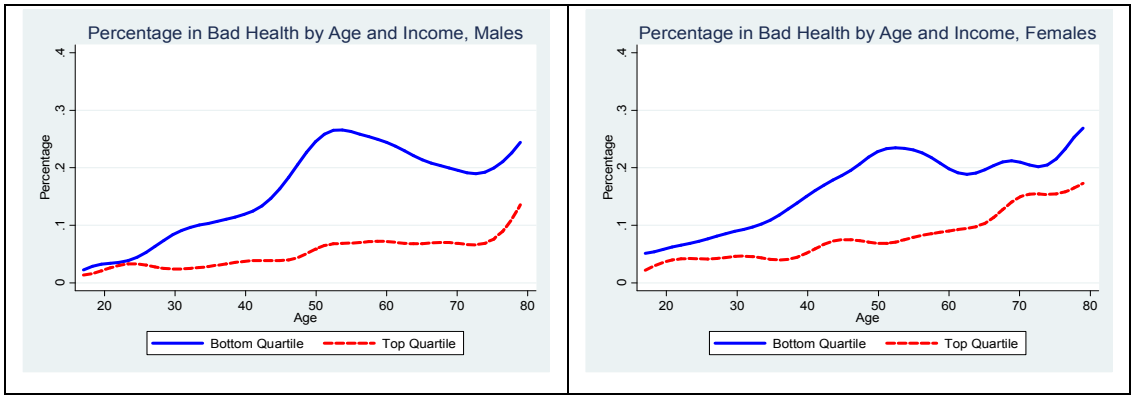
From the Municipality Register – in the linked administrative data – we observe each death, its timing, and the gender and date of birth of the deceased person. The Municipality Register is linked to income tax files of the previous year, allowing us to compute the age-gender-specific mortality rate by income quartile. This dataset is then linked to the Cause-of-Death Register to identify additional deaths that are not reported in the Municipality Register. We observe income information between 1998-2000 and 2002-2004 for a random sample of around one-third of the Dutch population, corresponding to about 5 million individuals per year (which is linked to mortality information for 1999-2001 and 2003-2005). The age-specific income quartiles are calculated for each year using annual household income calculated after taxes and social benefits and adjusted for household size and age structure.[9]

# 4 Socioeconomic Differences in Health over the Life Cycle in the Netherlands

## *4.1 The life-cycle profile of self-reported health by income*

Figure 1 shows a clear income gradient in reported bad health at all but the youngest ages. For example, there is a 10% prevalence of morbidity in the bottom income quartile of females already at age 35; while in the top quartile this prevalence is only reached at 65. The age profile of the gradient displays striking consistency with the evidence reviewed in section 2. For both genders, but particularly for males, income differences in health diverge until 55 or so, at which point almost 30% of males in the bottom quartile report variable or bad health, compared with only 5% in the top quartile, before converging in old age. The increase in the income gradient until the age of 55 is due to a very sharp increase in reported poor health in the bottom quartile, which contrasts with the much more steady increase in the top quartile. This is consistent with the patterns in the US data that were identified by Smith (2005a). The decline in reported ill-health in the age range of 55-65 is very marked at the bottom of the income distribution, but is absent at the top. That health is apparently improving in this age range at the bottom of the income distribution is rather surprising. We return to possible explanations of this phenomenon below.

**Figure 1: Self-reported health by age, split according to income quartile and gender, the Netherlands**

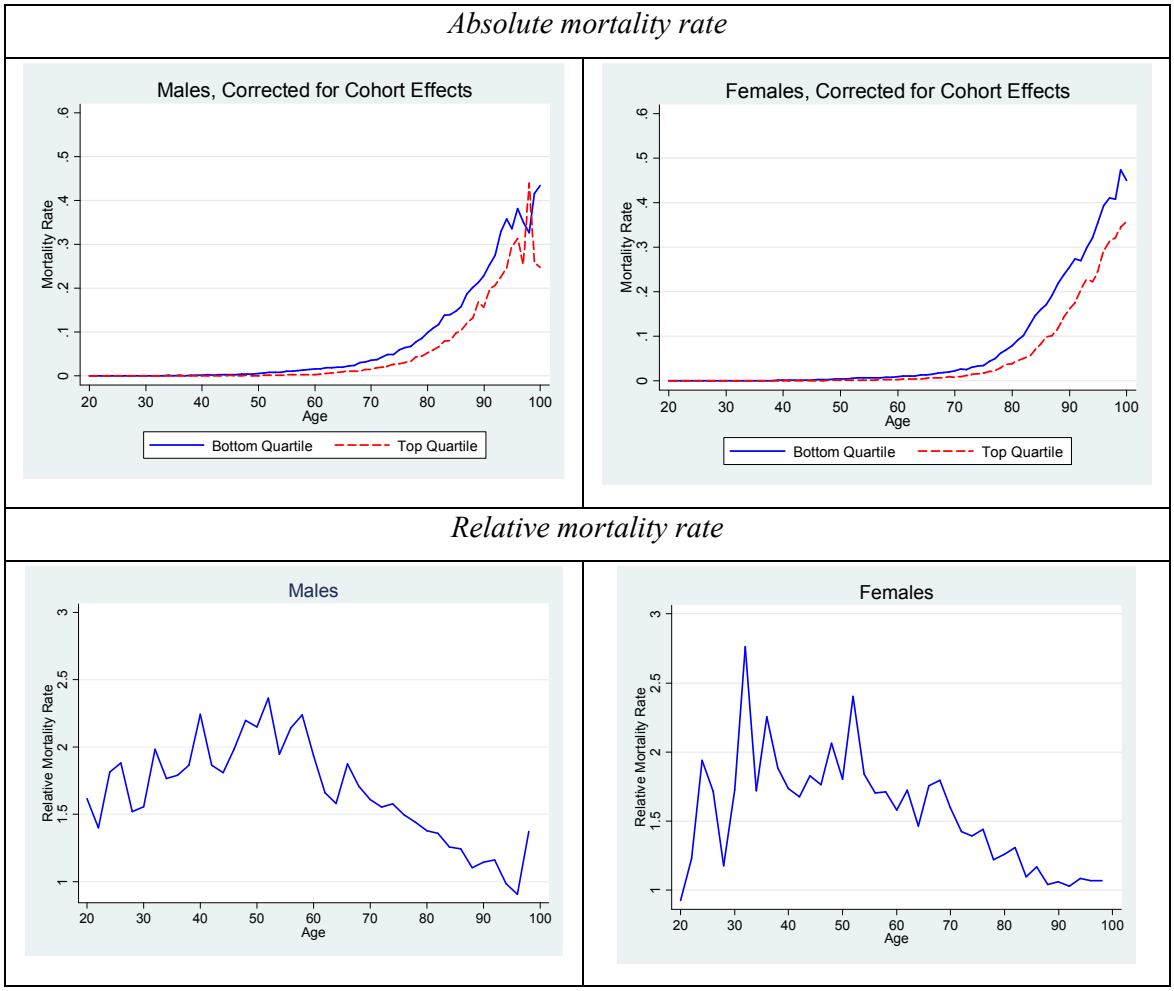



*Source: Authors' calculations from CBS Health Interview Surveys, 1983-2000. Sample weights applied.*

Concluding from the evidence that the impact of SES on health first waxes and then wanes as individuals age may be premature, given a number of methodological issues discussed in the previous section that could influence the patterns observed in the data. Figure A1 in the Appendix is the counterpart of Figure 1 after correction for cohort effects. Comparing the two figures it would appear that (particularly for males) any cohort effects are small and that life-cycle profiles can be approximated fairly well by raw age variation. This is consistent with previous findings for a number of northern European countries (Van Kippersluis *et al.*, 2008).

Figure 2 (top panel) shows mortality rates by income quartile after correction for cohort effects. Beyond the age of 60, one can observe large differences in mortality rates by income. Cumulative differences are even more pronounced. Below 60, differences are difficult to discern since the absolute rates are so small. But the graphs in the bottom panel of figure 2 reveal that relative differences in mortality rates are largest between 50 and 60, around the age at which differences in reported health peak. Clearly selective mortality is a potentially important contributor to the observed life-cycle patterns in reported health. Put differently, part of the convergence in the life-cycle profiles of health is due to the fact that only the most healthy of the lowest income quartile survives to a certain age.

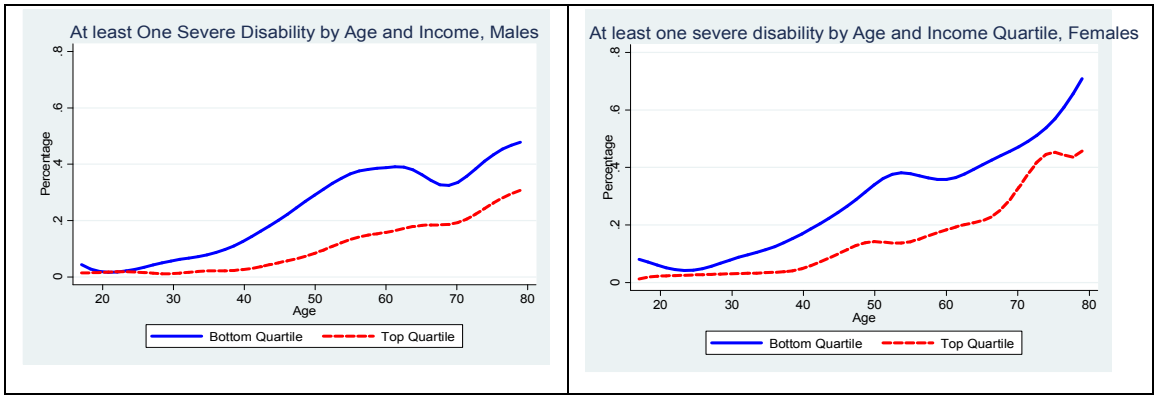
**Figure 2: Mortality rate over the life cycle, split according to income and gender with correction for cohort effects, the Netherlands**




*Source: Authors' calculations from linked Dutch administrative data, 1999-2001 & 2003-05. The vertical axis in the bottom panel shows the ratio of the mortality rate for the bottom quartile and the mortality rate of the top quartile.*

Comparison of Figure 3 with Figure 1 reveals income differences in the life-cycle profile of disability are similar to those in general health. One difference is that the upward trend in disability with age is stronger for the top income quartile than is true of the trend in general health. As a result, income differences in disability do not widen by quite as much, up to middle-age, as those in general health. Part, but by no means all, of this divergence may therefore be attributable to differential reporting of general health.

**Figure 3: Prevalence of disability by age, split according to income and gender, the Netherlands**

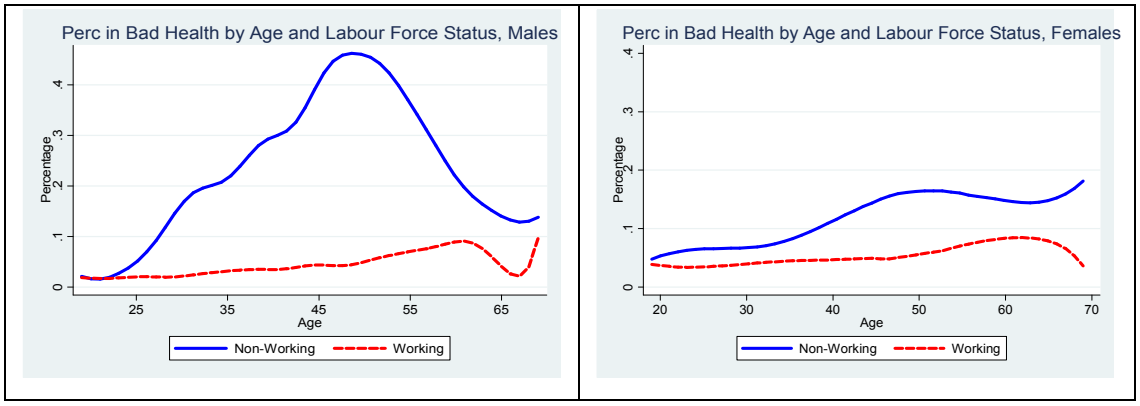



*Source: Authors' calculations for CBS Health Interview Surveys, 1989-2000.*
*Sample weights applied.*

### *4.2 How much does labor-force status matter?*

The US evidence suggested that part of the trend observed in the income-health gradient is due to the increasing impact of health on income through employment. To gain further insight into the plausibility of this hypothesis, we now compare directly the evolution of health with age across workers and non-workers. The age profiles of the prevalence of reported bad health for these two groups are given in Figure 4.

**Figure 4: Self-reported health by age, split according to work status and gender, the Netherlands**

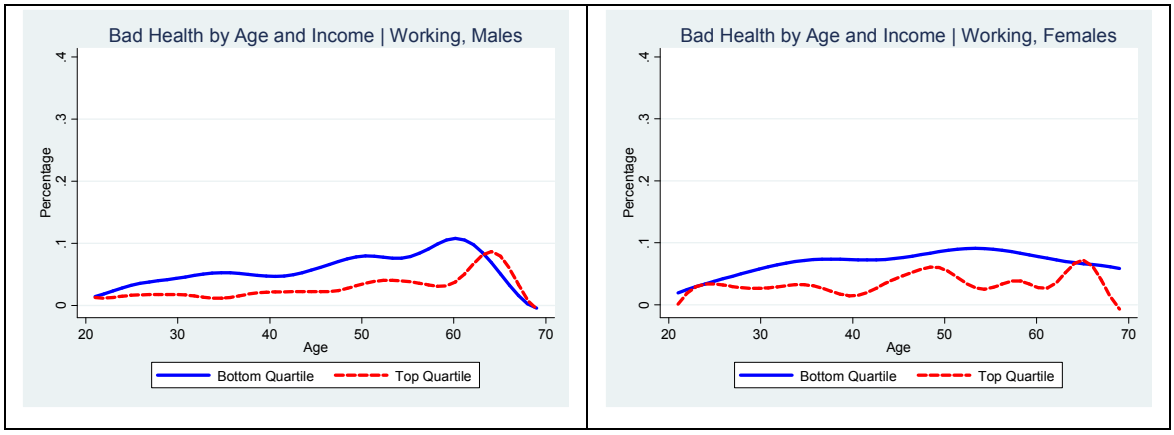



*Source: Authors' calculations for CBS Health Interview Surveys, 1983-2000.*
*Sample weights applied.*

The first striking observation is the rather flat profile of reported bad health for those working at each age. Practically no working males in early adulthood report bad health; the proportion begins to increase from age 30, but approaches 10% only by age 60. In contrast, already before the age of 30 around 15% of non-working males report bad health, and the proportion rises very steeply with age, such that 45% of non-working men report bad health at the age of 50. Non-working men are always in poorer health, and the widening differential suggests that health progressively becomes a more important reason for not working until age 50. The decline after age 50 in the prevalence of reported ill health amongst non-workers must be due to the growing importance of non-health reasons for not working— principally, voluntary retirement. The fact that ill health continues to rise among those that carry on working over this age range is consistent with this explanation. To the extent that income is determined by labor-force status, these graphs suggest that the observed widening and then narrowing of the income gradient in health over the life cycle may be driven by the varying effect of health on employment. Figure A2, presented in the Appendix, confirms that income is strongly correlated with work status; the non-participation rate is highest in the lowest income quartile, and this correlation peaks in middle age and falls substantially at older ages.

The pattern in the profile for non-working women is quite different. The prevalence of ill health among non-working women does not rise steeply with age, and never differs so markedly from the prevalence among working women. These differences reflect the lower participation rate of women, which is particularly low by European standards in the Netherlands, and the relatively lower importance of ill health as a reason for non-participation. This adds further support to the hypothesis that the effect of health on employment is an important determinant of the life-cycle variation in the income gradient of health, which is more pronounced for males than for females.

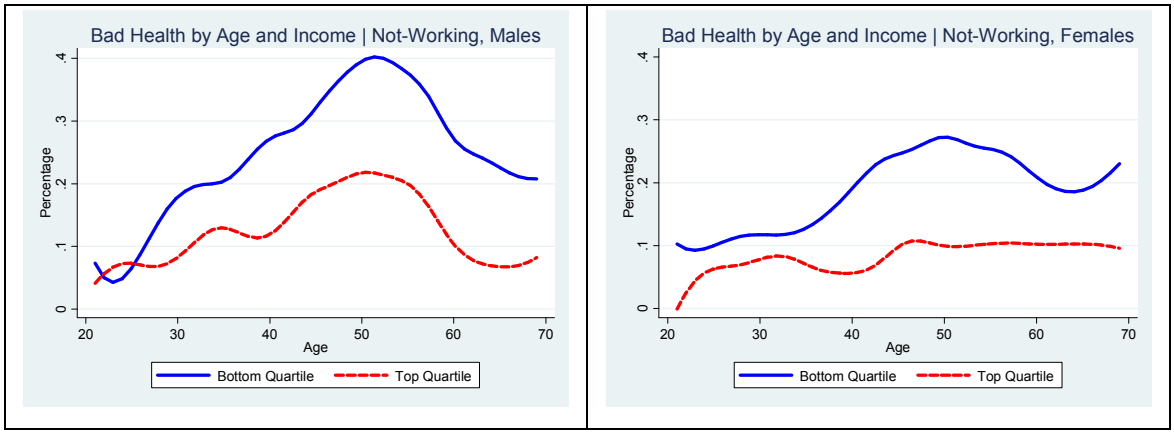
**Figure 5: Self-reported health among workers by age, split according to income and gender, the Netherlands**




*Source: Authors' calculations for CBS Health Interview Surveys, 1983-2000. Sample weights applied.*

We have argued that the widening income gradient in ill health may be at least partly attributable to an increasing impact of health on work, and thus on income. To gauge the force of this mechanism, we plot the health profiles by income group separately for workers and non-workers. Once one controls for working status (Figure 5), health differences across income groups disappear almost entirely. Apparently, labor force participation accounts for a large part of the health-income association. For non-workers (Figure 6), the differences are still apparent. While this is consistent with some impact of income (or a correlated socioeconomic characteristic) on health after controlling for employment status, it may also be true that low-income non-workers are more likely to be inactive for health reasons.

**Figure 6: Self-reported health among non-workers by age, split according to income and gender, the Netherlands**




*Source: Authors' calculations for CBS Health Interview Surveys, 1983-2000. Sample weights applied.*

### *4.3 Is the picture different by education or occupation?*

This subsection examines whether the socioeconomic gradient in health follows the same life-cycle profile, irrespective of the indicator of SES used. We compare gradients by education and occupation with those presented above by income. The causal pathways linking health to education and to occupation will differ from those responsible for the relationship between health and income. While our descriptive analysis cannot determine causality, comparison of the relationships over the life cycle can nonetheless be revealing about their nature and may be helpful in suggesting the possible underlying mechanisms.

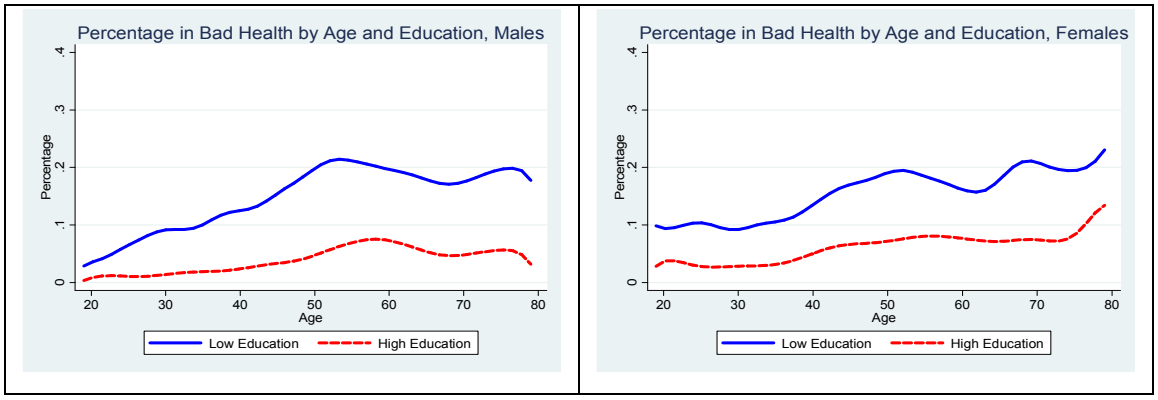
Educational attainment hardly varies over adulthood and so, for the vast majority, it will not be affected by adult health. Clearly, this does not hold for income. For this reason, education can be considered as a predetermined contributor to the production of adult health, and some even claim it to be "the most important correlate of good health" (Grossman, 2003). In contrast, income is contingent on labor-market behavior, and as we argued above, its correlation with health may derive from an effect of health on income through employment. The evidence of Smith (2007), consistent with a causal effect of education on health but not of income on health, provides an additional reason to compare health profiles relative to these two indicators of SES.

Figure 7 presents the profiles of the prevalence of reported bad health for the low and high education categories. For males, a widening of the education gradient up

to late middle age is immediately apparent. Compared to the income gradient in Figure 1, the magnitude of the education gradient is larger in early adulthood (which is probably due to the fact that, in this age range, education provides a better indicator than income does of the characteristics of the individual's social background that affect health), and smaller in late middle age. Hence, the widening of the education gradient over the years of normal working age is less pronounced than that for the income gradient. Further, while there is some narrowing of the education gradient beyond the age of 60, this is much less evident than is the case for the income gradient. These differences are consistent with the evidence from the US (Smith 2005a). A plausible explanation is the fact that, unlike income, education is not responsive to health changes. The income gradient may strengthen with age, as health shocks increasingly lead to labor-market withdrawal and a drop in income. But there is no such mechanism to drive the dynamics of the education-health relationship.

For females, the picture is quite different. Already at young ages there is a very strong education gradient in reported health, which remains stable throughout the years of younger adulthood before increasing moderately in middle age. The lack of a pronounced widening of the gradient contrasts both with the pattern observed for males, and with that of the income gradient for females. The latter difference again can probably be attributed to the differential responsiveness of education and income to health. The difference with the pattern for males may be due to differential disease patterns, with low-education females being less prone to the onset of cardiovascular disease than low-education males are, and education-determined occupational choice being less relevant to the health of women than of men.

**Figure 7: Self-reported health by age, split according to education and gender, the Netherlands**




*Source: Authors' calculations for CBS Health Interview Surveys, 1983-2000. Sample weights applied.*

To better gauge the relative importance of work status versus socioeconomic status in determining the life-cycle profile of health, Figure 8 presents the prevalence of bad health for the low- and high-education category— but conditioned on those currently working. Apparently, most of the life-cycle variation in health, and about half of the difference across education categories— evident from a comparison with Figure 7— vanishes after conditioning on those currently working. This suggests that the increasing gradient observed in Figure 7 may be attributable to vulnerability to health conditions that interfere with employment rising with age more steeply for the low educated. It could also be that the low educated are more likely to withdraw from the labor force as they age, and report poor health as justification for this.

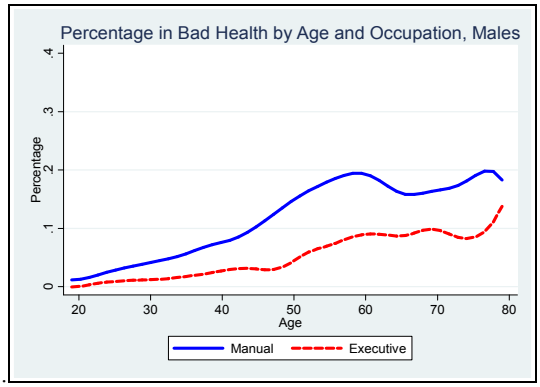
**Figure 8: Self-reported health among workers by age, split according to education and gender, the Netherlands**


*Source: Authors' calculations for CBS Health Interview Surveys, 1983-2000. Sample weights applied.*

According to Case and Deaton (2005), occupations may impact differentially on health through physical and mental strain— and this will result in different life-cycle profiles of health by occupation. Occupation is less predetermined than education, but is more so than income, offering another opportunity to explore whether the pronounced widening of the income gradient in health over the life cycle may be strongly influenced by the impact of health on work activity. We restrict our attention to males, for whom the manual vs. non-manual distinction is likely to be more crucial in identifying work of different levels of physical effort.

The profile for self-reported health presented in Figure 9 shows a widening of the occupational gradient in health up to late middle age, which is comparable to that observed for education but, as anticipated, is less stark than that observed for the income gradient. In early adulthood, differences in health by occupation are evident but not marked. Given that little time has passed at this stage of the life cycle for occupation to exert an influence on health, the observed differences presumably derive from earlier childhood experiences that impact on both occupational choice and health. But the steeper health trajectories experienced by manual workers mean that, by age 45, 10% of them report bad health— whereas non-manual workers reached this prevalence of ill health only at the age of 60.

**Figure 9: Self-reported health by age, split according to occupation, the Netherlands**




*Source: Authors' calculations for CBS Health Interview Surveys, 1983-2000. Sample weights applied*

## 5 Discussion

Our analysis demonstrates that in the Netherlands socioeconomic differences in health widen until late middle-age before narrowing in old-age. This life-cycle profile in the socioeconomic-health gradient is remarkably similar to that observed in the US despite the stark differences that exist between the countries in characteristics such as health system finance and organisation, income inequality, social protection and disability insurance, which would be expected to influence socioeconomic inequalities in health and their life-cycle evolution. It seems that countries with very different social welfare and health insurance systems end up displaying not quite identical, but nonetheless remarkably similar dynamic associations between health and socioeconomic status. This suggests that fundamental mechanisms linking age, health, income and education that are relatively unresponsive to policy parameters, at least within the range observed in western, high-income economies, may be responsible for these relationships. On the basis of our analysis and the more robust causal evidence available in the literature, two mechanisms are beginning to emerge as particularly important in understanding socioeconomic differences in health. First, there is a large effect of health on income that operates through employment and grows with age until voluntary retirement begins to dominate health as the main reason for labor force withdrawal (Case and Deaton, 2005; Smith, 2005a). Second, there is a non-negligible life-long effect of education on health. Education is not only the most important correlate of good health (Grossman, 2003), at least part of the large association stems

from a direct, causal impact of education on health outcomes (Oreopoulos, 2006; Smith, 2007; Silles, 2009). In contrast, although large health differences across income groups are visible, these do not derive from a causal impact of income on health (Adams *et al.,* 2003; Contoyannis *et al.,* 2004; Smith, 2005a; Case and Deaton, 2005; Frijters et al, 2005).

It is hardly surprising that health-related exit from the labor force is an important causal mechanism linking health and socioeconomic status at middle age in the US, a country with relatively limited social protection mechanisms. It is perhaps more surprising that the same holds for a country like the Netherlands, known for its generous social protection, disability insurance and retirement schemes. But this generosity can itself increase the observed correlation between income and health, if individuals with chronic health problems are encouraged to withdraw from the labor force, and given that replacement rates, although generous, are less than 100%. Kapteyn *et al.* (2007) demonstrated that more than half of the much higher rate of reported disability in the Dutch working population compared to that of the US could be explained by differential reporting of specific health conditions. This suggests that the generosity of Dutch disability insurance and the readiness for this to be used as a route out of work into retirement has exerted a considerable bias on the income-health gradient and its life-cycle profile. It is supposition, of course, but it seems plausible that in the Netherlands the impact of health on work, strengthened by welfare incentives, plays an even stronger part in explaining the observed income gradient in health and its life-course pattern than is the case in the US. Indeed, this is a potential explanation for the surprising apparent improvement in health beyond age 55 observed in Figure 1 among the poorest individuals. Once individuals reach an age at which they can legitimately withdraw from the labour force for non-health reasons, there is less incentive to report poor health. This is not to say that this is the only explanation for the phenomenon. Selective mortality must also play a role.

Selective mortality also appears to contribute to the observed decline in health inequalities in old age. While this is an inevitable consequence of the ageing process (with biological determinants of health dominating socioeconomic ones), it probably also reflects the survival of only the fittest members of the more disadvantaged socioeconomic groups. Hence, the narrowing of observed health inequalities in old age is itself the result of socioeconomic disparities in mortality at younger ages. We

confirm the existence of such mortality disparities by income in the Netherlands, using administrative data that links death registers with tax files.

More interesting than the decline in health inequality in old age is its increase from early adulthood until late middle age. While this pattern is evident for all indicators of socioeconomic status, it seems that the causal mechanisms, and the direction of causality, differ. US evidence suggests that education affects health (Lynch, 2003; Oreopoulos, 2006; Smith, 2007; Silles, 2009), and health impinges on work status and consequently income (Case and Deaton, 2005; Smith, 2005a). Differences in health by education appear to result, at least in part, from socioeconomic disadvantages increasing the onset of health problems (Smith, 2007). Once cohort effects and (to the extent possible) selective mortality are controlled for, there is substantial evidence that the health penalty of a low education accumulates with age (Lynch, 2003). In other words, on average, the health of the less educated deteriorates more rapidly with age. There is much less evidence that financial dimensions of SES exert a similar independent effect on health trajectories (Adams *et al.,* 2003; Contoyannis *et al.,* 2004; Smith, 2005a; Case and Deaton, 2005; Frijters et al, 2005). Some of the observed effect of health on work (and subsequently income) may be overstated as a result of non-workers justifying their status by ill health, but analyses based on the onset of health conditions prior to changes in labor-market status, which are less vulnerable to this bias, seem largely to confirm these effects (Smith, 2005b, 2007).

While the direction of causality in the education-health relationship appears to be the reverse of that in the income-health gradient, the two relationships can be integrated into a unified theory of cumulative advantage over the life course. This would start with early-life conditions and parental background affecting education. We have not reviewed the literature on the lifetime economic and health consequences of early childhood conditions here, but the evidence base to support causal effects is growing (Barker, 1995; Case *et al.*, 2002, 2005; Currie and Stabile, 2003; Currie *et al.*, 2007; van den Berg *et al.*, 2006; van den Berg and Lindeboom 2007). Education strongly influences the choice of occupation, and thereby the extent to which an individual's physical health determines his productivity, but also the health consequences of work itself. Someone with little or no education often has no option but to enter into heavy manual labor, which is likely to exert a greater toll on his health; that person is also more likely to be laid-off once health problems begin to

impede productivity. So, the health-related earnings losses that are partly responsible for the income-health gradient are themselves, to some extent, the result of socioeconomic differences in lifetime opportunities and their impact on health.

Overturning these processes of cumulative advantage represents a major challenge even to countries as egalitarian as the Netherlands. The potential rewards are, however, immense. Getting closer to a goal of equality of opportunity could raise national wealth by breaking the connection between low education, poor health and early labour force exit. There could also be substantial savings on expenditures on health care. Of course, breaking the cycle requires identifying the specific causal mechanisms that link education with later life health outcomes but, at present, there is very little robust evidence. Besides interventions in education, policies aimed at improving health conditions at work (particularly for those in low-skilled occupations) are important in preventing health-related labor-force exits, thereby extending working lives and maintaining the financial sustainability of pension systems. Given the moral hazard effects that are inevitably created by financial protection against health-related loss of employment, it seems crucial to enact policies in the workplace that can both prevent the development of health problems and reduce the impact of those problems on work capacity by providing appropriate support to partially disabled workers.

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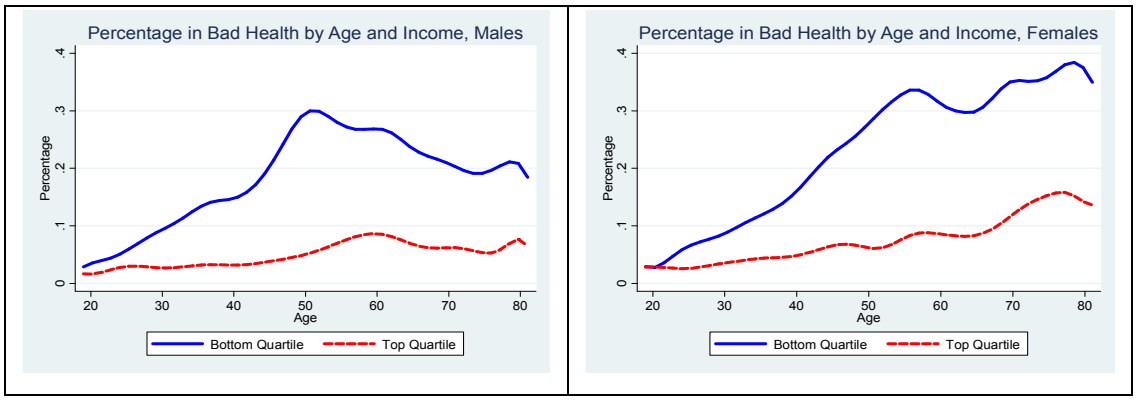
## Appendix

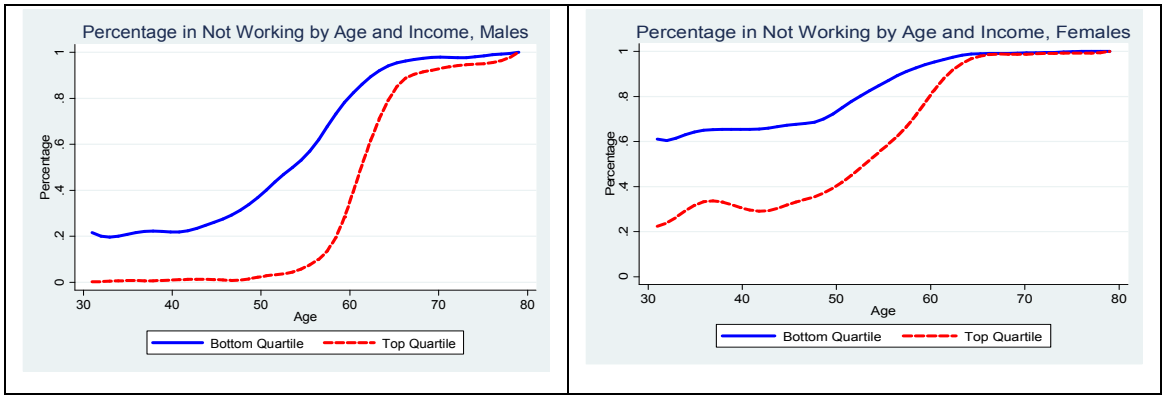
**Figure A1: Self-reported health over the life cycle, split according to income and gender (cohort corrected), the Netherlands**




*Source: Authors' calculations for CBS Health Interview Surveys, 1983-2000.*

*Sample weights applied.*

**Figure A2: prevalence of population working over the life cycle, by gender and income quartile in the Netherlands**




*Source: Authors' calculations for CBS Health Interview Surveys, 1983-2000*

*Sample weights applied*

## Endnotes

[1] Own calculations using data files made available by the Netherlands Central Bureau of Statistics (CBS) on the regional income distribution of persons and households, derived primarily from the Tax Administration (RIO) and the Municipality Register (GBA), from the Permanent Survey on Living Conditions (POLS basis, 1998-2004) of the CBS, and from the Cause-of-death statistics (DO) 1998-2005.

[2] Our results are not sensitive to this dichotomisation. The profiles of the percentage in 'good health' (the upper two categories) mirror those shown in the graphs below.

[3] Although conceptually important, period effects have been found to be empirically unimportant in analyzing life-cycle profiles of health (van Kippersluis *et al.*, 2008). Therefore, we have restricted the analysis in this paper to cohort and life-cycle effects only.

[4] We disregard individuals born before 1915 because of small cell sizes and drop individuals born after 1979 because these can be at most 20 on average in the last wave, leaving too little overlap to identify a cohort effect.

[5] In practice, this is done as follows. First, we regress the prevalence of morbidity for each cohort in each year between 1983 and 2000 (and separately for both genders and the top/bottom income quartile) on a set of age and cohort dummies (see van Kippersluis *et al.* (2008)). Next, we present the life-cycle profiles— separately for each income quartile and gender— by plotting the estimated coefficients for the age dummies. Since the cohort dummies enter linearly in the regression specification, we assume that the cohort effects cause only parallel shifts in the life-cycle profiles, which means that it does not matter (at least up to a constant) for which cohort we present the life-cycle profile. In this application, we have opted to show the life-cycle profiles that apply to the youngest cohort.

[6] The activities that are asked include (1) Hear normal conversation with three or four other persons, (2) Hear normal conversation with another, (3) Read ordinary newsprint, (4) See the face of someone from four meters, (5) Bite and chew on hard foods, (6) Carry an object of five kilos for ten meters, (7) Bend down (when standing) and pick up shoe, (8) Walk for 400 meters without resting.

[7] For students, we use the education level that is currently attended. Less than one percent of the respondents (both non-students and students) do not report education. Note that this percentage is 20 percent for the income measure. Repeating the analysis with a sample excluding the individuals not reporting income revealed similar education-specific profiles; we thus conclude that income item non-response can be treated as random, at least for the purposes of our empirical exercise.

[8] About 87 percent of the sample reports an occupation, of which 39 percent can be classified as manual, and 26 percent as non-manual (executive jobs). We repeated the analysis expanding the non-manual category to include service, administrative and commercial occupations, and manual to include fishermen. The resulting life-cycle profiles were very similar to those reported.

[9] The CBS provides adjusted (equivalent) income computed using a weight of 1 for the head of household, 0.38 for each additional household member over 18, and weights between 0.19 and 0.30 for household members under 18, depending on age and birth order. Besides the application of this equivalence scale, the income measure differs from the one available from the CBS Health Interview Survey in that it is the income recorded on the individual's tax return and is obviously continuous.