NIH Public Access
Author Manuscript
Res Econ Inequal. Author manuscript; available in PMC 2014 June 02.

Published in final edited form as:
Res Econ Inequal. 2013 January 1; 21: 311–332. doi:10.1108/S1049-2585(2013)0000021014.

The contribution of occupation to health inequality

Bastian Ravesteijn, **Hans van Kippersluis**, and **Eddy van Doorslaer**
Erasmus School of Economics, Rotterdam and Tinbergen Institute

Abstract

Health is distributed unequally by occupation. Workers on a lower rung of the occupational ladder report worse health, have a higher probability of disability and die earlier than workers higher up the occupational hierarchy. Using a theoretical framework that unveils some of the potential mechanisms underlying these disparities, three core insights emerge: (i) there is selection into occupation on the basis of initial wealth, education, and health, (ii) there will be behavioural responses to adverse working conditions, which can have compensating or reinforcing effects on health, and (iii) workplace conditions increase health inequalities if workers with initially low socioeconomic status choose harmful occupations and don't offset detrimental health effects. We provide empirical illustrations of these insights using data for the Netherlands and assess the evidence available in the economics literature.

Keywords

Health; Labour; Occupation; Life cycle models; The Netherlands

Introduction

Health and mortality are distributed unequally by occupation (Marmot et al. 1999; Mackenbach et al. 2008). For example, Davey-Smith et al. (1998) show that in the UK, those in the highest occupational classes had a 70 percent lower mortality rate over a 21-year period than those in the bottom occupational class. Not only mortality rates differ: Case and Deaton (2005) find that in the US those employed in manual occupations self-report lower health than those who work in professional occupations, and that their health declines more rapidly with age. Van Kippersluis et al. (2010) similarly find that among working Dutch males, health differences across manual and non-manual workers widen until around early retirement age and decline thereafter. Does this evidence mean that lower skilled occupations exert a higher health toll and thereby contribute to observed health disparities by socioeconomic status (SES)?

In this chapter we review the literature on whether occupation affects health and, if so, to what extent this contributes to socioeconomic inequalities in health. The discussion is illustrated with descriptive evidence from the Netherlands, which provides an interesting context in which there is a heated ongoing debate on whether certain 'hard' occupations should be exempted from a proposed rise in the statutory retirement age, and where it only

recently became possible to link occupational information to administrative registers containing mortality and disability figures. Our assessment of the literature is guided by a theoretical framework, which indicates that it is vital to understand the association between occupation and health along three dimensions.

First, it is unclear whether the strong and persistent association between occupation and health derives from a direct, causal effect of occupation on health. Alternatively, the association between occupation and health could stem from health enabling and/or limiting factors that induce individuals to self-select into certain types of occupation. A third possibility is that predetermined characteristics such as education or initial endowments affect both occupation and health, implying that health inequalities by occupation are simply a reflection of ‘deeper’ societal inequalities across socioeconomic groups. Even if a causal effect of occupation on health is established, it is essential to understand which occupational characteristics are most important in producing these health differentials. Is it simply the manual aspect of the job in terms of hard physical labour, or are health differences mostly caused by the psychosocial stressors, such as low job control and high work load? The answers to these questions have implications for policies that aim to prolong working lives and provide foundations for possible differentiation of the statutory retirement age on the basis of individual occupational histories.

Second, individual choices are not made in isolation. Decisions regarding occupational choice are made simultaneously with decisions regarding health investment and consumption. Hence, workers may (partially) offset the occupation-related damage to their health by investing in health, or may add to this health risk by engaging in unhealthy types of consumption.

Third, given a heavily constrained occupational choice set, workers with worse endowments may choose to “sell” part of their health by engaging in harmful occupations, in return for higher earnings. If this health risk is not fully compensated, it implies that occupation could exacerbate socioeconomic inequalities in health. If workers with poor endowments are more likely to choose such harmful occupations and are not fully compensated financially, there is scope for compensating labour market policies to offset health inequalities resulting from “hard” occupations.

Our review suggests that the evidence on the causal impact of occupation on health – in contrast to evidence on the association – is fairly thin. Identification of causal effects is particularly hampered by the sheer difficulty of finding suitable sources of exogenous variation in occupational and working conditions. Recent contributions do suggest that, while health differences across occupations largely reflect health-based selection, at least some part of the effect runs through physical working conditions affecting health outcomes, thereby exacerbating socioeconomic inequalities in health.

The paper is organized as follows. In the next section we document patterns of occupation, health and longevity in the Netherlands. In the third section we describe the basics of an economic model of health behaviour across the life cycle which can help us understand

occupational differences in health. In the penultimate section we review the scientific evidence guided by the core insights derived from the theory. The final section concludes.

Patterns of association between occupation and health in the Netherlands

The association between occupation and self-reported health, as well as other measures of morbidity, has been widely documented, both internationally, and for the Netherlands (Kunst et al, 1990; Cavelaars et al, 1998; Mackenbach et al. 2008). There is some evidence of an association between occupation and mortality (Kunst, et al, 1990), but less on the association between occupation and the onset of disability (e.g. Currie and Madrian, 1999). We add to this with evidence from the Netherlands, made possible through the recent linking of surveys and administrative registers by Statistics Netherlands.

We use the Dutch *Permanent Survey of Living Conditions* (Dutch acronym POLS) which has been linked to the registers since 1997. POLS is a repeated cross section survey which includes questions on measures of self-assessed health (SAH) and a measure of type of occupation based on the Dutch Standard Classification of Occupations (SBC, 1992). We use observations of individuals in the years 1997 through 2006, 115,888 of whom report an occupational title. The earliest cross-sections are much larger, with the first four years accounting for 70 percent of observations.

We distinguish between five major occupational groups: elementary, low-level, mid-level, high-level and university-level occupations (CBS, 2012). The 1992 SBC occupational classification is based on the skill level that is required for each occupation.[1] Examples of elementary occupations include conveyer belt workers or cleaners; low-level occupations include lumberjacks, miners and construction workers; mid-level occupations include foremen, building contractors or mechanics; high-level occupations include primary school teachers, mid-level managers, and head nurses; university-level occupations include medical doctors, accountants, and architects.[2] We investigate the association between occupational type and three measures of health. We find that workers in a “higher” type of occupation on average report better health, are less likely to become disabled and live longer than workers in lower ranked occupations.

Occupation and self-assessed health

In the survey years 1997 to 2001, respondents were asked to assess their health on a five-point scale from poor to very good. We restrict the sample to working-age individuals between 20 and 65 years old, which is the current legal retirement age. Figure 1 shows the health self-reports, uncontrolled for age and gender, for workers in five occupational groups, for those on disability benefits, and for those not working. Only a very small proportion of people on disability benefits reports good health. People on disability benefits report worse health than others who are not in paid employment. The figure shows that health status monotonically improves with higher levels of occupation: 81 percent of elementary workers

[1]The idea here is to present associations of an occupational measure and health outcomes. While we acknowledge that this classification is likely to pick up not just the effects of occupation, but additionally the effects of education and other individual characteristics, similar issues would plague other classifications of occupation into e.g. blue and white collar jobs.
[2]Due to changes in the coding procedure, 17,897 observations of occupational titles had to be excluded from the analyses

report good or very good health as opposed to 90 percent of those in high-level and university-level occupations

Figure 2 shows the proportion in good or very good health of individuals in the five occupational groups at different ages. It is striking that already at age 25 marked differences in health are observed across occupational groups. Since occupation is unlikely to have had much of an effect on health already at that age, this strongly suggests that there is health-related selection into occupations. The health disparities between occupational groups increase with age, suggesting rapid health deterioration among workers in the lower occupational groups, yet it should be kept in mind that these are not lifecycle profiles and hence could reflect cohort effects, selective promotion between occupational groups, selective mortality and other sources of confounding. The occupational health gradient by age is somewhat steeper for men than for women (not shown).

Occupation and disability

In the Netherlands, people who become unable to work because of health reasons qualify for a disability benefit. Using a linkage with longitudinal data from the Social Statistics File (Dutch acronym SSB), we can follow up all workers aged 20 to 65 observed in the POLS survey data to identify those moving into disability (until 2006). This allows analysis of the duration until exit out of a disability-free spell and into disability of all individuals who reported to be working at the time of the POLS survey. We take into account the left-truncation resulting from the fact that we start to observe individuals at different ages and we take into account right-censoring because of death, reaching the retirement age of 65 or the fact that we observe disability only until 2006. We estimate a Cox proportional hazard model of the duration until exit to disability. The base category is elementary work and the likelihood of exiting into disability monotonically decreases with level of occupation. Taking into account the 95 percent confidence intervals, individuals in low-level occupations are between 17 and 33 percent less likely to exit into disability than elementary workers at any age. Individuals in mid-level occupations are between 38 and 51 percent less likely to exit to disability. For individuals in high-level occupations this is between 45 and 57 percent and for university-level occupations this is between 56 and 70 percent.

Figure 3 shows the proportion of the working population that survives disability-free until the age of 65. At the age of 55, already 18 percent of elementary workers have exited to disability while only 7 percent of university-level workers are receiving disability benefits. Also very striking is the monotonicity of the gradient: with every step down the occupational ladder, the risk of disability increases significantly. The survivor function flattens after the age of sixty, most likely reflecting the increased likelihood of exiting the labour force into early retirement instead of disability.

Occupation and mortality

Occupational disparities in health are also reflected by differential survival. While these have been documented for many countries, hitherto they could not be examined for the general Dutch population because of absence of mortality data by occupation. Linkage of the POLS survey to the Cause of Death registry (Dutch acronym DO) enables analysis of the

duration until death of individuals by occupational status. As for disability, our duration analysis accounts for left-truncation and we also account for right censoring because we observe mortality only until 2010.

Again, we estimate a Cox proportional hazard model of the duration until exit due to death. At any age, individuals receiving disability benefits are more than twice as likely to die in the period of observation compared to individuals who were in an elementary occupation when they were observed in the POLS survey. In our sample, taking into account the 95 percent confidence intervals, individuals in low-level occupations are between 7 and 23 percent, those in mid-level occupations are between 20 and 32 percent, those in high-level occupations are between 32 and 44 percent, and university-level occupation even between 45 and 57 percent less likely to die at any given age compared to elementary workers.

Figure 4 shows the estimated survival curves by occupation. It can be seen that, at the age of 65, more than 20 percent of individuals who were on disability benefits have passed away, around 13 percent of elementary workers, and around 7 percent of university-level workers. In the coming years, the legal retirement age in the Netherlands will be increased to 67. At that age, and not taking into account any increase in life expectancy, 16 percent of elementary workers will have passed away, as opposed to 8 percent of individuals in university-level occupations. It is clear that both the probability of reaching retirement age, as well as the survival chances beyond that age, decrease monotonically with lower occupations.

All in all, the analysis confirms that in the Netherlands – as in many other industrialized countries – patterns of morbidity, disability and mortality differ by occupation. Health and survival prospects generally improve monotonically when moving up the occupational ladder. This raises the question of the extent to which these disparities reflect selection of healthier individuals into higher occupations, as opposed to these occupations offering a health advantage. In the case that the differences do reflect a causal effect of occupation on health, it is still of crucial importance to know to what extent this derives directly from the physical or psychosocial working conditions or rather follows from different life styles caused by occupation (e.g. through peer effects).

Theoretical framework

In this section, we present a theoretical framework based upon Grossman (1972), Case and Deaton (2005) and Galama and Van Kippersluis (2010) (see also Galama and van Kippersluis (this volume)), which represents choices of occupation, health investment, and consumption levels. It should help us to better understand (a) the empirical patterns observed in the previous section and (b) the evidence obtained so far in the wider literature.

Model formulation

The individual maximizes discounted lifetime utility, which depends on consumption c and health h in each period, by choosing a level of consumption, of health investment m, and of physical and psychosocial occupational attributes in vector o, given his information set I_t which includes all state variables at time t.

$$\max_{\{c_{t+j},m_{t+j},\mathbf{o_{t+j}}\}_{j=0}^{T-t}} E\left[\sum_{j=0}^{T-t}\beta^j u(c_{t+j},h_{t+j})|I_t\right] \quad (1)$$

The individual faces a health and a budget constraint. In each period, health is determined by permanent health *p*, the biological aging rate *a*, the history of idiosyncratic health shocks η, and the history of health investments and occupational choices.

$$h_{t+j}=f(p,\mathrm{a}_1,\ldots,\mathrm{a}_{t+j},\eta_1,\ldots,\eta_{t+j},\mathrm{m}_1,\ldots,\mathrm{m}_{t+j-1},\mathbf{o_1},\ldots,\mathbf{o_{t+j-1}}) \quad (2)$$

Permanent, time-invariant health is a function of endowments $p = g(e)$ and reflects characteristics and circumstances that are stable over time, such as genetic predisposition for certain illnesses. Health deteriorates with age and with exposure to harmful occupational characteristics, but can be improved by health investments. Initial health is viewed as the health level at the beginning of the working career, and it is determined by permanent health, health depreciation due to age, and the effects of all past health shocks on current health. The effect of the history of health shocks is typically smaller than the sum of these health shocks.

Expenditures on consumption and health investment (at prices p_c and p_m) may not exceed total earnings. Wages *w* depend on endowments, current health, and on the current level of harmful workplace conditions, which can be chosen in each period. Current health and endowments determine the maximum wage (the 'wage frontier') the individual can attain. The wage can be increased by undertaking jobs with harmful workplace conditions that have a deleterious impact on health, leading to health compensating wage differentials. There is no initial wealth in this simple model, endowments take the form of human capital.

$$\sum_{k=1}^{T}(p_c c_k+p_m m_k)\leq\sum_{k=1}^{T}\mathrm{w}(\mathbf{o_k};h_k,e) \quad (3)$$

The model emphasizes that the realization of lifetime utility depends on endowments, effort and institutions. Endowments are characteristics of the individual that are not chosen by the individual, like gender, race or genetic predisposition for learning, athletic ability or disease. But individuals are also endowed with their family background. For example, later-life outcomes may be determined by the level of education and income of the parents or by their ability to raise children. Second, lifetime utility is determined by individual effort: e.g. investment in health is costly but this type of effort is rewarded in terms of earnings potential and future health. Similarly, working may be harmful to health, but work is rewarded with earnings. Third, institutions determine how initial endowments and effort are rewarded in terms of utility and they determine the parameters of the constraints. For example, remedial teaching programs may reduce the importance of endowments while payroll taxes reduce the rewards of endowments and effort in terms of earnings.

Equilibrium conditions

If we make the simplifying assumption that the time preference rate is equal to the interest rate, then, in each period, consumption and health investment are each chosen to equate the respective marginal benefit and marginal cost represented by the conditions,

$$\frac{\partial u}{\partial c_t} = \lambda p_c \quad (4)$$

$$\sum_{j=1}^{T} \frac{\partial h_{t+j}}{\partial m_t} \left[\frac{\partial u_{t+j}}{\partial h_{t+j}} \beta^j + \lambda \frac{\partial w_{t+j}}{\partial h_{t+j}} \right] = \lambda p_m \quad (5)$$

where λ is the 'value' (or shadow price) of lifetime wealth and the LHS of (5) distinguishes the direct utility and indirect production benefits of health investment. These benefits include the future returns to current health investment through earnings and the discounted marginal utility of health in future periods.

The optimal level of harmful occupational characteristics is determined by

$$\lambda \frac{\partial w_t}{\partial o_t} = -\sum_{j=1}^{T} \frac{\partial h_{t+j}}{\partial o_t} \left[\frac{\partial u_{t+j}}{\partial h_{t+j}} \beta^j + \lambda \frac{\partial w_{t+j}}{\partial h_{t+j}} \right] \quad (6)$$

where the LHS represents the marginal return to entering an occupation that pays a wage premium in compensation for health hazards imposed and the RHS is the marginal health cost weighted by its direct and indirect consequences. The marginal costs include the effect of current occupational damage on future health and consequently on future earnings. Hence, there is an instantaneous wage benefit of harmful occupational attributes, yet future wages and future utility will be lower due to lower future health.

Core insights and empirical evidence

The economic framework yields several insights that are relevant for the interpretation of empirical evidence on occupation and health. In this section we discuss three core insights and the extent to which the empirical evidence in the economics literature is in line with them.

Selection and the estimation of causal effects

Individuals select into types of occupation on the basis of endowments, education, and health. Initial endowments influence one's health, but also one's wage prospects, since the marginal benefits of harmful occupational characteristics depend on endowments. Ravesteijn et al. (2013a) describe that in the Netherlands, those in "higher ranked" occupations are generally better educated. It is therefore important to account for all factors that simultaneously influence both occupational choice and health outcomes if we want to obtain estimates of the causal effects of occupation on health. Moreover, not only do occupational characteristics affect health, but health may influence occupational choices. Health, which is subject to shocks, co-determines the wage rate, and the marginal benefits of

engaging in harmful occupations. In simple terms, health determines the type of occupation one is able and willing to perform. Both unobserved heterogeneity and reverse causality prevent us from making statements about a causal effect of occupation on health on the basis of simple associations, such as those identified in US data by Case and Deaton (2005), Cutler et al (2011) and Morefield et al. (2011).

Several recent papers have made an attempt to go beyond the description of the occupation-health association and to estimate the health *effects* of occupation. Using an estimator that partially allows for correlation of regressors with time invariant unobservables, Datta-Gupta and Kristensen (2008) find that working in a satisfactory job environment improves self-reported health and reduces limitations in activities of daily living (ADL) in Denmark, France and Spain. Using data from 15 European countries, Cottini and Lucifora (2010) find that adverse working conditions negatively affect mental health, with the largest effect due to working at very high speed and tight deadlines, low job autonomy, and being involved in complex tasks. They seek to address the potential problem of endogeneity of job conditions by instrumenting working conditions with (i) occupational health and safety regulation by country, and (ii) job control defined by industry and occupation. Both instruments are based upon the idea that institutions or competition at an aggregate level are plausibly exogenous to the working conditions in a particular firm. Estimates exploiting these instruments show even larger effects of working conditions on mental health. Using Danish panel data with detailed information on physical and psychosocial workplace conditions, as well as physical and mental health, and allowing for correlated unobservable determinants of health, lifestyles and work conditions, Cottini and Ghinetti (2011) find that bad working conditions reduce especially mental health.[3]

Using US data and controlling for initial and lagged health using a random effects specification to allow for time-invariant and time-varying factors that may affect both health and occupation, Fletcher et al. (2011) find that physically demanding work has a strong negative effect on self-rated health for white women but not for men and non-white women, and that harsh environmental working conditions have a strong negative effect for young men but not for young women.

On the basis of analysis of German panel data, and exploring several empirical panel data approaches, Ravesteijn et al. (2013b) claim that 50 percent of the association between physical workplace conditions and self-rated health is due to the causal effect on health, while the remaining 50 percent reflects selection effects.

Compensating behaviours and clustering of occupational attributes

A second core insight from the theory is that choices are not made in isolation. An individual simultaneously selects his occupation and investment in health. Health behaviour may be adjusted in response to occupational choice, since the marginal benefits of health investment depend on occupation, through the terms $\partial h_{t+j}/\partial m_t$, and $\partial w_{t+j}/\partial h_{t+j}$ from equation (5). Note that the behavioural adjustment is different from the selection issue in terms of

[3]Limitations of the study are that it uses only two waves of the panel, fixed effects are not taken into account and there are no exclusion restrictions, with non-linearity relied on for identification.

timing. Ravesteijn et al. (2013a) describe that workers in lower occupations are more likely to smoke and less likely to engage in physical exercise. If these smoking differences in adolescence reflect different preferences across individuals which then lead to different occupational choices, this is considered selection. In contrast, if workers in certain occupations initiate smoking to cope with stress on the job or due to peer effects among colleagues, then these are considered behavioural adjustments. Therefore, the total health effect of a change in occupation is the sum of the direct effect of the occupational characteristics on health, and the indirect effect on health behaviour. In the absence of estimates of a full-fledged structural model – which inevitably requires strong functional form assumptions and very detailed data – or an experimental setting, it is extremely difficult to obtain an unbiased estimate of the direct effect since we only observe the total effect after the behavioural response.

Choo and Denny (2006) claim on the basis of Canadian data that even though the health effect of manual work is reduced by around 10 percent after controlling for health behaviours, there seems to be a direct effect of occupation on health. Cutler et al. (2011) similarly observe from US data that controlling for health behaviours reduces, but does not eliminate, occupational differences in health. Kelly et al. (2011) claim to be the first to estimate the causal impact of initial occupation on health behaviours. They find that entering the labour market as a blue collar worker raises the probability of obesity by 4 percent and of smoking by 3 percent. At least part of the observed health differences across occupational groups would appear to arise from differences in health behaviour differences.

Each occupation is characterized by psychosocial and physical workplace conditions. It is important to distinguish between the contributions of each of these attributes to health outcomes. Occupations with heavy manual work duties may simultaneously be characterized by low job control. Researchers should be careful in attributing certain health effects of an occupation to a specific attribute if this characteristic is simultaneously associated with other characteristics within occupational types.

In the Dutch POLS survey, individuals are asked to describe the characteristics of their jobs, including physical exertion, inconvenient work postures, repetitive work movements, and psychosocial aspects, such as time pressure and control over daily work activities. Table 3 shows clear gradients in both physical and psychosocial job characteristics favouring the higher occupations. The only exception is working under time pressure, which is reported more often among the higher-ranked occupations. There appears to be clustering of different job characteristics that are potentially damaging to health in certain occupations.

Karasek (1979) defines job strain as the interaction effect between decision latitude and job demands. Decision latitude refers to the degree to which a worker can influence his workplace situation (job control). Job demands are simply stressors on the job. Karasek argues that the combination of low decision latitude and high job demands is particularly bad for health.

According to the effort-reward imbalance model (Siegrist 1996)[4], it is imbalance between job demands in terms of physical and psychosocial effort, on the one hand, and recognition/

reward in terms of wages, esteem, job stability and career opportunities, on the other, that leads to a negative impact on health. Bosma et al. (1998) compare the job demand-control model of Karasek with the effort-reward imbalance model of Siegrist using data from the Whitehall II study. They confirm that the imbalance between personal efforts and rewards predicts higher risk of coronary heart disease. They also find that low job control in itself is strongly related to heart disease, while job strain or more generally high job demands are not.

The *Whitehall I and II studies* by Marmot et al. (1984; 1991; 1997a; 1997b) brought the concepts of "rank" and "social status" into the theory on psychosocial job demands. These studies showed that male British civil servants in low employment grades suffered from higher mortality and morbidity rates than their colleagues in high employment grades, despite a great deal of homogeneity across the six employment grades. After ten years, mortality for the highest employment grade was about one third of the mortality rate of the lowest for a wide range of causes of death. Marmot and colleagues argue that differences in health outcomes between civil servants of higher and lower rank are due primarily to seniority in the employment hierarchy – rank. They show that low job control seems important, yet they reject the Karasek hypothesis that high demand at work plays an important role.

Case and Paxson (2011) confirm that entry grade and current occupational grade in Whitehall are significantly related to self-assessed health, yet they show that the associations are eliminated after controlling for *future* occupational grades. This suggests that occupational grade may be more of a marker than a cause of poor health. Using first-difference models, they find *no* association between current civil service grade and future self-assessed health. In contrast, they *do* find a significant association between current self-assessed health and future civil service grade. These findings support the health selection hypothesis, rather than the hypothesis that social position in adulthood influences changes in health status[5].

Fletcher et al. (2011) combine information on physical requirements of work and environmental work conditions identified in the in the *Dictionary of Occupational Titles* (DOT) with U.S. panel data and find that both physical demands and harsh environmental conditions harm self-reported health. Fletcher (2012) uses the DOT to construct a 'bad job' factor including ten adverse job conditions, including mostly physical job hazards and perceived reward. While he finds that starting a career in a 'bad job' is detrimental for later life self-reported health, he is unable to disentangle the individual contributions of the ten job conditions. Ravesteijn et al. (2013b) find that the annual effect of a one standard deviation increase of physical occupational demands is equal to the health deterioration experienced in six months of aging for German workers. They find no evidence of a causal effect of psychosocial workplace conditions on health.

[4]We refer to Bakker and Demerouti (2007) for a complete overview and review of the two models and proposed alternatives.
[5]A recent study by Anderson and Marmot (2012) does find evidence that promotion on the job reduces the risk of heart disease.

In sum, there is little doubt that physical demands of a job matter for health. There is more controversy surrounding the question whether and how psychosocial aspects of the job matter for health.

Occupational characteristics and socioeconomic inequalities in health

The third insight from the theoretical model is that occupational choices may contribute to socioeconomic inequalities in health. Agents with low endowments, for example in terms of parental background and intelligence, have lower permanent health and lower earnings for each choice of occupation. They may choose to "sell" part of their health capital – by choosing harmful occupational attributes – to obtain an earnings bonus (Adam Smith, 1776; see also Viscusi, 1978; 1979). Hence, the choice for a compensating wage differential may be induced partly by initial endowments, and therefore represents a heavily constrained choice.

This phenomenon could occur through multiple channels. First, since the marginal utility of consumption is higher for low levels of consumption, marginal increases in consumption are more attractive for agents with low endowments. Second, the marginal benefit of engaging in harmful occupational characteristics increases in the value of lifetime wealth, λ, as can be seen in equation (6). The value of lifetime wealth is generally assumed to decrease with more wealth (e.g. Galama and Van Kippersluis, 2010), such that those with low endowments will have a higher value of lifetime wealth and hence higher marginal benefits for harmful workplace conditions. Finally, Case and Deaton (2005) argue that the marginal benefit of harmful job characteristics decrease with endowments and education, that is $\partial^2 w/\partial o \partial e < \mathbf{0}$, since *"professors, unlike construction workers, (…), get no increase in earnings by wearing out their bodies more rapidly"*. This would imply an additional reason for those with fewer endowments to accept an unhealthy job.

The compensating wage premium historically was associated with a potentially dangerous occupation requiring hard physical labour, e.g. mining, yet a modern-era variant is perhaps an investment banker who depletes his health capital through high levels of job stress and long working hours in exchange for a relatively high wage. Hence, the sign of $\partial^2 w/\partial o \partial e$ may depend on the actual type of workplace condition, e.g. plausibly negative for physical demands, yet potentially positive for psychosocial stressors on the job.

The gradient between socioeconomic status and health becomes steeper if workers with a lower socioeconomic status in terms of education, parental background, and financial wealth are more likely to choose occupations with harmful workplace conditions, and if they don't fully offset these negative effects on health by making health investments. This implies that workplace conditions could directly contribute to health inequalities.

In the epidemiological literature there have been numerous attempts to assess the contribution of occupation to health inequalities by socioeconomic status. Typically, the bivariate association between health and one particular socioeconomic indicator is estimated, after which occupation or occupational characteristics are added to the regression to assess how the association changes (e.g. Marmot et al. 1997; Borg and Kristensen, 2000). These studies suggest a large role for occupation: for example, Borg and Kristensen estimate

that as much as 59% of socioeconomic disparities can be attributed to occupation and the work environment. Yet, simply adding occupation to a regression of health outcomes on other socioeconomic indicators does not provide a reliable estimate of the contribution of occupation to socioeconomic inequalities in health. Since occupation is 'intervening' in the relationship between some other socioeconomic indicators and health, and occupation is clearly endogenous, this provides a particular form of the "bad controls" problem (Angrist and Pischke, 2009), that is elaborated upon in this context by Ravesteijn (2013). One requires sources of exogenous variation in *both* the socioeconomic indicator (the regressor of interest) *and* in occupation (the intervening control variable) in order to identify the contribution of the latter to socioeconomic-related health inequality, which is obviously a tall order.

Conclusion

There is a strong and persistent association between occupation and health. We have verified that occupation is correlated with self-assessed health, risk of disability and longevity in the Netherlands. For example, those in professional occupations are on average 63 percent less likely to enter into disability, and 51 percent less likely to die at any given point in time, when compared to those in elementary occupations.

While this evidence is often interpreted as indicating unfair health inequalities, a fully informed normative policy response requires knowledge of why health is related to occupation. We have sketched a theoretical model of choices with respect to occupation and health. Three core insights emerge: (i) there is selection into occupation on basis of initial endowments and health, (ii) there will be behavioural responses to adverse working conditions, which can be compensating in the form of health investment, or worsening in terms of unhealthy behaviours, and (iii) workplace conditions increase health inequalities if workers with initially low socioeconomic status choose harmful occupations and do not offset detrimental health effects.

Guided by these insights, four main conclusions emerge from our review of the evidence. First, while health inequalities across occupational largely reflect health-related selection into occupations, recent evidence suggests that there also exists a causal effect of occupation on health, that mainly derives from physical work conditions. We believe future research should go beyond the unravelling of (partial) associations to unveil the underlying *causal* health effects of job conditions. While the panel-data approaches are promising, an alternative would be to look for exogenous variation in occupational characteristics that might be obtained from changes in regulation, unanticipated firm downsizing, or plant closures.

Second, observed health outcomes across occupational groups may be the result from a behavioural response to changing job conditions rather than the direct effects of occupational characteristics. It is known that health behaviours differ across occupational groups – in the Netherlands close to 50 percent of workers in elementary occupations smoke versus just over 20 percent in university-level occupations. There is some evidence that at least part of these differences in health behaviours is caused by (first) occupation (Kelly et

al. 2011). Future research should focus on disentangling the direct effects of occupation and the indirect effects resulting from behavioural response, which is crucial for policy purposes.

Third, research should attempt to separate the contributions of the various physical and psychosocial aspects of work places. While there is convincing evidence both from the epidemiological literature (e.g. Bernard, 1997) and the economic literature (Fletcher et al. 2011; Ravesteijn et al. 2013b) that physical characteristics of occupations impact on health, there is more controversy on the impact of psychosocial aspects. Since adverse physical and psychosocial job conditions tend to be clustered, much remains to be learned on their relative contributions.

Finally, more effort should be devoted to establishing the cumulative effects of occupation on health, and the extent to which occupation contributes to the association between (childhood) socioeconomic status and health. This is the most challenging, but potentially also the most rewarding item on the research agenda. Improved understanding of the interrelation between (childhood) SES, occupation, and health is not only helpful for addressing SES-health inequalities, but is equally important in guiding policy choices regarding the regulation of occupational safety and regarding premature labour market exits for health reasons.

Acknowledgments

This paper was prepared with funding from Netspar to the Theme “Income, health, work and care across the life cycle II” and a panel paper grant. The authors further acknowledge funding from the National Institute on Aging of the National Institutes of Health under Award Number R01AG037398. We are grateful to Statistics Netherlands for (remote) access to the linked datasets used in this research, and to the editors for helpful comments and suggestions.

References

Angrist, JD.; Pischke, J-S. Mostly Harmless Econometrics: An Empiricist's Companion. Princeton University Press; 2009.

Bernard, BP., editor. Musculoskeletal disorders and workplace factors: A critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. Cincinnati, OH: Department of Health and Human Services, National Institute for Occupational Safety and Health; 1997.

Borg V, Kristensen TS. Social class and self-rated health: can the gradient be explained by differences in life style or work environment? Social Science & Medicine. 2000; 51:1019–1030. [PubMed: 11005390]

Bosma H, Pieter R, Siegrist J, Marmot M. Two Alternative Job Stress Models and the Risk of Coronary Heart Disease. American Joumal of Public Health. 1998; 88(1):68–74.

Case, A.; Deaton, AS. Analyses in the Economics of Aging, NBER Chapters: 185–212. National Bureau of Economic Research, Inc; 2005. Broken down by work and sex: How our health declines.

Case A, Paxson C. The Long Reach of Childhood Health and Circumstance: Evidence from the Whitehall II Study. The Economic Journal. 2011; 121(554):F183–F204. [PubMed: 22228912]

Cavelaars AEJM, Kunst AE, Geurts JJM, Helmert U, Lundberg O, Mielck A, Matheson J, Mizrahi Ar, Mizrahi A, Rasmussen N, Spuhler T, Mackenbach JP. Morbidity differences by occupational class among men in seven European countries: an application of the Erikson-Goldthorpe social class scheme. International Journal of Epidemiology. 1998; 27(2):222–230. [PubMed: 9602402]

CBS. 2012 from: http://www.cbs.nl/nl-NL/menu/methoden/classificaties/overzicht/sbc/1992/default.htm.

Choo, E.; Denny, M. Working Papers tecipa-258. University of Toronto, Department of Economics; 2006. Wearing out - the decline in health.

Cottini E, Lucifora C. Mental health and working conditions in European countries. IZA Discussion Paper No. 4717. 2010

Cottini, E.; Ghinetti, P. Working conditions, lifestyles and health; Working paper; 2011.

Currie J, Madrian BC. Health, health insurance and the labor market. Handbook of labor economics. 1999; 3:3309–3416.

Cutler, D.; Lleras-Muney, A.; Vogl, T. "Socioeconomic Status and Health: Dimensions and Mechanisms. In: Glied, S.; Smith, PC., editors. Oxford Handbook of Health Economics. Oxford University Press; 2011. p. 124-163.

Datta Gupta N, Kristensen N. Work environment satisfaction and employee health: panel evidence from Denmark, France and Spain, 1994–2001. European Journal of Health Economics. 9(1):51–61. [PubMed: 17297640]

Davey Smith G, Hart C, Hole D, MacKinnon P, Watt G, Blane D, Hawthorne V. Education and occupational social class: which is the more important indicator of mortality risk? Journal of Epidemiology & Community Health. 1998; 52(3):153–160. [PubMed: 9616419]

Fletcher JM. The Effects of First Occupation on Long Term Health Status: Evidence from the Wisconsin Longitudinal Study. Journal of Labor Research. 2012; 33(1):49–75.

Fletcher JM, Sindelar JL, Yamaguchi S. Cumulative effects of job characteristics on health. Health Economics. 2011; 20(5):553–570. [PubMed: 21433217]

Galama, TJ.; van Kippersluis, H. Tinbergen Institute Discussion Papers. Tinbergen Institute; 2010. A Theory of Socioeconomic Disparities in Health over the Life Cycle.

Grossman M. On the concept of health capital and the demand for health. Journal of Political Economy. 1972; 80(2):223–255.

Karasek RAJ. Job demands, job decision latitude, and mental strain: Implications for job redesign. Administrative Science Quarterly. 1979; 24(2):285–308.

Kelly, IR.; Dave, DM.; Sindelar, JL.; Gallo, WT. Working Paper 16803. National Bureau of Economic Research; 2011. The impact of early occupational choice on health behaviors.

Kunst AE, Looman CWN, Mackenbach JP. Socio-economic mortality differences in the Netherlands in 1950–1984: A regional study of cause-specific mortality. Social Science & Medicine. 1990; 31(2):141–152. [PubMed: 2389149]

Mackenbach JP, Stirbu I, Roskom AR, Schaap MM, Menvielle G, Leinsalu M, Kunst AE. Socioeconomic inequalities in health in 22 European countries. New England Journal of Medicine. 2008; 358:2468–2481. [PubMed: 18525043]

Marmot M, Bosma H, Hemingway H, Brunner E, Stansfeld S. Contribution of job control and other risk factors to social variations in coronary heart disease incidence. The Lancet. 1997a; 350(9073): 235–239.

Marmot M, Ryff CD, Bumpass LL, Shipley M, Marks NF. Social inequalities in health: next questions and converging evidence. Social Science and Medicine. 1997b; 44(6):901–910. [PubMed: 9080570]

Marmot MG, Shipley MJ, Rose G. Inequalities in death-specific explanations of a general pattern? The Lancet. 1984; 1(8364):1003–1006.

Marmot MG, Stansfeld S, Patel C, North F, Head J, White I, Brunner E, Feeney A, Smith GD. Health inequalities among British civil servants: the Whitehall II study. The Lancet. 1991; 337(8754): 1387–1393.

Morefield B, Ribar DC, Ruhm CJ. Occupational Status and Health Transitions. BE Journal of Economic Analysis & Policy. 2011; 11(3):1–27.

Ravesteijn, B.; Van Kippersluis, H.; Van Doorslaer, E. Netspar Panel Paper. Tilburg: 2013a. Long and healthy careers? The relationship between occupation and health and its implications for the statutory retirement age.

Ravesteijn, B.; Van Kippersluis, H.; Van Doorslaer, E. The wear and tear on health: what is the role of occupation?. Mimeo: Erasmus University Rotterdam; 2013b.

Ravesteijn, B. On intervening control variables. Mimeo: Erasmus University Rotterdam; 2013. Good, bad, and ugly controls.

Siegrist J. Adverse health effects of high-effort/low-reward conditions. Journal of Occupational Health Psychology. 1996; 1(1):27–41. [PubMed: 9547031]

Smith, A. An inquiry into the nature and causes of the wealth of nations. Methuen & Co; 1776.

Viscusi W, Kip. Wealth effects and earnings premiums for job hazards. The Review of Economics and Statistics. 1978; 60(3):408–416.

Viscusi, W.; Kip. Employment hazards: an investigation of market performance. Harvard Economic Studies; 1979.

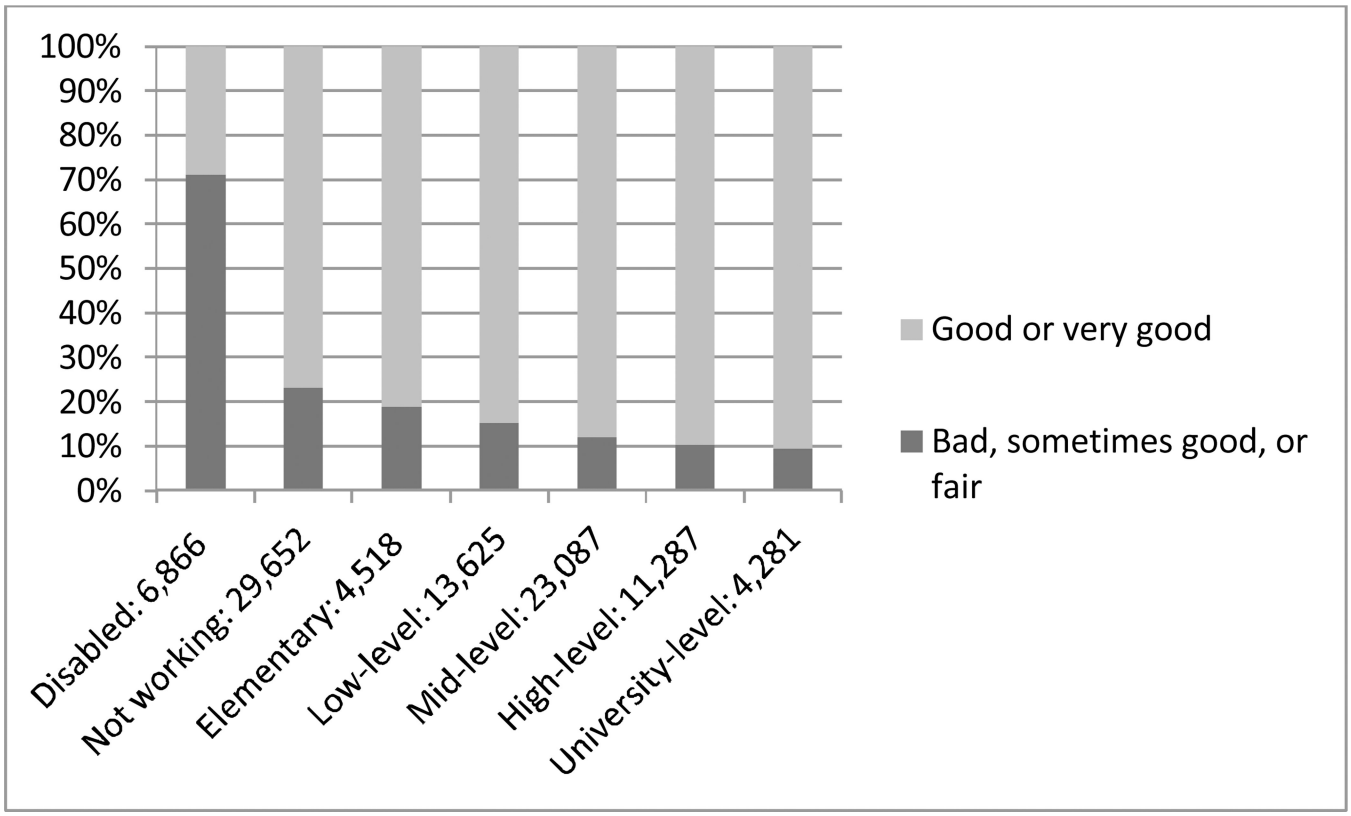

Fig. 1.
Self-assessed health by disability, employment and occupation (Netherlands POLS surveys 1997–2006)

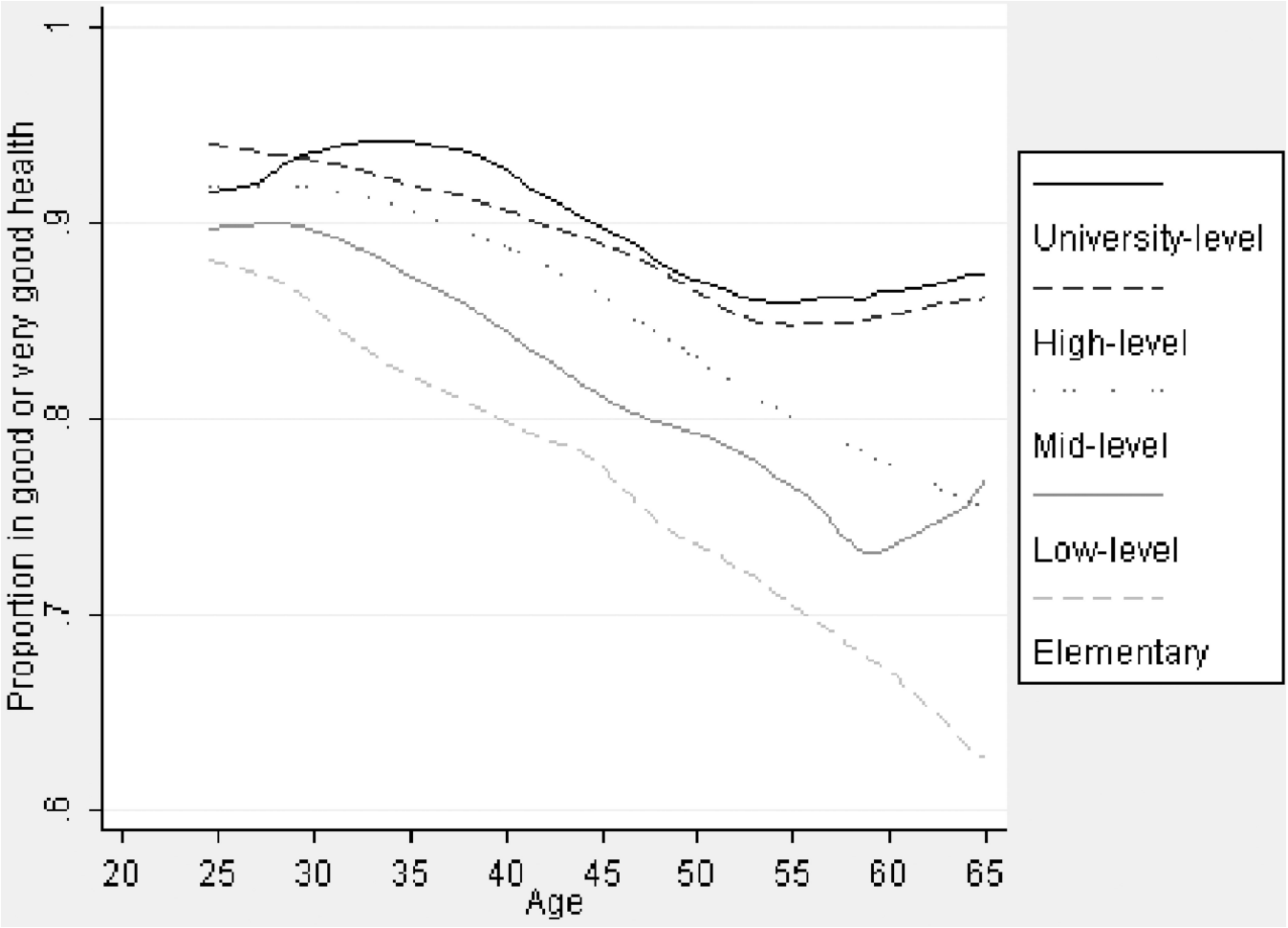

Fig. 2.

Proportion of workers in good or very good health by occupation and age (Netherlands POLS surveys 1997–2006)

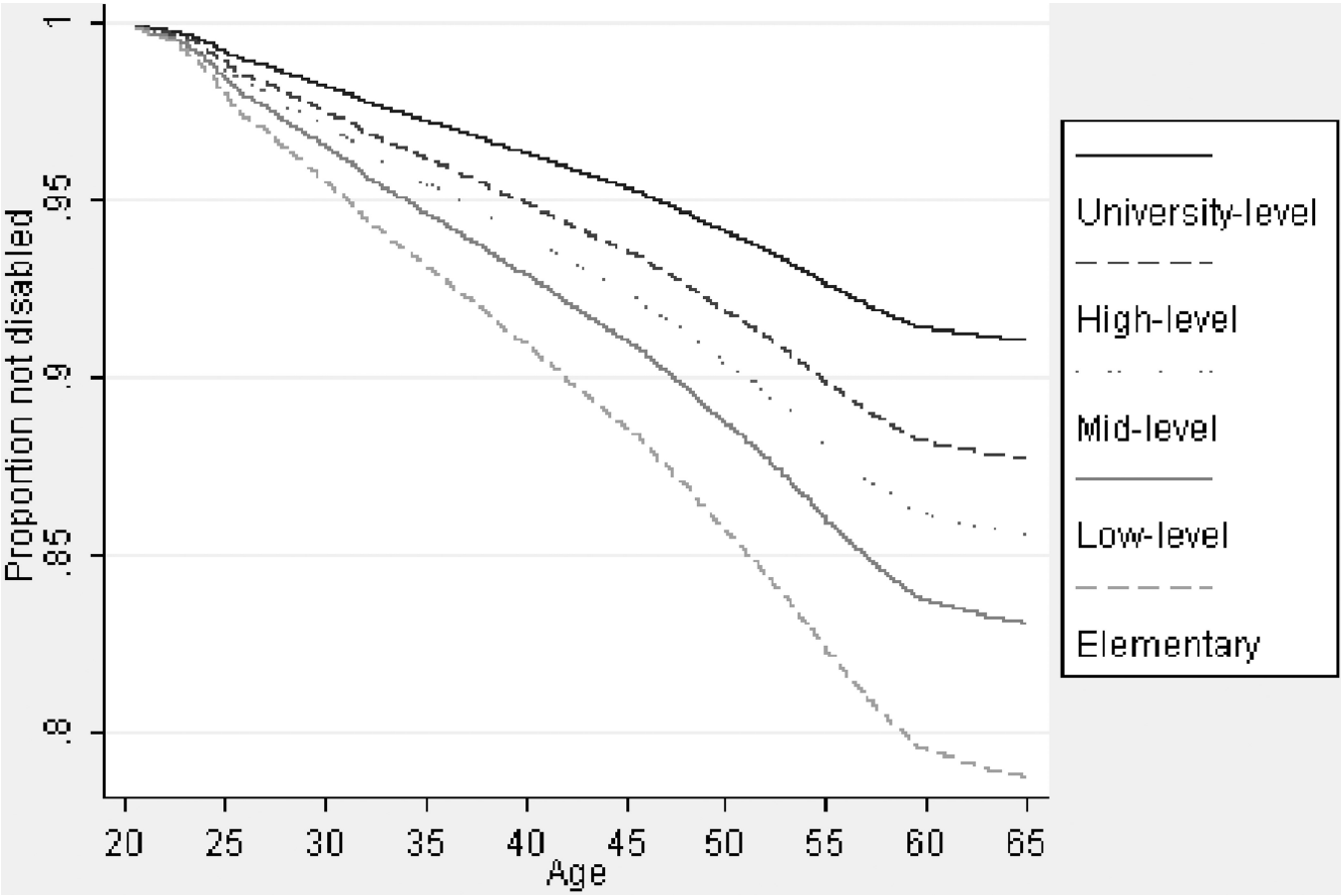

Fig. 3.

Survival until exit to disability by occupation. Cox proportional hazard model (Netherlands, POLS surveys and SSB follow-up until 2006)

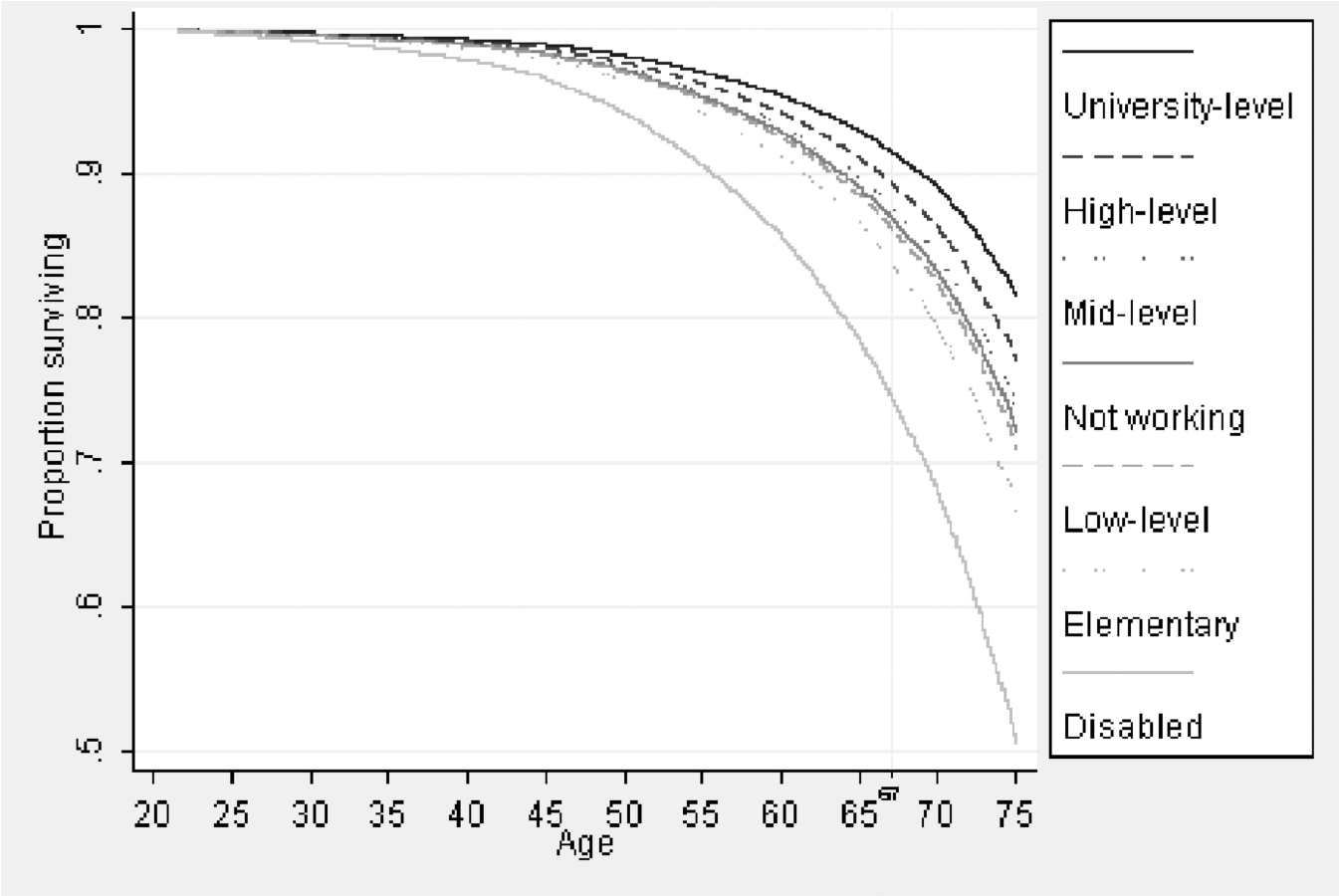

Fig. 4.

Survival until exit to death by employment and occupation, Cox proportional hazard model. (Netherlands POLS surveys 1997–2006 and cause-of-death follow-up until 2010)

Table 3

Occupational class and attributes. Percentage of respondents sometimes or regularly exposed to respective job attribute versus no exposure.

Occupation level	Physically demanding	Inconvenient work postures	Repetitive work movements	Job control	Under time pressure
Elementary	58%	39%	70%	63%	49%
Low	51%	40%	63%	68%	54%
Mid	39%	39%	57%	81%	70%
High	16%	19%	39%	81%	72%
University	9%	18%	41%	94%	86%