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Executive summary

Most analyses of the relationship between health and the economy focus on average health, but health is actually very unevenly distributed across society. In all countries with available data, significant differences in health exist between socioeconomic groups, in the sense that people with lower levels of education, occupation and/or income tend to have systematically higher morbidity and mortality rates. These health inequalities are one of the main challenges for public health, and there is a great potential for improving average population health by eliminating or reducing the health disadvantage of lower socioeconomic groups. This requires an active engagement of many policy sectors, not only of the public health and health care systems, but also of education, social security, working life, city planning, etcetera.

A fruitful dialogue between the public health and health care sector on the one hand, and other policy areas on the other hand, is likely to be facilitated if the economic benefits of reducing health inequalities were be made clear. It is the purpose of this report to explore the economic implications of health inequalities in the European Union. It addresses four specific questions. Firstly, how should we conceptualize the 'economic impact' of socioeconomic inequalities in health, and how can we measure this? Secondly, how large are socioeconomic inequalities in health in the European Union, and what is the magnitude of the burden of ill health and premature mortality associated with inequalities in health? Thirdly, what is the economic impact of socioeconomic inequalities in health in the European Union? And finally, what actions can reasonably be taken to reduce socioeconomic inequalities in health, and what are the potential economic benefits of investing in these strategies?

Our conceptual framework is based on the notion that health is both a 'consumption good' and a 'capital good'. As a 'consumption good', health directly contributes to an individual's 'happiness' or 'satisfaction', and as a 'capital good', health is an important component of the value of human beings as means of production. Our analysis has tried to attach a monetary value to the inequalities-related losses to population health in the European Union by combining these two complementary perspectives. Inequalities-related losses to population health were determined by

calculating the frequency of ill-health in the population which is attributable to the fact that not everybody has a high level of education, a higher occupational class, or a high income level. 'High' socioeconomic positions was arbitrarily be defined as the upper 50% of the population.

On the basis of currently observed patterns of mortality by educational level, the number of deaths that can be attributed to health inequalities in the European Union (EU-25) as a whole is estimated to be 707 thousand per year (all figures apply to 2004). The number of life years lost due to these deaths is about 11.4 million. Similarly, the number of prevalent cases of ill-health that can be attributed to health inequalities is estimated to be more than 33 million. The estimated impact of health inequalities on average life expectancy at birth in the EU-25 for men and women together is 1.84 years, and the estimated impact of health inequalities on average life expectancy in good health is 5.14 years.

Our estimates suggest that the economic impact of socioeconomic inequalities in health is likely to be substantial. While the estimates of inequalities-related losses to health as a 'capital good' (leading to less labour productivity) seem to be modest in relative terms (1.4% of GDP), they are large in absolute terms (€141 billion). It is valuing health as a 'consumption good' which makes clear that the economic impact of socioeconomic inequalities in health is really huge: in the order of about €1,000 billion, or 9.5% of GDP. The separately calculated impacts on costs of social security and health care systems and health care support these conclusions. Inequalities-related losses to health account for 15% of the costs of social security systems, and for 20% of the costs of health care systems in the European Union as a whole. It is important to emphasize that all these estimates represent yearly values, and that as long as health inequalities persist, these losses will continue to accumulate over the years.

During the past two decades, socioeconomic inequalities in health have increasingly been recognized as an important public health issue throughout Europe. As a result, there has been a considerable research effort which has permitted the emphasis of academic research to gradually shift from description to explanation. And as a consequence of that, entry-points for interventions and policies have been identified, providing the building-blocks with which policy-makers and practitioners have begun

to design strategies to reduce socioeconomic inequalities in health. Although relatively little is known yet about the effectiveness of these strategies, it is possible to make some educated guesses about their potential impact on the economic implications of health inequalities in the European Union.

For example, if it were possible to implement a number of equity-oriented anti-tobacco policies which would reduce the prevalence of smoking in the lower socioeconomic groups by 33%, while the prevalence of smoking in the higher socioeconomic groups would decline by 25%, our analyses suggest that a substantial impact would be generated. Not only would health inequalities be reduced considerably, but also some 7% of the economic costs of health inequalities through mortality and morbidity would be taken away (including the costs of health care and social security benefits). Inequalities-related losses to health as a 'consumption good' through mortality would be reduced by between about €75 billion per year for the EU-25 as a whole, and inequalities-related losses to health as a 'capital good' would be reduced by almost €9 billion per year.

Even though we re-analysed data from the most representative data source available at this moment, the ECHP, there is no guarantee that what has been found in a single data set will be reproduced in other data sets. There is an urgent need for analysis of additional data sets, including data on new EU member states. In addition, systematic reviews or meta-analyses are needed to assess the causal effect of ill-health on earnings in the European Union. Given the conservative nature of many of our assumptions and approaches, the full economic costs and potential benefits are likely to be larger than those in this report.

Because this is the first exploratory study of this important question, we do not pretend to have the final answers. The monetary estimates presented in this report represent only part of the full economic costs of health inequalities, and the potential benefits of reducing these inequalities. It is likely that a strong economic case for reducing health inequalities can be made. In order to arrive at more complete and more definitive estimates, however, further research will be needed, both into the quantification of health inequalities around Europe, and into the economic consequences of ill-health generally, and health inequalities particularly.

1. Introduction

1.1. Background

In recent years there has been growing attention to the potential economic benefits of improvements in population health. This is far from new: historically, one of the origins of the public health movement lies in the awareness that the prosperity of nations is partly dependent on the health of their populations. But this awareness has recently received a new stimulus from the publication in 2001 of the report of the WHO Commission on Macroeconomics and Health, which demonstrated that health improvement can be seen as a key strategy for income growth and poverty reduction in low- and middle-income countries (Commission 2001). This report was followed in 2005 by an overview of evidence concerning the impact of health on the economy in high-income countries, particularly the European Union (Suhrcke et al., 2005). The latter report concluded that there are strong economic arguments for investing in health – if Europe were to become more competitive globally, greater investments in human capital are necessary. Both reports suggest that investing in health should not only be seen as a cost to society, but also as a potential driver of economic growth.

Most analyses of the relationship between health and the economy focus on average health, but health is actually very unevenly distributed across society. In all countries with available data, significant differences in health exist between socioeconomic groups, in the sense that people with lower levels of education, occupation and/or income tend to have systematically higher morbidity and mortality rates (Appendix A). Socioeconomic inequalities in health usually present themselves as a gradient, characterized by a gradual but systematic increase of the rates of morbidity and mortality as one moves down the social ladder.

This gradient may be partly due to health-related social mobility (which increases the likelihood of people with health problems to move downwards in the social hierarchy, and of people with excellent health to move upwards). But longitudinal studies, in which socioeconomic position is measured first and health outcomes are assessed later, show that this gradient is largely due to unequal exposures of people at different

positions in the social hierarchy to a variety of health risks. Many health risk factors, including unfavourable living and working conditions, psychosocial factors, and health behaviours, are more frequent in lower socioeconomic groups, and have been shown to contribute in multivariate analyses to the explanation of health inequalities (Mackenbach, 2006). This strongly suggests that socioeconomic inequalities in health can be reduced by improving the life situations of people with lower levels of education, occupation or income.

Reducing these health inequalities are one of the main challenges for public health, and there is a great potential for improving average population health by eliminating or reducing the health disadvantage of lower socioeconomic groups (Mackenbach, 2006. This requires an active engagement of many policy sectors, not only of the public health and health care systems, but also of many other policy areas, including education, social security, working life, city planning, etcetera.

A fruitful dialogue between the public health and health care sector on the one hand, and other policy areas on the other hand, is likely to be facilitated if the economic benefits of reducing health inequalities can be made clear. If a case can be made for a positive economic spin-off of improvements in average health, it is a logical question whether perhaps the same applies to reducing socioeconomic inequalities in health. What would be the economic impact of improving the health of groups with a lower socioeconomic status to that of more advantaged sections of the population?

1.2. Research questions

This report aims to answer this question for the European Union, by addressing the following subquestions. Firstly, how should we conceptualize the ‘economic impact’ of socioeconomic inequalities in health, and how can we measure this? Secondly, how large are socioeconomic inequalities in health in the European Union, and what is the magnitude of the burden of ill health and premature mortality associated with inequalities in health? Thirdly, what is the economic impact of socioeconomic inequalities in health in the European Union? And finally, what actions can

reasonably be taken to reduce socioeconomic inequalities in health, and what would be the economic benefits of investing in these strategies?

1.3. Reading guidance

Because this is the first analysis dealing with such questions, we do not pretend to offer any final answers. We do believe, however, that our explorations have produced some interesting insights. Our general approach will be described in **chapter 2**, which will also discuss various components of welfare that may be affected by health inequalities, and the mechanisms by which these components are influenced. In **chapter 3** we will give an overview of the magnitude of socioeconomic inequalities in health in the European Union, largely based on recent comparative studies including morbidity and mortality data for a large number of European countries. The chapter will provide an estimate of the burden of ill health and premature mortality that is related to the fact that not all people enjoy the same health and length of life as those in the upper socioeconomic groups. In **chapter 4** we turn to the economic impact of socioeconomic inequalities in health. We present some new empirical results derived from ECHP data on the impact of health on personal income, labour participation and productivity, social benefits and health care consumption, and the socioeconomic gradients of this impact. These results are transformed into estimates of the impact of socioeconomic inequalities in health on Gross Domestic Product, and presented together with estimates for impacts on other indicators of welfare. In **chapter 5** we summarize current views about opportunities to reduce socioeconomic inequalities in health. Taking the case of tobacco control, we provide a quantitative illustration of the extent by which socioeconomic inequalities in health can be reduced, and of the economic benefits that such a policy would generate. In **chapter 6** we will draw preliminary conclusions, and we will evaluate a series of caveats. We will show that, given the conservative nature of many of our assumptions and approaches, the full economic costs and potential benefits are likely to be broader than those estimated in this report The main implications of our report for policy as well as for research and data collection are discussed in **chapter 7**.

In the appendices we present more detailed background data.

2. Framework for assessing the economic implications of socioeconomic inequalities in health

2.1. General approach

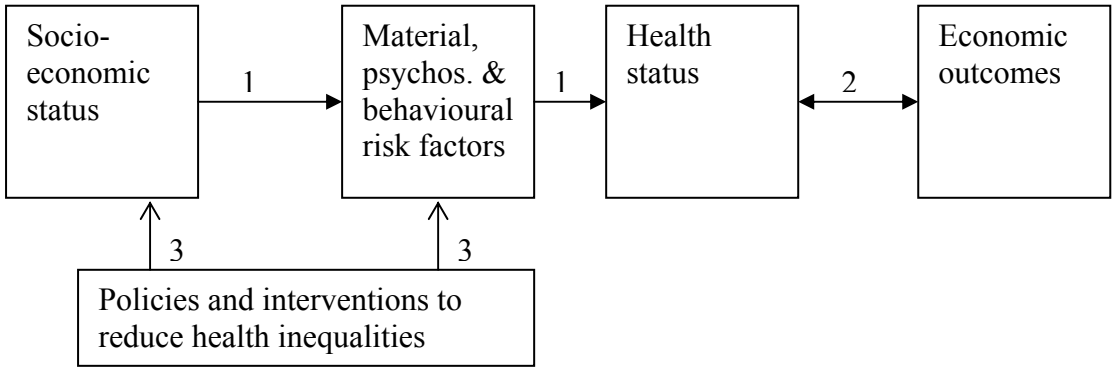
Health inequalities are largely due to the unequal distribution of health determinants between people with different positions at the social hierarchy. People in lower socioeconomic are more exposed to health hazards in the physical environment, they more often experience psychosocial stressors, and they are more likely to adhere to unhealthy behaviours, such as smoking, inadequate diet, excessive alcohol consumption, and lack of physical exercise. As a result of their greater exposure to such risk factors, people in lower socioeconomic groups more often suffer from disease and disability. Part of this association may be attributable to reverse "selection" effects of health of poor health on educational level or occupational position, e.g. due to health problems in early childhood on school attainment. However, these reverse effects have been found to play a minor role only. Health inequalities thus are principally a problem of unequal distribution of risk factors and health risks affecting mostly lower socioeconomic groups.

Starting from this perspective, this report aims to assess the economic implications of the greater burden of ill health among people with a lower socioeconomic position. In order to be able to quantify these economic implications, the report aims to assess the following three elements:

1. the magnitude of the burden of ill health and premature mortality associated with lower socioeconomic status in European countries;
2. the magnitude of economic costs associated with this burden of ill health and premature mortality;
3. the potential economic benefits of policies that could reduce, at least partly, this burden of ill health and premature mortality.

The approach in each of the three steps will be discussed in more detail below. Their interrelationships is clarified in the scheme below

Scheme 1. Conceptual overview of the interrelationships assessed in the three steps (denoted 1, 2 and 3) of the document



At this place, we would like to clarify that this report does not aim to address the question which level of health inequalities is "optimal" from the perspective of welfare economics, or to which extent a reduction of health inequalities can be justified from a broader economic perspective. Instead of this more theoretical analysis, this report has a strong empirical focus: it aims to estimate the economic costs of health inequalities as these are observed nowadays in the European Union, and to assess the potential economic benefits of realistic policy options to reduce these inequalities. From these assessments, we hope to demonstrate that the potential benefits of reducing the health disadvantage of lower socioeconomic groups are substantial not only in terms of health, but also in terms of euros.

2.1.1. Assessment of the magnitude of burden of ill health and premature mortality associated with low socioeconomic status (step 1)

In this report, we will utilise the methodology that has been developed in epidemiology to estimate the burden of ill health or premature mortality associated with specific risk factors such as smoking and overweight. As applied to smoking, this approach is based on the concept of Population Attributable Risk (PAR), and it basically consists of comparing the current situation with a hypothetical "reference" situation in which no person is exposed to the risk of smoking (Lynch et al., 2006). In

PAR calculations, the burden of ill health in lower is the reference situation than in the current situation, and the difference between the two situations is used to estimate the burden of ill health due to smoking in the current situation. The PAR expresses this value as a proportion of the total burden of ill health in the current situation.

In a similar way, the PAR approach can be used to estimate try to determine how much ill-health in the population is attributable to the fact that not everybody has a high level of education, a higher occupational class, or a high income level (Kunst et al, 2001). We will compare the current situation in European countries to the hypothetical situation that everyone would have (the health status corresponding to) a high socioeconomic position. Although the fact that health inequalities present themselves as a gradient implies that there is no natural reference level to which the rates in the lower socioeconomic groups could be lowered, we think that this perspective does present the most practical way to quantify the damage to population health of health inequalities. We will use a simple dichotomy between low and high socioeconomic status, in which 'high' socioeconomic positions are arbitrarily be defined as roughly the upper 50% of the population. Using the PAR approach, we thus assess the burden of ill health that is attributable to the fact that about half of the population has (the poorer health status corresponding to) a lower SES than the upper half of the population.

This PAR approach will be applied separately to measures of ill health and to measures of mortality. In these calculations, socioeconomic status will be indicated by educational level. Our preference for this indicator is in part based on pragmatic reasons, because educational level is the only SES indicator available in different types of data sets for most European countries. However, theoretical preferences also guided our choice for educational level. Since this educational level is established before full adulthood and maintained throughout adult life, it acts as a precursor to health and economic outcomes achieved in adulthood, and it can thus be used to identify the health and economic trajectories of people in different socioeconomic strata.

While the PAR approach is clear in its concept and its calculation, the price of its clarity is to ignore many of the complexities of real world.

- On the one hand, this approach ignores the gradient nature of health inequalities. Larger health differences would be observed if more extreme educational levels were distinguished, and the PAR would be larger if the reference situation were to refer to the highest educational levels, instead of the upper educated half of the population. This will be evident its application to life expectancy, where the PAR estimate is 1.84 years when two broad educational levels are compared (table 3), compared to more than 3 years if a finer educational distribution were used (Appendix A).
- On the other hand, our PAR approach assumes that all observed variations in health according to educational level can be attributed to an effect of low education on health, rather than the other way around. In fact, part of the educational differences in health can probably be attributed to reverse causation effects. If these effects were discounted from the calculations, the PAR estimates would be smaller.

Thus, ignoring the gradient nature leads to underestimation, while ignoring reverse causation leads to overestimation of the PAR. It is hard to state in general terms which of these two biases might be larger, although we think that an underestimation is the most likely net result.

2.1.2. Assessment of the magnitude of economic costs associated with this burden of ill health and premature mortality (step 2)

When the burden of ill health and premature mortality associated with low education is estimated, the next step is to assess the corresponding economic costs. In this economic evaluation, is important to distinguish between health as "consumption good" and health as "capital good". Health directly contributes to an individual's utility, but health also is an important component of human capital. The next section presents a general discussion on these two complementary perspectives on the valuation of health.

For the evaluation of health as "capital good", estimates had to be made of the extent to which ill health was related to poor economic outcomes, including reduced labour participation, lower hourly wages, and receipt of more social benefits. For the present

purposes, these estimates had to be representative of European countries, and in addition they had to be stratified according to educational level. Such comprehensive estimates were not available from previous studies, which were usually limited to specific countries and in addition failed to differentiate by educational level. We therefore decided to prepare these estimates by re-analyses of data from the European Community Household Panel (ECHP).

A main challenge to the assessment of the effects of poor health on economic outcomes was to take into account the fact that observed associations between health and economic outcomes also reflect the reverse effects of economic parameters on health. Sophisticated econometric models are commonly used to try to disentangle cause and effect from panel survey data. This type of analysis was beyond the scope of the present report, which instead had to rely as much as possible on a review of published reports of economic studies on the "endogeneity bias" (Appendix B). Based on this review, we assumed that approximately two thirds of the observed association between health and economic outcomes could be attributed to the effect of health on economic outcomes, with about one third being attributable to reverse effects or other factors.

Thus, using the observed association between health and economic outcomes may overestimate the magnitude of the causal effect of health on income etc. However, there are also reasons to expect the observed effects of health on income could underestimate of true magnitude of the effect. Measurement error in the measurement of health could lead to a considerable underestimate of the association between health and income. Also, there are spillover effects of health on the income earned by other household members (appendices B and C). Taking these considerations together, we assumed that the observed association of health with economic outcomes represents the best estimate of the true causal effect of health, although with considerable margins of uncertainty.

2.1.3. The potential benefits of policies to reduce part of the higher burden of ill health and mortality in lower SES groups (step 3)

A reduction of health inequalities can be achieved through two main routes. "Upstream" policies aim to improve the general living conditions of lower socioeconomic groups through improvement of their socioeconomic parameters, e.g. through measures to increase the labour market participation and income situation of deprived socioeconomic groups. "Downstream" policies aim to improve the exposure to specific risk factors of health, such as interventions aimed at improving the physical environment or health-related behaviours of the most disadvantaged groups (Mackenbach & Bakker, 2001). Both types of policies, if successful, would improve the health situation of lower socioeconomic groups and thereby reduce the economic costs associated with health inequalities.

In this perspective, health inequalities are not reduced by redistribution of health from the rich to the poor, but by "levelling up" health from lower socioeconomic groups. Most analyses of opportunities for reducing health inequalities conclude that policies and interventions should aim for an "upward levelling" of health inequalities, by which the higher rates of morbidity and mortality of the lower socioeconomic groups are reduced to the level of more advantaged groups in society (Whitehead, 2007). While it may not be realistic to achieve such a 'levelling up' in the short term, it may not be realistic in the longer term to achieve at least a partial 'levelling up'.

It is important to acknowledge the likely cost associated with reducing health inequalities as well as the fact that inequalities will never be completely eliminated. Complete elimination of health inequalities does not seem realistic also in view of the persistency of health inequalities across all times and places. Reduction of health inequalities might be more difficult to the extent that these inequalities are more intimately linked to "upstream" factors which can only be addressed by "upstream" policies. An "upstream" policy such as the reduction of income inequalities is limited to the extent that a certain level of income inequalities is essential for an effective functioning of the economy.

This report does not aim to explore the full extent to which health inequalities could possibly be reduced against reasonable investments or in a cost-effective way. Instead, we will evaluate the economic benefits of two specific scenarios for the reduction of socioeconomic inequalities in health. The first scenario is outlined in national programs aimed at the reduction of health inequalities, as formulated in for example Sweden, the Netherlands and the UK. Most of these programs formulated ambitious but realistic targets for the reduction of these inequalities, through a range of upstream and downstream policies. The second scenario focuses on one specific policy area, i.e. tobacco control, where important health benefits among lower socioeconomic groups are likely can be attained in a cost-effective way. Chapter 5 presents estimates of the potential economic benefits of these ambitious but not too unrealistic scenarios for the reduction of health inequalities.

2.2. The economic valuation of health

In this section we discuss the economic valuation of health, which is essential to second step of the general approach. We start from the notion that health is both a 'consumption good' and a 'capital good' (Grossman, 1972). One should take a broad view of the welfare effects of health, and that both aspects should be taken into account in determining the economic impact of ill-health.

As a 'consumption good', health directly contributes to an individual's 'utility' (economic language for 'happiness' or 'satisfaction'), because a good health status is enjoyable as such, and because a good health status enables individuals to enjoy work and leisure activities. As a 'capital good', on the other hand, health is an important component of 'human capital' (economic language for the value of human beings as means of production). Just like an adequate level of education, a good health status enables people to engage in formal and informal labour activities and to be productive, and will, through its effects on the production of goods and services, indirectly contribute to people's happiness or satisfaction.

The value of health as a capital good can (partly) be captured by its effects on common economic measures such as labour participation, labour productivity and income. The estimation of the value of health as a consumption good, however, is more problematic as no market exists for health. We will first deal with ways to value health as a capital good, and then discuss ways to value health as consumption good. After that, we will briefly explain how we have dealt with two specific and often used categories of the costs of ill-health to society, social security benefits and health care costs.

2.2.1. The valuation of health as a capital good

The economic impact of ill-health through its effects on human capital can be disentangled into several mechanisms (Suhrcke et al., 2005):

1. *Labour supply*. Labour supply (or labour participation) is the product of the proportion of individuals participating in work activities and the number of hours worked (e.g. per week). Although labour includes both formal and informal labour (e.g. child care, household activities), for the matter of simplicity this is often restricted to formal labour. Individuals in good health have better chances on the labour market, and are able to work more hours per week, and a good health status can therefore be expected to increase labour supply.
2. *Labour productivity*. Individuals with a good health status can also be expected to be more productive per hour worked, because they experience fewer sickness absence and can devote more energy to their work.
3. *Education*. Health may be positively related to the level of educational attainment, either through a larger number of years in education or through a higher educational level. This counts especially for health at younger ages. Healthy children are expected to demonstrate less school absence and school drop-out. Education is an important component of human capital, and has long-term economic benefits, because higher educated persons are expected to be more productive.
4. *Savings*. Because of their longer life expectancy, healthy individuals may be inclined to have more savings than individuals in poor health. Higher savings as a

proportion of national income increases opportunities for investments, and may therefore indirectly lead to higher (national) incomes.

5. *Labour supply of relatives*. It is likely that the health of individuals also influences the labour supply of relatives, although not uniformly so. Poor health may urge relatives to increase their labour supply to compensate income loss of the family. On the other hand, poor health may also be a reason for partners and relatives to (temporarily) reduce their labour supply to save time for caring activities.

There is good evidence, both at the individual and at the aggregate level, that health does indeed influence economic output through one or more of these mechanisms. A review of the literature on individual-level relationships showed that the occurrence of health problems has important effects on labour participation, labour productivity, and earnings throughout life. These effects have been demonstrated in studies from different countries, using different types of study designs. Especially the presence of chronic illness has a negative effect on labour participation and number of hours worked (for more details see Appendix B).

At the aggregate level, the evidence is less consistent, and mainly limited to low- and middle-income countries (although including historical evidence for currently high-income countries). Nevertheless, as explained in appendix B, we believe it is reasonable to think that better population health in high-income countries will generally have a positive effect on the production of goods and services.

In our analysis, we will try to determine the monetary value of health as a capital good through its effects on labour supply and labour productivity only. The other mechanisms mentioned above cannot easily be quantified, while the effect of health on labour supply and labour productivity can be (and usually is) measured through its effect on wages. The main assumption behind this approach is that in a perfect labour market wages will reflect the value of a person's labour output, i.e. labour supply times labour productivity. This assumption is of course unlikely to be completely true. Wages are the result of bargaining processes in which other factors and interests play a determining role, in addition to labour productivity only. Another counterargument is that non-market goods such as informal labour have no price, and are therefore not accounted for when only wages are used. Nevertheless, we believe that an

approximation of the value of health through its effect on wages is reasonable, particularly if some of the potential problems of this approach are explicitly taken into account.

Our valuation of health as a capital good, through its effects on wages, will be in terms of a conventional measure of economic output, namely Gross Domestic Product (GDP). In National Accounts, GDP can be calculated by three different approaches: production, consumption, and earnings. In the latter approach, chosen here, GDP consists of three components: (1) compensation of employees (gross earnings + employers' social contributions); (2) gross operating surplus and mixed income (among which firm profits, earnings from self-employed persons, and depreciation of capital goods) and (3) taxes less subsidies on production and imports. Provided that the same income definitions are used as in National Accounts, the individual level effects of health on wages can directly be translated into GDP components.

2.2.2. The valuation of health as a consumption good

The standard calculation of GDP is confined to market goods and services, and it is uncontroversial that this makes GDP an imperfect indicator of welfare. Among other things, it disregards the utility of health as a consumption good. For this reason, it is often argued that a broader view of the economic impact of health is necessary, i.e. a so-called 'full income' approach which also takes into account its value as a consumption good (Suhrcke et al., 2005).

As health has no market value, a surrogate measure of its 'full income' impact should be derived with appropriate methods. In the literature different approaches can be found (Eichler et al., 2004):

1. *Values proposed by individuals or institutions*. For example, the WHO Commission on Macroeconomics and Health has proposed three times GDP per capita as a reasonable upper limit to the cost per Disability-Adjusted Life-Year (DALY) averted to be used in health care investment decisions (Commission, 2001). Recently, on the basis of an extensive review of the literature and consultation of stakeholders, the Dutch National Council for Public Health and

Health Care proposed an upper limit of €80,000 per QALY gained for health care resource allocation decisions in the Netherlands.

2. *Willingness to pay (WTP) studies*. Studies of this type fall into two general categories. 'Contingent valuation' studies attempt to infer individuals' preferences in various artificial situations, such as discrete choice experiments. 'Revealed preference' studies attempt to infer individuals' preferences on the basis of empirically observed trade-offs which people appear to make between e.g. job risks and wages. In a systematic review of WTP-studies, the average monetary value per Quality-Adjusted Life-Year (QALY) gained was $161,000 in contingent valuation studies, $93,000 in revealed preference studies of non-occupational safety, and $428,000 in revealed preference studies of job risks (Hirth et al., 2000).

   WTP studies do not go without criticism. These concern the wide variation in estimates inferred from contingent valuation studies (which is actually much wider than the averages quoted here), and its sensitivity to the method used to elicit preferences. Another major concern is its insensitivity to the size of the good that is valued, i.e. the phenomenon that respondents are unwilling to pay more for larger health gains than for smaller health gains ('scope insensitivity') (Olsen et al., 2001).

3. *Past allocation decisions of health authorities*. For example, upper limits to the cost per life year gained range from €27,000 to €50,000 for reimbursement decisions on pharmaceuticals in Australia (George et al., 2001). Similarly, in the UK the cost per QALY upper limits range from about €30,000 to €45,000 (Towsend et al., 2002).

Although there is a consensus that health should be valued very highly, there is no consensus on a specific 'full income' value of health. We, like others (Luce et al., 2006) will base our estimates on figures that were derived and proposed by the American economist Nordhaus (2002). On the basis of a review of WTP studies which included a range of estimates similar to the ones mentioned above, he settled on a value of $3.0 million (or appr. €2.3 million) per life saved, and a value of one

current life-year of $100,000 (or appr. €77,000). The first figure can be used to indicate the monetary value of avoidance of death at adult age (about 40 years), while the second figure can be used to indicate the monetary value of an additional year of life lived now.

These values apply to the United States around 1990. It is unknown to what degree they also apply to the European Union today. The estimate may need to be adjusted downwards to account for differences in health valuation between the US and the EU, or they may need to be adjusted upwards for inflation since 1990. Nordhaus' estimates of the value of one current life-year of about €77,000 correspond well with estimates of the value of life years (VOLY's) in the range of €50,000 to €100,000, which was estimated for the EU-funded ExternE project on the economic effects of health consequences of air pollution (www.externe.info).

However, Nordhaus' estimate of €2.3 million per life saved appears to be too high for our purposes. This value was largely based on estimates from labour market studies, which focussed on the economic importance of deaths among working-aged persons. The average loss of life years due to death at working age is considerable larger as compared to the average loss of life years of deaths due to health inequalities in the general population. For Europe, we estimated a loss of about 15 years per death due to health inequalities, compared to about 40 years per death at working age. In order to account for this difference, the monetary value of a death avoided will be adjusted by a factor 15/40, which makes €862.500 per death avoided.

Being aware of the large margins of uncertainty surrounding these figures, we will use them for illustrative purposes only. Readers can easily impute their own values if they hold different views of the valuation of health as a consumption good.

2.2.3. Social security benefits and health care expenses

Although some of people's willingness-to-pay for health as a consumption good may be related to the fact that ill-health has negative income consequences (i.e. a negative effect on human capital), the two measures of health as a capital good and of health as a consumption good do not substantially overlap. There is overlap, however, with two other possible indicators of the economic implications of ill-health, namely social security benefits and health care expenses.

Health is often closely associated with the receipt of social security benefits, for example because poor health increases risks of unemployment, or is a requirement for receiving a disability benefit. Social security benefits are transfer payments, therefore are no opportunity costs to society, and so should not be added to the costs of ill-health through its effects on wages (and on GDP). Nevertheless, we think there are good reasons for looking separately at the effects of ill-health on the volume of social security benefits. Not only does this represent a clearly visible type of social costs of ill-health, but also there may be indirect effects on economic growth. Higher amounts spent on social security benefits will lead to higher social contributions (by employers and employees) and thus to higher labour costs, and this may have a negative effect on the economic competitiveness of companies, branches of industry, and whole nations.

Similarly, health is also an obvious determinant of health care utilization. The costs of health care utilization, however, cannot simply be added to the costs of ill-health through its effects on wages (and on GDP). Health care costs can be seen as 'repair costs', and certainly represent a cost of ill-health to society, but health care costs are already included in GDP as part of the total production of goods and services. Here again, however, we think it is useful to separately present the costs of ill-health in terms of health care utilization, both because of the visibility of these costs to society, and because higher insurance premiums or tax rates may lead to higher labour costs, and thus to lower economic competitiveness.

3. Estimates of the magnitude of socioeconomic inequalities in mortality and morbidity in Europe

3.1. Introduction

At the start of the 21st century, all European countries are faced with substantial inequalities in health within their populations. People with a lower level of education, a lower occupational class, or a lower level of income tend to die at a younger age, and to have a higher prevalence of most types of health problems.

This became clear in a recent report written at the request of the UK Presidency of the European Union (EU), which aimed to review the evidence on the existence of socioeconomic inequalities in health in the EU and its immediate neighbours (Mackenbach, 2006). It presented data on inequalities in mortality in 21 countries and on inequalities in self-assessed health in 18 countries. Here, we will briefly summarize the main findings of this report, and then present some quantitative estimates of the damage to over-all population health of socioeconomic inequalities in health, using the PAR approach described in the previous chapter.

3.2. Socioeconomic inequalities in mortality

Although no individual can escape death, important differences in mortality *rates* (in numbers of deaths per 1000 persons per year) are typically found between population subgroups, including population subgroups classified according to socioeconomic position. In all European countries with available data, mortality rates are higher among those in less advantaged socioeconomic positions, regardless of whether socioeconomic position is indicated by educational level, occupational class, or income level.

For this report, we have made an effort to collect information on socioeconomic inequalities in mortality during a recent time-period (the 1990s or later) from as many

countries in the European Union and its immediate neighbours as we could find. The results have been summarized in a large table (table 1). Because of potential problems of comparability between countries (e.g. because of differences in socioeconomic classification, measurement of mortality, or inclusion and exclusion of specific subgroups of the population), it is important to focus on the over-all picture. Data on inequalities in mortality are available for a wide range of European countries, and the over-all picture is extremely clear: the mortality rates are consistently higher in lower, than in higher socioeconomic groups. This is indicated by the fact that all rate ratios (i.e., the ratio of the death rate in the lower as compared to the higher socio-economic groups) are clearly above 1. Many of the figures given in table 1 apply to middle-aged adults, and this implies that differences in mortality rates can be interpreted as differences in the risks of dying prematurely. Not only is the size of these inequalities often substantial, in the order of an excess risk of dying in the lowest socioeconomic groups of 25 to 50%. But relative inequalities in mortality have also risen substantially in the past decades (Mackenbach et al., 2003), without much evidence that the widening of the mortality gap will stop in the near future. From studies that have included women, it has become clear that inequalities in mortality exist among women as they do among men. Compared to men, inequalities in mortality among women are smaller at middle age, but not at post-retirement age.

Some comparative studies have tried to assess whether the magnitude of inequalities in mortality differs systematically between European countries. Most of these studies have been limited to Western Europe, and have found that the range of between-country variation in relative inequalities is rather small. For example, a comparative study of 8 Western European populations in the 1990s found that the excess risk of mortality in people with lower education, as compared to those with higher education, ranged between 22 and 43 percent in men, and 20 and 32 percent in women.

Table 1. Inequalities in mortality by socioeconomic position in 21 European countries[a].

Country	Indicator of socioeconomic position	Period	Age-group	Rate Ratio[b]		*Source*
				Men	***Women***	
Austria	Education[2]	1991-1992	45+	1.43*	1.32*	National census-linked mortality follow-up
Belgium	Education[2]	1991-1995	45+	1.34*	1.29*	National census-linked mortality
	Housing tenure[1]	1991-1995	60-69	1.44*	1.43*	follow-up
Czech Republic	Education[6]	End 1990s	20-64	1.66*	1.09*	Unlinked cross-sectional study
Denmark	Education[1]	1991-1995	60-69	1.28*	1.26*	National census-linked mortality
	Housing tenure[1]	1991-1995	60-69	1.64*	1.47*	follow-up
	Occupation[3]	1981-1990	45-59	1.33*	n.a.	National census-linked mortality follow-up
England/Wales	Education[2]	1991-1996	45+	1.35*	1.22*	National census-linked mortality
	Housing tenure[1]	1991-1996	60-69	1.65*	1.58*	follow-up
	Occupation[3]	1981-1989	45-59	1.61*	n.a.	National census-linked mortality follow-up; representative sample
Estonia	Education[11]	2000	20+	2.38*	2.23*	National cross-sectional study
	Education[6]	1988	20-74	1.50*	1.31*	National cross-sectional study
Finland	Education[2]	1991-1995	45+	1.33*	1.24*	National census-linked mortality
	Housing tenure[1]	1991-1995	60-69	1.90*	1.73*	follow-up
France	Education[1]	1990-1994	60-69	1.31*	1.14	National census-linked mortality
	Housing tenure[1]	1990-1994	60-69	1.27*	1.25*	follow-up
	Occupation[3]	1980-1989	45-59	2.15*	n.a.	National census-linked mortality follow-up; representative sample
Hungary	Education[9]	2002	45-64	1.97*	1.58*	Cross-sectional ecological analysis
	Occupation[10]	1984-1985	45-64	1.61	1.33	National cross-sectional study
Ireland	Occupation[3]	1980-1982	45-59	1.38*		National cross-sectional study
Italy	Education[2]	1991-1996	45+	1.22*	1.20*	Urban census-linked mortality
	Housing tenure[1]	1991-1996	60-69	1.37*	1.33*	follow-up (Turin)
	Education[4]	1981-1982	18-54	1.85*	n.a.	National census-linked mortality follow-up
	Occupation[3]	1981-1982	45-59	1.35*	n.a.	National census-linked mortality follow-up
Latvia	Education[7]	1988-1989		1.50	1.20	National cross-sectional study
Lithuania	Education[5]	2001	25+	2.40*	2.90*	Unlinked cross-sectional analysis
Netherlands	Education[23]	1991-1997	25-74	1.92*	1.28	GLOBE Longitudinal study (Eindhoven)
Norway	Education[2]	1990-1995	45+	1.36*	1.27*	National census-linked mortality
	Housing tenure[1]	1990-1995	60-69	1.44*	1.36*	follow-up
	Occupation[3]	1980-1990	45-59	1.47*		National census-linked mortality follow-up
Poland	Education[8]	1988-1989	50-64	2.24	1.78	National cross-sectional study
Portugal	Occupation[3]	1980-1982	45-59	1.36*	n.a.	National cross-sectional study
Slovenia	Education	1991 & 2002	25-64	2.44	2.66	Unlinked cross-sectional study
Spain	Education[2]	1992-1996	45+	1.24*	1.27*	Urban and regional census-linked mortality follow-up (Barcelona & Madrid)
	Occupation[3]	1980-1982	45-59	1.37*	n.a.	National cross-sectional study
Sweden	Occupation[3]	1980-1986	45-59	1.59*		National census-linked mortality follow-up
Switzerland	Education[2]	1991-1995	45+	1.33*	1.27*	National census-linked mortality follow-up
	Occupation[3]	1979-1982	45-59	1.37*		National cross-sectional study

[a] Because of differences in datacollection and –classification, the magnitude of inequalities in health cannot always directly be compared between countries.
[b] Rate Ratio: ratio of mortality rate in lower socioeconomic groups as compared to that in higher socioeconomic groups.
Asterisk (*) indicates that difference in mortality between socioeconomic groups is statistically significant. N.a. indicates 'not available'.

Due to the fact that countries differ substantially in average mortality rates for the population as a whole, absolute differences in mortality between socioeconomic groups usually do show clear between-country variations. For example, because of its low average death rates, Sweden has rather small absolute differences in mortality between socioeconomic groups, although relative differences are not clearly smaller than elsewhere. This is not to say that systematic differences between countries in the magnitude of relative inequalities in mortality do not exist within Europe. Although strictly comparable data are not yet available, there are some suggestions that relative inequalities in mortality are rather large in some Eastern European countries, perhaps as a result of the economic and social problems following the political changes around 1990 (table 1). We don't think, however, that the evidence is strong enough to warrant separate calculations of the economic implications of mortality inequalities for different parts of Europe.

Most studies of socioeconomic inequalities in mortality have focussed on adults, particularly on middle-aged men and women. There are clear inequalities in mortality at other ages as well, however. Socioeconomic inequalities in mortality can already be seen at the very start of life, and persist into the highest age-groups. Most studies show that, starting with young adults (e.g. 30-39 year olds), relative inequalities (rate ratios comparing a lower and a higher socioeconomic group) decrease gradually with age. On the other hand, absolute inequalities (rate differences comparing a lower and a higher socioeconomic group) increase consistently with advancing age, and reach their highest values among the oldest old (e.g. 90+).

Variations in patterns of cause of death between socioeconomic groups provide valuable clues for the explanation of disparities in mortality, because they point to the mechanisms that link lower socioeconomic position to higher risk of premature mortality. In all countries with available data, mortality from cardiovascular disease is higher among men and women with a lower socioeconomic position. This does not, however, apply to all specific diseases of the cardiovascular system. Of these, ischemic heart disease (myocardial infarction) and cerebrovascular disease (stroke) are the most important. Whereas mortality from stroke is always higher in the lower socioeconomic groups, this is not the case for ischemic heart disease. For ischemic heart disease, a

North-South gradient has been found, with relative and absolute inequalities being larger in the North of Europe (e.g. the Nordic countries and the United Kingdom) than in the South (e.g. Portugal, Spain and ltaly). Inequalities in cancer mortality tend to be smaller than those for cardiovascular disease mortality, both in Western and in Eastern Europe. Among women, inequalities in mortality from all cancers combined are even negligible in magnitude in many countries, with rate ratios just slightly above (or even clearly below) 1.00, indicating that women in lower socioeconomic groups often do not have a higher risk of dying from cancer than women in higher socioeconomic groups. Among men, however, the usual pattern of higher mortality in lower socioeconomic groups applies to cancer as it does to most other diseases.

As a result of these differences in the risk of dying as observed at various ages, people from lower socioeconomic groups tend to live considerably shorter lives than those with more advantaged social positions. 'Life expectancy' is a summary measure of the age-specific mortality risks as observed in a particular period of time, and can be interpreted as the number of years that an average person could expect to live if he or she were to experience these age-specific risks of dying throughout his or her life. Differences in life expectancy at birth between the lowest and highest socioeconomic groups (e.g. manual versus professional occupations, or primary school versus postsecondary education) are typically in the order of 4 to 6 years among men, and 2 to 4 years among women, but sometimes larger differences have been observed. In England and Wales, for example, inequalities in life expectancy at birth among men have increased from 5.4 years in the 1970s to more than 8 years in the 1990s.

3.3. Socioeconomic inequalities in morbidity

Many countries have nationally representative surveys with questions on both socioeconomic status and self-reported morbidity (e.g. self-assessed health, chronic conditions, disability). Inequalities in the latter are substantial everywhere, and practically always in the same direction: persons with a lower socioeconomic status have higher morbidity rates.

For one indicator, self-assessed health (measured with a single question on an individual's perception of his or her own health), the availability of these data is as great as that for inequalities in mortality (table 2). The over-all pattern is clear again: prevalence rates of less-than-'good' self-assessed health are higher in lower socioeconomic groups, as shown by the fact that almost all Prevalence Rate Ratios in the table are higher than 1.

Table 2. Inequalities in self-assessed health by socioeconomic position in 18 countries[a].

Country	Indicator of socioeconomic position	Period	Age	Odds Ratio[b]		Source
				Men	**Women**	
Austria	Education[13]	1991	25-69	3.22*	2.67*	Mikrozensus Fragen zur Gesundheit
Belgium	Education	1997	25-74	2.55*	2.36	Belgium Health Interview Survey
Bulgaria	Education[16]	1997	18+	2.19*	2.84*	National representative
	Income[16]			1.86	1.50	survey of the population of Bulgaria
Denmark	Education[13]	1994	25-69	2.16*	3.00*	Danish Health and Morbidity Survey
	Occupation[12]	1986-1987	25-69	2.19*	n.a.	Danish Health and Morbidity Survey
Estonia	Education[15]	1996	25-79	3.11*	3.59*	Estonian Health Interview
	Income[15]			2.37*	1.66*	Survey
Finland	Education[13]	1994	25-69	2.99*	3.29*	Finnish Survey on Living
	Income[13]			3.09*	2.43*	Conditions
France	Occupation[12]	1991-1992	25-69	2.24*		Enquête sur la Santé et les Soins Médicaux
Germany (West)	Education[13]	1990-1991	25-69	1.76*	1.91*	National Health Survey
	Income[13]			2.05*	2.40*	
	Occupation[12]			1.63*		
Great-Britain	Income[13]	1996	25-69	3.88*	3.92*	British General Household Survey
	Occupation[12]	1991	25-69	2.32*	n.a.	General Household Survey
England	Education[13]	1995	25-69	3.08*	2.66*	Health Survey for England
Italy	Education[13]	1994	25-69	2.94*	2.55*	Health Interview Survey
Latvia	Education[14]	1999	25-70	2.21*	2.48*	Norbalt-II Living Conditions
	Income[14]			5.10*	3.26*	Survey
Netherlands	Education[13]	1997-1999	25-69	2.81*	2.12*	Permanent Survey on Living
	Income [13]			4.50*	3.01*	Conditions
	Occupation[12]	1991-1992	25-69	2.40*		Health Survey
Norway	Education[13]	1995	25-69	2.30*	2.84*	Health Survey
Poland	Education	1993	35-64	1.27	1.72	Household Survey Pol-MONICA survey (Warsaw)
Poland	Education	1993	35-64	2.08	0.93	Household Survey Pol-MONICA survey (Tarnobrzeg)
Spain	Education[13]	1997	25-69	2.58*	3.10*	Spanish Health Survey
Sweden	Education[13]	1997	25-69	2.37*	3.06*	Swedish Survey on Living
	Income[13]			4.11*	2.80*	Conditions
	Occupation[12]	1991	25-69	2.79*	n.a.	Swedish Level of Living Survey
Switzerland	Occupation[12]	1992-1993	25-69	2.12*	n.a.	Swiss Health Survey

[a] Because of differences in datacollection and –classification, the magnitude of inequalities in health cannot always directly be compared between countries.

[b] Odds ratio: ratio of odds (a measure of risk) of less-than-'good' self-assessed health in lower socioeconomic groups as compared to that in higher socioeconomic groups. Asterisk (*) indicates that difference in mortality between socioeconomic groups is statistically significant. Notes refer to references given in the back of this report. N.a. indicates 'not available'.

Studies of trends in inequalities in self-reported morbidity suggest a high degree of stability of these inequalities in many European countries. No clear patterns have emerged in the magnitude of socioeconomic inequalities in self-assessed health between European countries. There is some evidence that inequalities in self-assessed health by income level are smaller in countries with smaller income inequalities, such as the Nordic countries. Inequalities in self-assessed health in Eastern Europe tend to be large, although it is still difficult to say whether they are larger than in Western Europe. On the whole, however, there is no strong basis for differentiating calculations of the economic implications of inequalities in morbidity.

These inequalities in self-reported morbidity persist into old-age. After the age of 60, relative and absolute inequalities in e.g. self-assessed health, limitations in daily activities, and long-term disabilities by income level and level of education tend to decrease by age, but remain substantial until at least the seventh decade of life for all health indicators. Beyond early adulthood, socioeconomic differences in self-reported morbidity have been found in all countries where this has been examined. For children and adolescents, however, the picture is more mixed. Some studies have suggested that in adolescence, the period between childhood and adulthood, there is a genuine narrowing of health inequalities, perhaps as a result of the transition between socioeconomic position of family of origin and own socioeconomic position. Among children the picture is more consistent: many studies find that parents in lower socioeconomic groups report more ill-health for their children than parents in higher socioeconomic groups.

Respondents to health interview surveys are unlikely to be perfect reporters of their health problems, and there may also be differences between socioeconomic groups in the accuracy of reporting health problems. Where more objective data have been available for comparison, however, similar pictures of higher incidence and prevalence of health problems have been obtained. This applies to a wide range of physical and mental health problems, including their consequences in terms of limitations in functioning various forms of disability.

We have seen above that the higher mortality rates in lower socioeconomic groups lead to substantial inequalities in life expectancy: people in lower socioeconomic

groups tend to live between 2 and 8 years less than people in higher socioeconomic groups. The fact that morbidity rates (among those who are still alive) are higher too, contributes to even larger inequalities in 'healthy life expectancy' (the number of years which people can expect to live in good health). Inequalities in the number of years lived in good health are usually in the order of more than 10 years among men and women.

3.4. Inequalities-related losses to population health

As was explained in section 2.5, we have chosen to estimate the economic implications of health inequalities on the basis of the amount of ill-health in the population which can be attributed to a lower-than-optimal socioeconomic position. This PAR (Population Attributable Risk) approach yields an estimate of the amount of ill-health in the whole population of the European Union that is associated with the fact that not everyone has (the health corresponding to) a high level of education, occupation, or income. 'High' has arbitrarily, but conservatively, been defined as representing the upper half of the population distribution by socioeconomic position. Because data on health inequalities by level of education are available at a wider scale than those by occupational class and income level, all calculations apply to educational inequalities, comparing a broad lower group (lower secondary education and lower) to a broad higher group (upper secondary education and higher).

Table 3 presents the results of these calculations, using measures of mortality (deaths averted), morbidity (cases of ill-health averted), life expectancy (years of life gained), and morbidity-free life expectancy (number of morbidity-free years gained). All data apply to 2004, and are for the European Union as a whole (EU-25, before the recent enlargement to EU-27).

Table 3. Aggregate estimates of the population health impact of educational differences in mortality and morbidity in the EU-25 in 2004

	Total EU-25 population: observed rates and numbers (1)	Total EU-25: estimates assuming rates of higher educated (2)	Impact of health inequalities (1) – (2)
Death rate	0.01009	0.00855	0.00154
Absolute number of deaths (* 1000)	4,633	3,926	707
Total years of life lost (* 1000)	n.a.	n.a.	11,364
Prevalence rate of "fair/poor" health	0.397	0.324	0.073
Absolute number of cases (* 1000)	182,212	148,745	33,468
- in "fair" health	126,857	45,188	10,167
- in "poor" health	55,356	103,556	23,300
Life expectancy at birth	78.65	80.49	-1.84
Expectancy of life in poor health	31.22	26.09	5.14

For sources and estimation procedures: see Appendix A.

In the upper part of the table, the impact of health inequalities is expressed in terms of the number of deaths that occur each year (in this case, 2004), and the losses in length of life that these events imply. On the basis of currently observed patterns of mortality by educational level, the number of deaths that can be attributed to health inequalities is estimated to be 707 thousand (the difference between the 4.6 million deaths which currently occur each year in the EU-25 as a whole, and the more than 3.9 million which would occur if everyone were to have the mortality of the higher educational part of the population). The number of life years lost due to these deaths (now and in the near future) is about 11.4 million in the EU-25 as a whole. Similarly, the number of prevalent cases of ill-health that can be attributed to health inequalities is estimated to be more than 33 million. As the reference period is one year (i.e. 2004), this number is equal to the current number of person-years-lived-with-health-problems which can be attributed to health inequalities.

The lower part of the table presents estimates in terms of life table-derived measures. The estimated impact of health inequalities on average life expectancy at birth in the EU-25 for men and women together is 1.84 years (please note that this is based on our conservative scenario of upward leveling to the upper half of the population, which ignores the fact that the highest educational groups sometimes have substantially higher life expectancy still). The estimated impact of health inequalities on life expectancy in fair/poor health is 5.14 years. When the mortality effects (1.84 years) and morbidity effects (5.14) are added, we arrive at an estimate of 6.98 years, as a measure of the extent to which health inequalities have reduced the expectancy of life in good health in the total population. These 7 years are an important demonstration of the large impact of health inequalities in Europe.

4. Estimates of the economic costs of socioeconomic inequalities in health in Europe

4.1. Introduction

In this chapter we will present an estimate of the economic implications of socioeconomic inequalities in health, starting from the conceptual framework as discussed in chapter 2, and using empirical data on European health inequalities as illustrated in chapter 3.

First, we will present a calculation of the monetary value of 'inequalities-related losses to health' as a capital good. For this purpose, we need an estimate of the effect of ill-health on labour supply and labour productivity, particularly in lower socioeconomic groups. As will be explained in the next paragraph, we have performed an analysis of European panel data to derive such estimates. Second, we will present a calculation of the monetary value of 'inequalities-related losses to health' as a consumption good. This is a more speculative analysis, which nevertheless gives an important additional perspective on the economic (or welfare) implications of health inequalities. Finally, we will present separate estimates of the total costs of social security benefits and health care utilization linked to the ill-health generated by lower-than-optimal socioeconomic status.

4.2. Analysis of impact of health on economic outcomes

In order to derive estimates of the impact of ill-health on labour supply and labour productivity in the European Union, particularly in lower socioeconomic groups, we have conducted regression analyses using data from the 5th wave (1997) of the European Community Household Panel (ECHP). More details on the design and the results of the analysis can be found in Appendix C.

The data included 11 out of the current 25 EU member states (79% of the EU population). With this analysis, we first quantified the effect of current and past self-

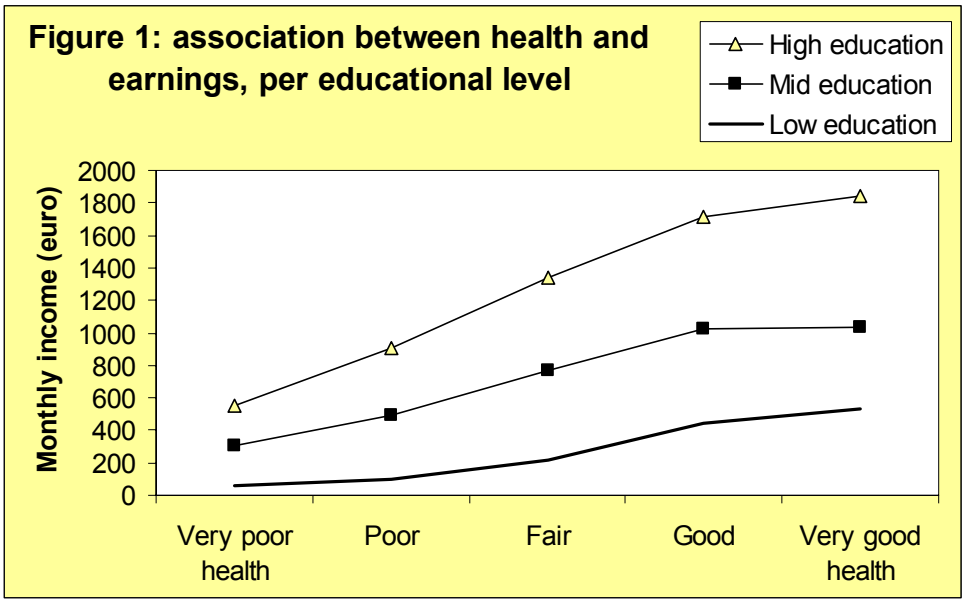
assessed health (from the 1st and 3rd wave, 1993 and 1995) on a number of outcome measures for the population as a whole, taking into account the effect of various confounders (age, sex, marital status, and country). A key outcome measure was gross monthly personal income (wages and salaries of employees, excluding transfer payments and capital returns). This measure was central to the analyses because, in later analyses, it can be aggregated from the individual level towards the societal level, i.e. in terms of GDP. We supplemented these analyses by studying the effect of health on labour market participation, number of hours worked, and hourly income. These three variables were considered as key components that together help to understand the effects of health on personal income. Additionally, we analyzed the effect of health on unemployment and disability benefits, and health care utilization (physician visits, hospitalization days), but these results will be presented in a later section.

Next, we determined whether the impact of self-assessed health on earnings (and the separate components of labour market participation, number of hours worked, and hourly income) differed according to people's initial socio-economic position, as measured by their educational level. To the extent that people's earnings represent their economic output, it is important to take into account the fact that people from lower socioeconomic groups, where inequalities-related losses to health are concentrated, generally have lower earnings than people in higher socioeconomic groups.

Education was used as the key indicator of socioeconomic position. The advantage of this socioeconomic indicator is that it is established early in life and stable over time. Educational level may therefore have potentially large effects on health (and through health on economic variables) while reverse effects (of health on education) are likely to be small.

We observed large differences in the level of personal earnings according to the general health of people. Persons with "very good" or "good" health had about 4 times higher earnings than those with "poor" and "very poor" health (unadjusted for confounders). The relative impact of health on personal income was larger for lower educated persons. In absolute terms, health had a greater impact on personal income

among the higher educated, because of the higher overall levels of personal income of higher educated compared to lower educated (figure 1).



Current and past health had an independent effect on personal income and its underlying components, but the effect of current health is largest. The use of more objective measures of health (compared to self-reported general health) increased the impact of health on personal income and labour participation, as expected. The effect of health on personal income is about equally large for men and women, and is much larger for persons 55-64 years than for younger age groups, especially as compared to persons younger than 45 years.

In our analysis, the main cause of lower earnings among those with poor health was their lower labour force participation. People with “very poor” health were about 2 times less likely to participate in the labour force than those with “very good” health. To a lesser extent the number of hours worked among economically active persons and hourly wages contributed to differences in income between persons with good and poor health. The effects of health on labour force participation, number of hours worked and hourly wages were generally larger (in relative terms) among persons with lower educational level. Some of these effects also differed according to age group, sex or country.

It is difficult to be certain about the exact size of the causal effect of ill-health on earnings. On the one hand, part of the observed 'effect' of ill-health on personal income may actually due to a reverse effect of income (or other aspects of socioeconomic position) on health, which was not removed by our longitudinal analysis design. On the other hand, there are also reasons to suspect that we may have underestimated the true effect of ill-health on earnings. Past health (up to 4 years back) was found to have an independent impact on current personal income, but we were not able to take into account the role of health in the further past. Health was also measured imperfectly and incompletely, e.g. we largely ignored mental health problems. Finally, possible spillover effects of health on the earnings of the partner were ignored in our analysis. Combining these considerations we think that the estimates which we present may not be far from the truth, but surrounded by considerable uncertainty.

4.3. Inequalities-related losses to health as a capital good

We used the results of the ECHP analysis to estimate the impact of inequalities-related health losses on GDP in the European Union in 2004. We again applied PAR (Populationa Attributable Risk) calculation, comparing the actual situation to the hypothetical situation in which all persons have the same level of health as higher educated persons. For details on these estimates we refer to Appendix D.

As was shown in table 3, the number of inequalities-related cases of "very poor" or "poor" health amounted to more than 33 million persons in the 25 EU member states in 2004. Similarly, 707 thousand deaths in the EU-25 in 2004 could be attributed to health inequalities. Table 4 shows the economic costs corresponding to these numbers of people. If people in lower educational groups were to have the same level of health as people in higher groups, and if their personal income were to increase correspondingly (taking into account the association between health and income among low educated people), the average personal income in the European Union would increase by 2.77%.

Because the personal income definition used in these calculations corresponds with the wages and earnings component (excluding employers' social contributions) in GDP National Accounts, we can now calculate the impact of inequalities-related health losses on GDP. The share of this wages and earnings component in total GDP vis 39%, and the 2.77% impact on personal incomes can thus be translated into a 1.08% increase in GDP, or €113 billion for the 25 EU member states taken together in 2004.

The total GDP impact is likely to be larger because part of the added value of employees is included in firm profits, and because we did not include the economic impact of health among the self-employed. We assumed that the effect of health inequalities on the category of firm profits and mixed incomes is 0.69%, which is equal to one quarter of the 2.77% effect on wages and salaries. The share of this mixed income component in total GDP is 38%, and the impact on total GDP will therefore be around €28 billion or 0.27% for the EU-25 member states in 2004. As a result, the combined effect of health inequalities on total amounts to €141 billion or 1.35% of GDP.

In view of the annual growth rates of GDP (in the order of 2 to 4%), this seems a modest effect, at least in relative terms. It is important to note, however, that this estimate excludes several mechanisms which link ill-health to human capital (see section 2.2). In addition, by accepting the market price of the labour supplied by people with a lower socioeconomic status we may have underestimated their contribution to the total economic output. We will come back to these caveats in chapter 6.

4.4. Inequalities-related losses to health as a consumption good

As described in chapter 2, GDP is an imperfect measure of welfare. It does not capture a number of welfare components, such as the value of non-market goods including health. Although there is no consensus on the monetary value of health, we

will use adopted versions of Nordhaus' estimates for illustrative purposes. The results are presented in table 4.

The yearly number of inequalities-related deaths in the European Union (EU-25) was estimated to be 707,000 (table 3). If a life saved were valued at €862.500 (see section 2.2.2), the total value of this mortality reduction would amount to €610 billion. We estimated the number of life-years gained by these saved individuals to be 11.4 million. If these life-years were valued at €77,000 each, and one would take a standard discount rate of 1.5% per annum over an average of 16 years to take into account that these life-years will not be gained immediately, the total value of this gain in life would amount to €778 billion. Thus, the two alternative approaches to value the economic impact of annual deaths yield estimates between about €600 and €800 billion. They suggest as a reasonable estimate of the economic impact of mortality inequalities is in the order of €700 billion, or about 6.7% of current GDP.

According to section 3.4, the total impact of inequalities in self-assessed health was estimated to be about 23 million cases of "fair" health and 10 million cases of "poor" health (table 3). These numbers can be given a monetary value if we can convert them into numbers of years of life-in-good-health lost. This conversion can be done using health utility functions or disability weights (ranging from 1=perfect health to 0=death). Using data of the ECHP we made a distinction between "fair health" and "poor health", for which we estimated the disability weights to be 0.90 and 0.80, respectively (details are available upon request). These disability weights imply that 23 million person-years of "fair health" in 2004 equal 2.3 million years of life-in-good-health lost, while 10 million person-years of "poor health" in 2004 equal 2.0 million of years of life-in-good-health lost. The sum of these two is 4.3 million years, which is about 40% of the mortality effect of 11.4 million years (see above), which would add another €280 billion to the economic impact of health inequalities.

Because the monetary values for morbidity and those for mortality were calculated using different procedures, we should be careful to simply add these values. None the less, summing the values for mortality and morbidity would suggest that the total impact of inequalities in mortality and morbidity combined is 980 billion, or 9.38% of the GDP of the EU-24 in 2004.

Tabel 4. Economic impact of socioeconomic inequalities in health, EU-25 member states, 2004

	Total value		Impact of health inequalities		
	In billion euro	As % of GDP	Share (%) of total	In billion euro	As % of GDP
GDP of EU-25, 2004	10,451	100.0%			
Health as a capital good: GDP income components					
- wages and salaries	4,071	39.0%	2.77%	113	1.08%
- firm profits, mixed income etc	4,021	38.5%	0.69%	28	0.27%
- total income	8,092	77.4%	1.74%	141	1.35%
Health as a consumption good					
- mortality	n.a.	n.a.	n.a.	700	6.70%
- morbidity (40% of mortality)	n.a.	n.a.	n.a.	280	2.68%
- total health	n.a.	n.a.	n.a.	980	9.38%
Health care costs					
- physician services	157	1.5%	16.38%	26	0.25%
- hospital services	267	2.6%	22.07%	59	0.56%
- total health services	888	8.5%	19.96%	177	1.70%
Social security benefits					
- unemployment benefits	178	1.7%	2.71%	5	0.05%
- disability benefits	222	2.1%	24.71%	55	0.53%
- total benefits	401	3.8%	14.91%	60	0.57%

Notes on calculation

1. All estimates in the columns 1 and 2 refer to the 25 EU member states in 2004. Most data were obtained from the Eurostat website. Health care data are for 2003, available at OECD, for 18 countries. See Appendix D for details.
2. In column 3, the impact of health inequalities was estimated using the Population Attributable Risk approach, using all persons with at least upper secondary education as the reference group. The estimation procedure is explained in sections 4.3 and 4.5, and in Appendix D, sections 3 to 5.
3. The values in column 1 are multiplied with those in column 3 to obtain the estimates in column 4 and 5. The estimates for "health as a consumption good" were derived following the procedure outlined in section 4.4.

4.5. Social security benefits and health care expenses

Our analysis of the ECHP panel data confirms that poorer health is strongly associated with receipt of disability benefits (see appendix C). People with "very poor" health on average receive about 20 times more disability benefits than those with "very good" health. Among lower educated groups, the effect of health on disability benefits is slightly smaller in relative terms. Similar patterns were observed among both men and women, and in all European countries included in this study. The association between poorer health and receipt of unemployment benefits was much weaker and less consistent, however. In general, those with poor health received more unemployment benefits, although this association is weak among low educated people. When comparing countries, it was found that poorer health was related with more employment benefits in Northern European countries, while the opposite association was observed in France and most Southern European countries. Because of the possibility of various forms of bias, including 'justification bias' (see section 2.2), these international variations should be interpreted with caution.

If all persons would have the health corresponding to those high educational levels, this would clearly lead to fewer applications for unemployment and disability benefits. On the basis of our analysis of ECHP data, we estimate that unemployment benefits would decrease by 3% on average in the European Union as a whole, representing about €5 billion annually in social security costs. Disability benefits would decrease by 25% representing €55 billion annually (table 4). The total of €60 billion corresponds to 15% of the total costs of social security systems.

The analysis of ECHP data also confirmed that poor health was consistently related to GP visits, specialist visits and hospitalization rates (see appendix C). People with "very poor" health had more than 6 times more GP visits and more than 9 times more specialist visits than those with "very good" health. Virtually identical associations were observed within both higher and lower educated groups.

If all persons would have the health corresponding to those high educational levels, this would also decrease the number of GP visits and specialist visits by 16%, and the

number of nights in hospital by 22%, in all persons aged 16 years and older. Assuming that the impact of health on health care utilization is similar in children up to 15 years, we estimated the impact of health inequalities on health care costs as €26 billion for physician services, and €59 billion for hospital services. According to OECD data, physician visits and hospitalizations represent almost half of total health care costs (see data base at OECD website). Analyses of utilization of other health services (e.g. physical therapy, home care, mental health services) in the Netherlands demonstrated that an identical or even stronger association exists with poor general health and with low education (Kunst et al., 2007). If the empirical results for physician visits and hospitalizations were to apply to total health care, the total impact of health inequalities on health care costs would represent €177 billion euro, or around 20% of total health care costs in the EU-25.

4.6. Conclusion

Our estimates suggest that the economic impact of socioeconomic inequalities in health is likely to be substantial. While the estimates of inequalities-related losses to health as a 'capital good' (leading to less labour productivity) seem to be modest in relative terms (1.4% of GDP), they are large in absolute terms (€141 billion). It is valuing health as a 'consumption good' which makes clear that the economic impact of socioeconomic inequalities in health is really huge: in the order of about €1,000 billion, or 9.5% of GDP). The separately calculated impacts on costs of social security and health care systems and health care support these conclusions. Inequalities-related losses to health account for 15% of the costs of social security systems, and for 20% of the costs of health care systems in the European Union as a whole. It is important to emphasize that all these estimates represent yearly values, and that as long as health inequalities persist, these losses will continue to accumulate over the years.

5. Potential economic benefits of policies to reduce socioeconomic inequalities in health

5.1. Introduction

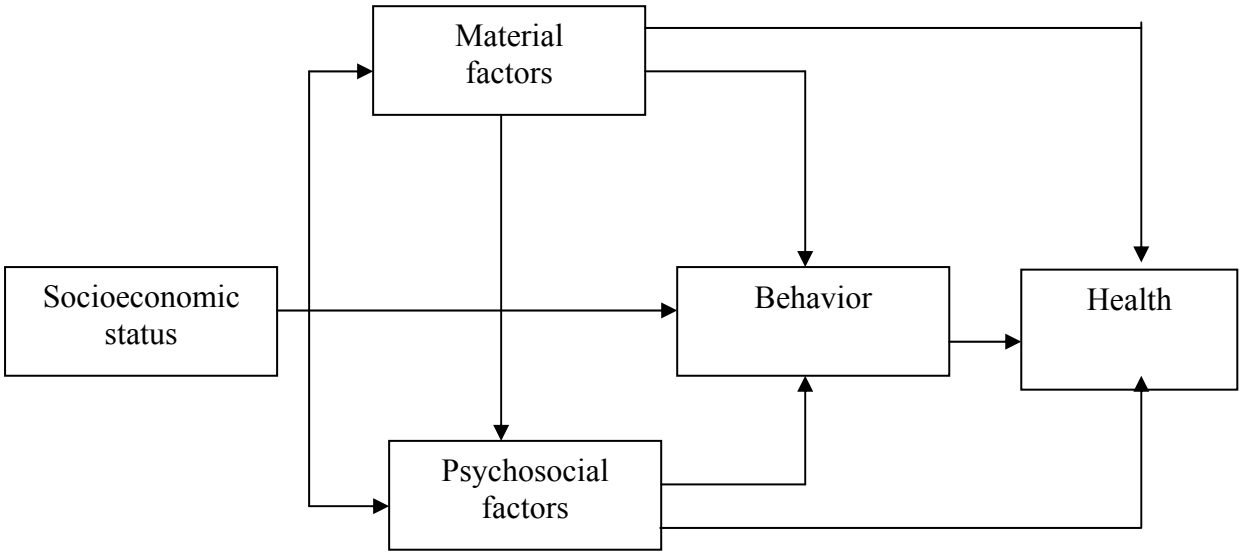
During the past two decades, socioeconomic inequalities in health have increasingly been recognized as an important public health issue throughout Europe. As a result, there has been a considerable research effort which has permitted the emphasis of academic research to gradually shift from description to explanation. And as a consequence of that, entry-points for interventions and policies have been identified, providing the building-blocks with which policy-makers and practitioners have begun to design strategies to reduce socioeconomic inequalities in health (Mackenbach & Bakker, 2001).

In this chapter we will first briefly summarize these developments, and try to demonstrate that it is feasible to reduce socioeconomic inequalities in health (section 5.2). At the present state of knowledge it is unclear what the quantitative impact on socioeconomic inequalities in health of implementing the available policy options would be. To illustrate the potential economic benefits of policies to reduce socioeconomic inequalities in health we will therefore use two approaches. The first focuses on policies to reduce inequalities in smoking. Because of our relatively good understanding of the quantitative contribution of inequalities in smoking to inequalities in morbidity and mortality in Europe, we can illustrate what the economic benefits of eliminating inequalities in smoking would be (section 5.3). The second approach uses the quantitative targets for reducing health inequalities which have been set within the framework of some national strategies to reduce health inequalities. We will show what the economic benefits would be if these targets were achieved (section 5.4). We will end with a number of conclusions and caveats (section 5.5).

5.2. Entry-points for policies and interventions to reduce socioeconomic inequalities in health

The effect of low socioeconomic status on health is likely to be largely indirect: through a number of more specific health determinants which are differentially distributed across socioeconomic groups (figure 2).

Figure 4. Simple explanatory diagram: factors which have been shown to 'mediate' between low socioeconomic position and risk of ill-health.



Many risk factors for morbidity and mortality are more prevalent in lower socioeconomic groups, and it is these inequalities in exposure to specific health determinants which should be seen as the main explanation of health inequalities.

There is no doubt that 'material' factors, i.e. exposure to low income and to health risks in the physical environment, are part of the explanation. All European countries have large inequalities in income. According to Eurostat, the 20% of the population with the highest income in the European Union (EU-25) received 4.5 times more than the 20% of the population with the lowest income in 2001. The proportion of the population who is at risk of poverty (defined as having an income less than 60% of the national average) was 15% in the EU as a whole (www.eurostat.eu). Although income inequality and poverty rates differ between countries, partly as a result of

differences in income taxation and social security benefit schemes, it is quite likely that inequalities in financial disadvantage play an important role in the explanation of health inequalities in all European countries. Financial disadvantage may affect health through various mechanisms: psychosocial stress and subsequent risk-taking behaviours (smoking, excessive alcohol consumption, …), reduced access to health-promoting facilities and products (fruits and vegetables, sports, preventive health care services, …), etc. Occupational health risks (exposure to chemicals, accident risks, physically strenuous work, …) and health risks related to housing (crowding, dampness, accident risks, …) are other examples of 'material' factors which have been shown to make important contributions to the explanation of some health inequalities (Mackenbach, 2006; Van Oort et al., 2005).

The second group of specific determinants which contribute to the explanation of health inequalities are psychosocial factors. Those who are in a low socioeconomic position on average experience more psychosocial stress, in the form of negative life events (loss of beloved ones, financial difficulties, …), daily hassles, 'effort-reward imbalance' (high levels of effort without appropriate material and immaterial rewards), and a combination of high demands and low control. These forms of psychosocial stress can in their turn lead to ill-health, either through biological pathways (e.g. by affecting the endocrine or immune systems) or through behavioural pathways (e.g. by inducing risk-taking behaviours). Psychosocial factors related to work organization, such as job strain, have been shown to play an important role in the explanation of socioeconomic inequalities in cardiovascular health (Mackenbach, 2006).

The third group of contributory factors are health-related behaviours, such as smoking, inadequate diet, excessive alcohol consumption, and lack of physical exercise. In many European countries one or more of these 'lifestyle' factors are more prevalent in the lower socioeconomic groups. By far the most widely available data on a specific determinant of health inequalities relate to smoking. In many European countries, particularly in the North of Western Europe, cigarette smoking is the number 1 determinant of health problems (Kunst et al., 2004). This is not only because of its role in lung cancer and some other specific diseases, for which smoking is the main cause. It is also because of its role in (premature) mortality in general,

less-than-'good' self-assessed health and disability, for which smoking is an important contributory factor. The prevalence of smoking differs strongly between socioeconomic groups in many European countries, but there are important differences between countries in the magnitude, and sometimes even the direction, of these inequalities. A number of comparative studies have demonstrated a North-South gradient, with larger inequalities in current smoking in the North of Europe and smaller (sometimes even 'reverse') gradients in the South (Kunst et al., 2004). In addition to smoking, several other health-related behaviours may play a role too in explaining health inequalities, including excessive alcohol consumption (usually more frequent in lower socioeconomic groups, particularly among men), dietary factors (regular consumption of fruit and vegetables tend to be more frequent in higher socioeconomic groups), lack of leisure-time physical activity (which tends to be more common in the lower socioeconomic groups too), and overweight and obesity (this is one of the very few indicators where socioeconomic inequalities are larger for women than for men in many European countries) (Mackenbach, 2006).

These three groups of factors together account for a sizable fraction of health inequalities, as shown by multivariate analyses which have been performed in various European countries (Van Oort et al., 2005). Although not all inequalities can be explained from these factors, their contribution typically adds up to at least 50%, suggesting that there is a considerable potential for reducing health inequalities by tackling these determinants.

5.2. Illustration 1: the economic benefits of tackling inequalities in smoking

As mentioned above, the higher prevalence of cigarette smoking in lower socioeconomic groups is part of the explanation of socioeconomic inequalities in health in the European Union. Although inequalities in smoking rates cannot be seen in isolation from other factors, for example the unfavourable material and psychosocial conditions of lower socioeconomic groups, it is reasonable to assume that if it were possible to lower their rates of smoking to the levels seen in higher

socioeconomic groups, this would after some time result in a reduction by 'levelling' up of inequalities in mortality and morbidity.

As shown in appendix E, smoking accounts for around 30% of socioeconomic inequalities in mortality, and around 15% of socioeconomic inequalities in morbidity, among men in many European populations. For women the contribution of smoking is much more variable, with sizable contributions to health inequalities in Northern Europe (because women in lower socioeconomic groups smoke more) and small or negative contributions in Southern Europe (because women in lower socioeconomic groups still smoke less).

There are many cost-effective intervention strategies to reduce tobacco consumption, including bans on advertising and promotion, bans on smoking in public and work places, price increases, better consumer information, warning labels, and medication and counselling to help dependent smokers stop (Giskes et al., in press). There are wide variations between European countries in the extent to which these intervention strategies have been implemented, and there is thus considerable scope for further reducing smoking rates (Joossens & Raw, 2006).

Some of these intervention strategies could potentially generate larger reductions in smoking prevalence in lower socioeconomic groups. Raising the price of tobacco has a stronger deterrent effect on lower socioeconomic groups, and targeting smoking cessation services to deprived areas has been shown to narrow the gap in smoking between higher and lower socioeconomic groups (Chesterman et al., 2005). As we argue in more detail in appendix E, it is reasonable to expect that tobacco control policies which ensure sufficient reach and effectiveness among lower socioeconomic groups, by strict enforcement of laws and regulations, removal of financial barriers for smoking cessation services uptake, geographic targeting of services, and tailoring of communication, will achieve important reductions of smoking in lower socioeconomic groups.

In order to illustrate the economic benefits of these policies, we have made the following calculations (table 5). For details of the estimation procedures, we refer to Appendix E. In the European Union as a whole, a reduction of average smoking rates

among men by 25% is certainly feasible. (This will have important economic benefits in itself, which are however irrelevant for the purposes of this report.) We think it would be possible to achieve a slightly larger reduction of the smoking rate in lower socioeconomic groups, say by 33%, if tobacco control policies were partly targeted to lower socioeconomic groups. We have calculated the effect of these two tobacco control scenarios on a number of health outcomes.

First, there is an effect on death rates. The number of smoking-related deaths in the EU-25 in 2004 was 1.085 million (around 23% of the total number of deaths as reported in table 3). More of these deaths occur in the lower half of the educational population distribution than in the upper half, and while both scenarios reduce the number of smoking-related deaths in the lower and upper educated groups, the second scenario has a larger effect in the lower educated groups. As a result, under the second scenario, inequalities in mortality diminish through a larger decrease in the number of deaths than under the first scenario. The absolute difference between the two scenarios is about 54,000 deaths less in the EU-25. Similarly, the number of persons in “fair”/”poor” health will also be reduced by both scenarios, but more so in the second (the absolute difference is about 2,200,000 cases of ill-health less in the EU-25).

These reductions in the numbers of deaths and cases of ill-health translate into substantial numbers of life-years and healthy life-years gained (lower half of table 5). We estimate the difference between the two scenarios in gain in life-years to be about 1 million (1.082 million, which equals about 54,000 deaths times 20 years - the average gain in life-years for an averted smoking-related death). The difference in gain in healthy life-years is about 2 million.

The results of these calculations can now be combined with some of the data from section 4, to estimate the monetary value of an equity-oriented approach to tobacco control. Both scenarios have substantial effects on mortality and morbidity in the population as a whole, which also generate important economic benefits.

Table 5. Aggregate estimates of the impact of smoking reductions on mortality and mortality in the EU-25 in 2004

	Baseline situation (EU-25 in 2004)	Policy scenario 1: 25% reduction of smoking prevalence in all groups	Scenario 2: 25% in higher groups, and 33% in lower groups	Additional effect of 2 compared to 1 (equity effect)
Smoking prevalence (%)				
- higher groups	0.25	0.19	0.19	0.00
- lower groups	0.35	0.26	0.23	-0.03
- total population	0.30	0.23	0.21	-0.02
Smoking-related deaths (* 1000)				
- total population	1,085	865	811	-54
- higher groups	393	310	310	0
- lower groups	692	555	501	-54
Cases of smoking-related "fair/poor" health (* 1000 persons)				
- total population	42,833	34,165	31,979	-2.186
- higher groups	14,875	11,743	11,743	0
- lower groups	27,958	22,422	20,236	-2.186
Years of healthy life lost due to smoking in total population (* 1000 years)				
- through mortality [a]	21,696	17,032	16,220	-1.082
- through prevalence of "poor/fair" health [b]	42,833	34,165	31,979	-2.186
Potential gain in healthy life years compared to baseline (* 1000 years) [c]				
- through mortality reductions	n.a.	4,395	5,477	-1.082
- through reduction in "poor/fair" health	n.a.	8,668	10,854	-2.186

For data sources and estimation procedures we refer to Appendix E, section 4.

[a] Estimated as number of deaths times the number of years of life lost per death on the average. For smoking-related mortality, this average is estimated to be 20 years (i.e. 4 years higher than for total mortality, because of the younger age at death of most smoking-related deaths in Europe, especially among women).

[b] Calculated as the number of persons-years in "fair/poor" health in 2004. Set equal to the observed number of persons "fair/poor" health, given above.

[c] Calculated as the difference between the two policy scenarios as compared to the baseline situation.

What concern us here, however, are the additional economic benefits of the second scenario. The impact of health inequalities on mortality was estimated to be 707,000 deaths in 2004 (table 3), and this would be reduced by about 54,000 (7.6%) if the second scenario were realized (table 5). The impact of health inequalities on morbidity was estimated to be 33,468,000 cases of "" fair"/ "poor" health in 2004 (table 3), and this would be reduced by 2,186,000 (6.5%) if the second scenario were realized. This implies that some 7% of the economic costs of health inequalities through mortality and morbidity would be taken away (including the costs of health care and social security benefits).

Applying this to some of the figures in table 4 shows that the potential economic benefits are indeed substantial. For example, inequalities-related losses to health as a 'capital good' through morbidity were estimated to total €141 billion, and a reduction of 6.5% would amount to about €9 billion. Inequalities-related losses to health as a 'consumption good' through mortality were estimated to be about €980 billion, and a reduction of 7.6% would amount to about €75 billion for the EU-25 as a whole.

5.3. Illustration 2: the economic benefits of achieving political targets to reduce inequalities in health

Different European countries are in widely different phases of awareness of, and willingness to take action on, socioeconomic inequalities in health. Some are still in a pre-measurement stage, whereas others have reasonable data without any sign of public awareness of socioeconomic inequalities in health. A few countries have had national research programs in this area during the 1990s, and some have entered a stage of explicit policy-making to address health inequalities (Mackenbach, 2006; Judge et al., 2005). As it is unlikely that any single policy or intervention will significantly reduce socioeconomic inequalities in health, 'packages' of policies and interventions of a more comprehensive nature have been devised by government advisory committees in Britain, Sweden and the Netherlands.

The Independent Inquiry into Inequalities in Health in Britain came up with 39 recommendations (123 in total, counting sub-clauses), and had a certain emphasis on addressing 'upstream' factors like income, education and employment, while recommendations on 'downstream' factors, like health-related behavior, are presented as part of more general strategies directed towards groups defined in terms of age, gender and ethnicity. The British government has implemented a large program to tackle health inequalities inspired by these recommendations. In Sweden the National Public Health Commission has developed a new national health policy with a strong focus on reducing health inequalities. The commission formulated 18 health policy objectives grouped in six large areas. Specific factors addressed by the strategy range from contextual factors such as social cohesion and housing segregation (with effects on children's educational opportunities) to work organization (with effects on job strain) and tobacco and alcohol consumption. In the Netherlands a national 'Program Committee on Socioeconomic Inequalities in Health' has issued a set of 26 specific recommendations. These were partly based on a series of intervention studies in which 12 different interventions addressing inequalities in health were subjected to quasi-experimental evaluation. The recommendations were grouped in four strategies to address four different entry-points: reducing socioeconomic inequalities, reducing the effect of low socioeconomic status on ill-health, reducing the effect of ill-health on low socioeconomic status, and offering extra health care to low socioeconomic groups (Judge et al., 2005).

Both in Britain and in the Netherlands quantitative targets were set for policies to reduce health inequalities (Judge et al., 2005). Target setting in this area was originally proposed by the World Health Organization, which as part of its 'Health for All' strategy launched in 1985 proposed a target of 25% reduction of health inequalities. This was renewed in its Health21 strategy, launched in 2000, which aimed for a reduction of inequalities in life expectancy of 25% by the year 2020. In Britain, the official targets of the government are to reduce the gap in infant mortality between lower occupational classes and the population average by 10% by the year 2010, and to reduce the gap in life expectancy between the fifth of most deprived areas and the national average by 10% by the year 2010. In the Netherlands, the government chose to reduce the difference in healthy life expectancy between people with a low and people with a high socioeconomic status by 25% by the year 2020, by

differentially raising healthy life expectancy in the lower socioeconomic groups (Judge et al., 2005).

With the exception of the British targets, these are clearly inspirational targets, which do not necessarily incorporate considerations of feasibility. They can be seen as an upper limit to what may be feasible, if efforts to develop effective interventions and policies are continued forcefully, and if all effective policies and interventions are implemented widely to reach all those in lower socioeconomic groups. In that case, a considerable 'upward levelling' of health inequalities could be achieved. This may then reduce the economic implications of health inequalities by a similar percentage of 10% (following the British target) or 25% (following the Dutch target).

If the European Union would succeed in reducing all health inequalities by 10% (25%), economic benefits would amount to €14 (35) billion Euros through gains in health as a 'capital good', €70 (175) billion through gains in health as a 'consumption good', €18 (44) billion through reduced health care costs, and €6 (15) billion through reduced social security costs.

6. Preliminary conclusions and evaluation of caveats

6.1. Preliminary conclusions

On the basis of currently observed patterns of mortality by educational level, the number of deaths that can be attributed to health inequalities in the European Union (EU-25) as a whole is estimated to be 458 thousand per year (all figures apply to 2004). The number of life years lost due to these deaths is about 7.4 million. Similarly, the number of prevalent cases of ill-health that can be attributed to health inequalities is estimated to be more than 33 million. The estimated impact of health inequalities on average life expectancy at birth in the EU-25 for men and women together is 1.84 years, and the estimated impact of health inequalities on average life expectancy in good health is 6.98 years.

Our estimates suggest that the economic costs of socioeconomic inequalities in health are likely to be substantial. While the estimates of inequalities-related losses to health as a 'capital good' (leading to less labour productivity) seem to be modest in relative terms (1.4% of GDP), they are large in absolute terms (€141 billion). It is valuing health as a 'consumption good' which makes clear that the economic impact of socioeconomic inequalities in health is really huge: in the order of about €1,000 billion, or 9.5% of GDP. The separately calculated impacts on costs of social security and health care systems and health care support these conclusions. Inequalities-related losses to health account for 15% of the costs of social security systems, and for 20% of the costs of health care systems in the European Union as a whole. It is important to emphasize that all these estimates represent yearly values, and that as long as health inequalities persist, these losses will continue to accumulate over the years.

Although relatively little is known yet about the effectiveness of strategies to reduce inequalities in health, it is possible to make some educated guesses about their potential impact on the economic implications of health inequalities in the European Union. For example, if it were possible to implement a number of equity-oriented anti-tobacco policies which would reduce the prevalence of smoking in the lower

socioeconomic groups by 33%, while the prevalence of smoking in the higher socioeconomic groups would decline by 25%, our analyses suggest that a substantial impact would be generated. Not only would health inequalities be reduced considerably, but also some 7% of the economic costs of health inequalities through mortality and morbidity would be taken away (including the costs of health care and social security benefits). Inequalities-related losses to health as a 'consumption good' through mortality would be reduced by between about €75 for the EU-25 as a whole, and inequalities-related losses to health as a 'capital good' would be reduced by almost €9 billion per year.

6.2. Evaluation of caveats

As stated in the introduction, these estimates should be seen as a first attempt at coming to grips with difficult issues. There are many uncertainties, and some of the caveats have already been mentioned in chapter 2. Here we list the main sources of uncertainty.

In chapter 3, we presented estimates of the magnitude of burden of ill health and premature mortality attributable to the fact that not everybody has a high level of education. These estimates are a bit uncertain. Although there are abundant data on the magnitude of socioeconomic inequalities in mortality and morbidity in the European Union, the validity of data is sometimes limited, and some countries still lack relevant data. In addition, the commonly available data on socioeconomic differences in health do not distinguish between the effect of socioeconomic position on health, and the reverse effect of health on socioeconomic position. On the whole, we think we have probably underestimated the inequalities-related losses to population health in the European Union, because of two reasons. First, our estimates only took into account health inequalities in relationship to educational level, thereby ignoring the health inequalities in relationship to other factors such ass occupational class and childhood living conditions. Second, in the PAR calculations, we conservatively took the upper half of the educational distribution as the reference category, instead of taking a higher educational group with lower rates of morbidity and mortality. For the example, the PAR for average life expectancy at birth was

estimated to be 1.84 years, whereas an estimate of more than 3 years would have been obtained by using a higher education level as the reference group.

In chapter 4, we prepared estimates of the monetary value of inequalities-related losses to health as a 'capital good'. There are important uncertainties with regards to estimates of the relationship between health and labour productivity and labour force participation. With regards to labour productivity, we assumed that the lower hourly wages of lower educated people reflect the lower value of their contribution to the production of goods and services, but the validity of this assumption could be debated.

There is additional quantitative uncertainty related to the fact that it is difficult to exactly identify the causal component in the association between ill health and personal income. By not taking into account reverse causality but simply using the observed association between health and economic outcomes, we may have overestimated the magnitude of the causal effect of health on economic outcomes. On the other hand, incomplete and biased measurement of health trajectories could lead to a considerable underestimate of the effect of past and current health on income (Appendix B). Taking these considerations together, we assumed that the observed association of health with economic outcomes represents the best estimate of the true causal effect of health, although with considerable margins of uncertainty.

Even though we re-analysed data from the most representative data source available at the start of our project, the ECHP, there is no guarantee that what has been found in a single data set will be reproduced in other data sets. A main drawback of the ECHP is that is does not cover the countries that have become EU member states since 1993. The effects may have been larger or smaller in northern and eastern countries that joined the EU later. There is an urgent need for analysis of additional data sets covering all or most current EU member states. In addition, systematic reviews or meta-analyses are needed to assess the causal effect of ill-health on earnings in the European Union.

Other uncertainties to the estimates in chapter 4 relate to the fact that we had to ignore losses generated through other mechanisms than the health effects on labour

participation and labour productivity. We could not take into account differences in savings between people in poor and in good health. Similarly, we could not take into account the effect of ill-health on educational careers. Poor health at a young age may lead to higher educational costs, and because education is a gateway to employment opportunities and productivity, poor health of children may restrict economic growth in the long term (Groot et al., 2003). Similarly, we had to ignore the value of informal labour, nor did we take into account the effect on partner's personal income. As shown in our analysis of ECHP data (presented in Appendix C), a good health is associated with a higher income earned by the partner. Even though the effects are smaller than the effects on own personal income, there is clear evidence for positive spillover effects on the labour participation and earnings of other household members. Taken together, when it would have been possible to take these other mechanisms in our quantitative estimates of the monetary value of inequalities-related losses to health as a 'capital good', these estimates could have been much higher than those presented in this report.

Finally, in chapter 4, our estimates with regards to health as a 'consumption good' also have a number of uncertainties, as there is no consensus on the monetary value of health, and the accuracy of our estimates is therefore strongly dependent on the validity of Nordhaus' estimates for the value of a life saved (€2.3 million, adjusted downwards by us to €0.86 million) and a current life-year lived (€77,000). In the literature, widely different estimates have been reported, and while Nordhaus' estimates represent a reasonable and well-documented choice, they cannot be seen as the ultimate truth. Here again, there is an urgent need for improving these estimates in order to better support policy making in Europe, not only in the field of health inequalities, but for other health domains as well (e.g. health care, health promotion and health protection).

In chapter 5, we estimated the potential benefits of policies and interventions to reduce inequalities in health. Although the emphasis of research on inequalities in health has shifted from description to explanation, and from there is shifting further towards intervention development and evaluation, our current understanding of the potential impact of policies to reduce health inequalities is still limited. We can be reasonably certain that tackling determinants of health inequalities, such as smoking,

bad working conditions, financial problems, or psychosocial stressors, will help to improve the health of socio-economically disadvantaged groups. However, it is currently difficult to predict the size of the effect. In the case of smoking, these uncertainties are a little bit less, and the example which we have elaborated shows that policies which achieve a modest extra reduction of the prevalence of smoking in lower socioeconomic groups would not only reduce health inequalities, but may also have considerable economic benefits. More generally, policies which would help European governments to achieve the target for reduction of health inequalities suggested by the World Health Organization would have enormous health benefits, which would translate into similarly large welfare benefits.

However, one additional point should be emphasized: it is currently unknown what these policies would cost. A near-complete reduction of health inequalities requires large investments and perhaps it would be inefficient from a macro-economic perspective. Investments needed for "levelling up" the health of lower socioeconomic groups would be large if a wide array of health determinants needs to be addressed, including the fundamental distribution of income and wealth. However, moderate reductions of health inequalities may be achievable and could be cost effective. In the case of smoking, it is reasonable to think that equity-oriented tobacco policies would be cost-effective because many interventions and policies have been shown to be highly cost-effective in the average population(Ransom et al., 2002), even ignoring the larger potential for health gain in lower socioeconomic groups. If benefits to health as a capital good are taken into account, this applies more generally for many health interventions, as shown by recent studies investigating the economic benefits of investing in health care (Cutler & McClellan, 2001). Nevertheless, further study of the likely costs of policies to reduce health inequalities is necessary.

In the "upward levelling" perspective taken in chapter 5, the potential benefits were estimates in relationship to the inequalities-related burden of ill health among lower groups. Estimates did not take into account the extent of inequalities in health per se, nor the extent of inequalities in wealth. An additional monetary value might have been attached to a specific magnitude of inequalities in health or wealth. Everything else being equal, a more equal distribution of health would add to the total national health output if the latter were to take into account aversion to large health

inequalities. Similarly, measures of GDP may be adjusted for aversion to large income inequalities. However, on the other hand, small income equalities may also have negative consequences. Beyond a certain point, a reduction of income inequalities may substantially reduce incentives to labour participation and productivity and thus affect national economic performance. Even though we recognise the importance of these issues, our quantitative estimates did not evaluate the economic value of alternative degrees of inequalities in health and wealth. Their evaluation would require more elaborate econometric models than could be applied in this report. More generally, it would be beyond the purpose of this paper to address the fundamental question which levels of health inequalities and wealth inequalities are "optimal" from the perspective of welfare economics.

Finally, we wish to clarify that the effects of inequalities in premature mortality have been expressed only in terms of health as a 'consumption good'. This approach disregards the effects of mortality, especially at working age, on labour force participation and economic productivity. On the short term, a reduction of levels of working-age mortality among lower socioeconomic groups has the effect to increase their absolute levels of labour force participation. On the longer term, however, mortality reductions imply an increase of the number of people living until old age, and thus an increase in the share of elderly in the total population. This long-term effect on the rates of population ageing would increase demand for health care, pension systems and some welfare systems. A balanced economic evaluation of this long-term effect is beyond the scope of this report, but should be part of evaluations of the economic consequences of the foreseen ageing of European populations during the next decades.

6.3. Conclusion

This is a first exploratory study on a complex but important question. We do not pretend to have the final answers. These issues at stake are much more complex than our tentative estimates would suggest. The evaluation above showed that the costs of health inequalities are much broader than the monetary estimates presented in this report. Given the conservative nature of most of our choices and assumptions, the

monetary estimates presented in this report are likely to represent only a part of the full cost of socioeconomic inequalities in health in the European Union.

7. Implications for health policy and for future research and data collection

Implications for health policy

- Socioeconomic inequalities in health are a major challenge for public health through the European Union. If it were possible to substantially reduce health inequalities, by raising the level of health of the lower socioeconomic groups, substantial gains in life expectancy and in morbidity-free life expectancy could be achieved.

- Socioeconomic inequalities in health have important economic implications. They contribute to the high levels of social security benefits and health care expenditure in the European Union. They reduce economic productivity, by lowering labour participation and labour productivity. And because of the high value that is attached to health, they also have a major negative effect on welfare in the European Union.

- Investing in programs to reduce health inequalities can have important economic benefits. Comprehensive programs to tackle health inequalities may, in 10 to 20 years from now, substantially reduce the negative welfare effects of health inequalities. Actions aimed at reducing inequalities in single risk factors, such as smoking, will also help to increase productivity and welfare and reduce social security and health care costs.

Implications for research and data collection

- This is the first attempt at estimating the economic implications of health inequalities. It has identified many sources of uncertainty in all steps of the analysis: estimating the magnitude of health inequalities in the whole European Union; estimating the effect of health inequalities on economic outcomes; and estimating the effect of policies and interventions on the magnitude of health

inequalities in the European Union. Further fundamental and applied research into these issues is needed to better support policy-making in this area.

- For the economic evaluation of health inequalities it is critical to improve the assessment of the effects of health status on economic outcomes, not only for national populations at large but also for specific socioeconomic groups. These effects can only be quantified using advanced causal analyses of longitudinal data sets. There is an urgent need for analysis of new international data sets covering most EU member states, as the magnitude of effects may substantially vary between countries.

- In addition, the area of research on the cost-effectiveness of policies and interventions to reduce inequalities in health needs to be fully developed during the next decade. A first step ahead is the estimation of the effectiveness of a policies and interventions according to socioeconomic group. There is a great need for generating new empirical evidence on differential effects, e.g. through re-analysis of existing data on past policies and interventions. In addition, efforts should be made to estimate the likely additional cost of focussing health sector interventions on lower socioeconomic groups, and the likely costs and benefits of "upstream" policies such as social welfare policies.

- Finally, improvements of national and European data collection systems are necessary to provide the necessary input for calculations of the economic implications of health inequalities. These systems should generate valid and nationally representative data on the magnitude of inequalities in mortality and morbidity for all member states of the EU.

We conclude that it is likely that a strong economic case can be made for reducing health inequalities. Important economic benefits are expected from reducing the health disadvantage of lower socioeconomic groups. This challenge requires a broad and active engagement, not only of the public health and health care systems, but of many other policy areas as well.

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Appendix A.
General overview of socioeconomic inequalities in health in Europe

1. Introduction

The objective of this chapter is to describe the patterns and size of socioeconomic inequalities in health in the European Union to the extent that good quality data are available. This overview aims to cover a maximum number of European countries, including the new EU member states. We will draw upon a number of comparative studies which have recently been completed, or are yet in progress, with financial support of the EC. Most of the results were recently summarised in an overview paper that we have written for the EC (Mackenbach, 2006). Selected parts of this overview paper are included in this chapter.

In this chapter, we give emphasis to findings that are relevant for understanding and estimating the macroeconomic impact of health inequalities. This implies a focus on health inequalities at working ages. For the same reason, we will focus on health outcomes that may directly determine economic productivity of large numbers of working-age people, such as functional impairments, disability and perceived general health. We will give less attention to inequalities in disease-specific outcomes such as mortality by cause of death.

For the purpose of this overview, socioeconomic inequalities in health are defined as systematic differences in morbidity or mortality between people with higher and lower positions in the social hierarchy. The socioeconomic position (SEP) of people is commonly measured by three complementary indicators: education level, occupational class or income level. In this overview, we will focus on health variations in relationship to educational level and occupational class, which generally represent the effect of socioeconomic position on health (social causation). The next chapters will specifically study the association between health and income, with the particular aim to estimate the extent to which this association represents an effect of

health on earnings (health selection). The conceptual link with next chapters is discussed at the end of this chapter.

2. General overview of health inequalities

Health inequalities are persistent and widespread across Europe

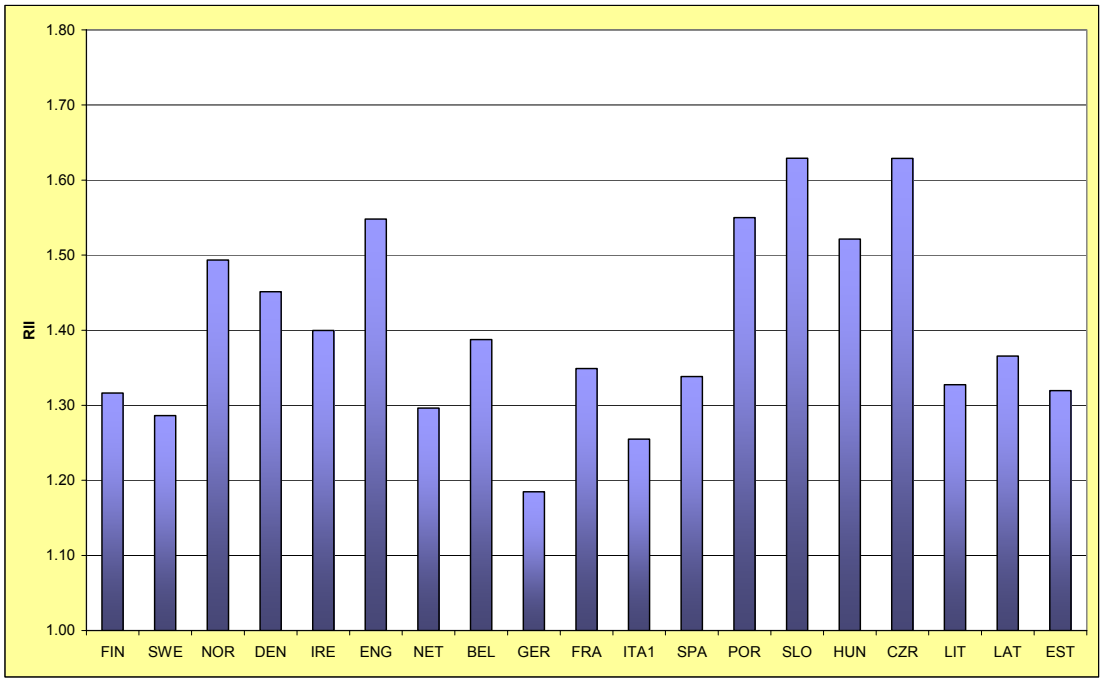
Historical evidence suggests that socioeconomic inequalities in health are not a recent phenomenon. It was only during the 19th century that socioeconomic inequalities were "discovered" by people such as Villermé in France, Chadwick in England and Virchow in Germany. Since the 19th century, the magnitude of inequalities in mortality has declined in absolute terms, thanks to the great declines in overall mortality levels. It is not clear, however, whether inequalities in mortality have also declined in relative terms. During the 20th century, the relative risks of dying for whose with a low SEP compared to those with a high SEP seem to have remained stable, and they even seem to have increased during the second half of the 20th century in many European countries.

At the start of the 21st century, all EU member states are faced with substantial inequalities in health within their populations. People from disadvantaged socioeconomic groups not only live shorter lives, they in addition more often suffer from physical and psychological problems during their shorter lives. Health inequalities have been found in countries in all European regions (see figure 1), and even if data for a particular country are not available, one can confidently expect large socioeconomic inequalities in health to exist there as well.

Health inequalities start early in life and persist into old age

Most studies on socioeconomic inequalities in health have focused on adults, particularly on middle-aged men and women, where health inequalities are substantial (see next sections). However, health inequalities have been observed for all phases of the life course. This has led to the notion that health is unequally distributed "from the cradle to the grave".

Figure 1. Educational Inequalities in self assessed health among women in 19 countries. Source: unpublished analyses of data from national health interview surveys.



The Y axis represents the Relative Index of Inequality. A positive value on the measure at Y-axis indicates that low educated men report more often less than "good" health. The higher the bar, the larger the inequalities.

Socioeconomic inequalities in health can already be seen at the very start of life. Children from lower socioeconomic families on average have lower birth weights, and are more often born prematurely or with congenital anomalies. Death rates are higher from conception onwards, as shown by socioeconomic differences in still births, in neonatal mortality, and in infant mortality. These inequalities in mortality continue throughout childhood and adolescence.

Children and adolescents from lower socioeconomic groups also more often report physical and mental problems. However, some studies have suggested that in adolescence, there is a genuine narrowing of health inequalities, perhaps because of the transition between socioeconomic position of the parents' family and own

socioeconomic position. Among children, the picture is more consistent: many studies find that parents in lower socioeconomic groups report more health problems for their children than parents in higher socioeconomic groups.

Inequalities in mortality and morbidity persist into the highest age-groups. Most studies show that relative inequalities (rate ratios comparing a lower to a higher socioeconomic group) are largest at ages of about 30 or 40 years, and decrease gradually with increasing age. On the other hand, absolute inequalities (difference between rates of a low and a high group) increase consistently with advancing age, and reach their highest values at about ages 80 or 90 years. Because most of the burden of mortality and morbidity occurs at older ages, inequalities in health among the elderly should be of main concern to public health.

Health inequalities appear to be large in terms of healthy life expectancy

As a result of differences in the risk of dying as observed at various ages, people from lower socioeconomic groups tend to live shorter lives than those with higher social positions. Differences in life expectancy at birth are typically in the order of 4 to 6 years among men, and 2 to 4 years among women. Sometimes, larger differences are observed. In Estonia, for example, inequalities in life expectancy at birth among women have increased from 3.6 years in 1990 to more than 8.6 years in 2000.

Among those who are alive, people with lower SEP have higher risks to suffer from health problems. This fact contributes to even larger inequalities in "healthy life expectancy" (the number of years which people can expect to live in good health). In most European countries, educational differences in total life expectancy at the 50th birthday are about 5 years. Thus, 50-years old men with higher education can expect to live 4 years longer compared to men with low education. These differences are aggravated by inequalities in the number of years lived with disability, which amount to about 6 years for men in many countries. Taking all age groups together, inequalities are even larger. Educational differences in the number of years lived in good health over the entire life course can amount to more than 10 years in many European countries (see table 1).

Table 1. Total life expectancy and life expectancy in "good" self assessed health according educational level. Estonia, late 1990s, in the age range 25th to 80th birthday (a maximum of 55 years of life). Source: unpublished analyses of mortality and health survey data.

Life table measure	Number of years			High minus low
	High education	Mid education	Low education	
Men				
- total life expectancy	47.3	41.0	36.3	11.0
- of which in "good" health	44.2	36.9	31.6	12.6
Women				
- total life expectancy	51.0	48.8	44.9	6.1
- of which in "good" health	46.7	42.0	36.9	9.8

Conclusion

The magnitude, persistence and omnipresence of health inequalities have contributed to a heightened awareness of the problem across Europe, and underlined the challenge that health inequalities pose to public health policy in all member states. As health is unequally distributed "from the cradle to the grave", policies to tackle inequalities in health should consider people in different phases of the life course, including infants, children, adolescents, young adults, middle-aged people, elderly and the oldest old. For the purpose of the present report, which focuses on macro-economic implications of health inequalities, particular attention should be given to men and women at working age.

3. Inequalities in morbidity at working age

Inequalities in self assessed health are omnipresent

Many countries have nationally representative surveys with questions on both socioeconomic status and self-reported morbidity (e.g. self assessed health, chronic conditions, disability). Similar data are available from a number of international surveys, such as the European Community Household Panel (ECHP). For self-

assessed health (measured with a single question on people's general judgment of their own health), data are available from nearly each health survey.

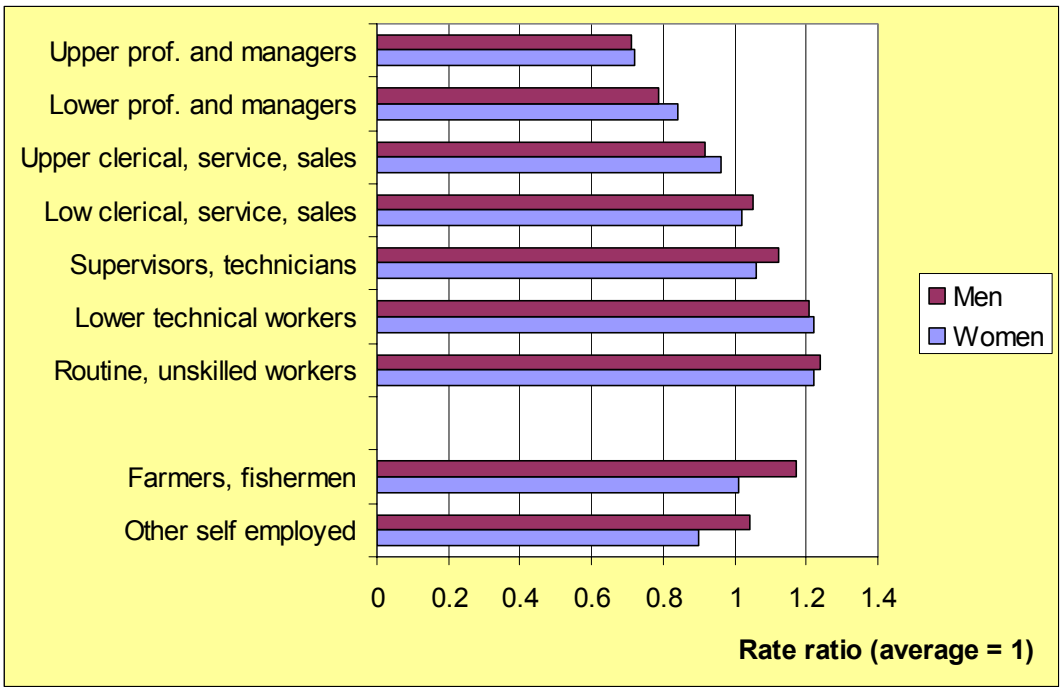
Wherever data are available, these have shown substantial inequalities in self assessed health among working-age populations. The overall pattern is clear: prevalence rates of less than "good" general health are higher among men and women with lower educational level or occupational class. For example, an analysis of ECHP data for 11 countries showed that the prevalence of less than "good" health among men and women in the class of "lower technical workers" and "unskilled, routine workers" was about two times as high as in the class of "higher professions and managers" (figure 2)

No consistent variations have been observed in the magnitude of socioeconomic inequalities in self assessed health between European countries. Inequalities in self-assessed health tend to be relatively large in Eastern Europe, although it is difficult to say whether they are larger than in Western Europe. Some studies have suggested that psychosocial risk factors are important in generating health inequalities in Eastern Europe in particular.

In recent decades, inequalities in general health have not diminished

Studies of trends in inequalities in self-reported health suggest a high degree of stability of these inequalities in many European countries. A study on 10 European countries looked at changes between the 1980s and the 1990s. There was no consistent evidence for a widening of the health gap. The only two countries for which a clear increase in educational differences in self assessed health was observed were Italy and Spain. For most other countries, changes in these differences were small or statistically not significant.

Figure 2. Prevalence of less than "good" health among middle-aged men and women in 11 European countries, according to occupational class, 1998. Source: unpublished analyses of ECHP.



Remarkably, health inequalities in Finland and Sweden did not increase between the 1980s and 1990s, despite the occurrence of a serious economic crisis half-way this study period. This finding suggested that the social welfare systems of these countries may have buffered the effects that the economic crises might otherwise have had on the health of vulnerable socioeconomic groups.

Overall, the persistence of large health inequalities in all countries with available data underscores the fact that these inequalities must be deeply rooted in the social stratification systems of modern societies, and it warns that is would not be realistic to expect a substantial reduction in health inequalities within a short period of time.

Functional limitations affect lower groups more and at an earlier age

Socioeconomic inequalities have not only been found for general health indicators, but can also be found for many specific indicators of health, including objective measurements of the incidence or prevalence of disabilities and functional limitations.

The prevalence of functional limitations tends to be higher among men and women in lower socioeconomic groups. Large inequalities were observed in self reports of many aspects of functioning, including difficulties in mobility and sensory functioning. Inequalities were also observed in objective measurements, e.g. of grip strength, walking speed, and concentration. These illustrate that inequalities in self reported impairments are real, and not a matter of reporting bias.

Socioeconomic inequalities in functional limitation translate into inequalities in restrictions with activities of daily living (ADL) such as dressing and bathing. They also translate into a greater number of people from lower classes who report that health problems seriously limit their ability to perform activities, and the proportion of people from lower classes who say that in the past 14 days they has to cut down on their daily activities due to health problems.

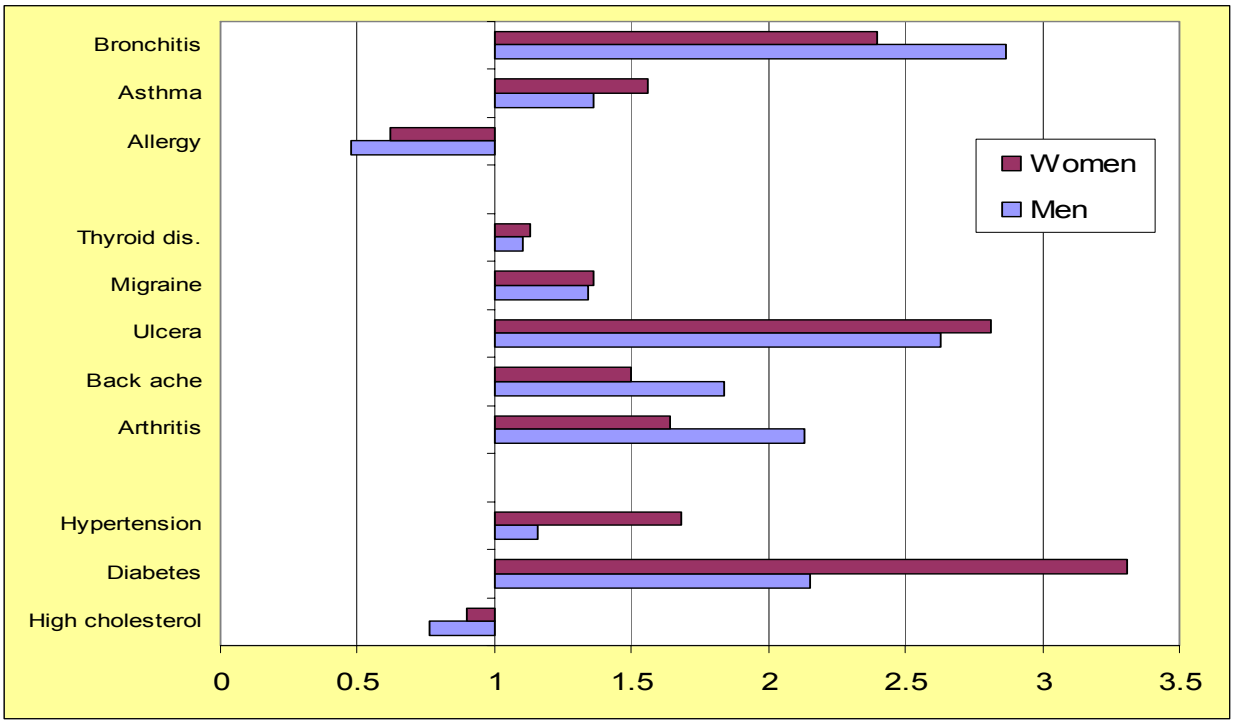
Even though the burden of disability is largely concentrated among elderly population, the incidence and prevalence of disabling health problems starts to increase already at middle age. There are marked socioeconomic variations in the timing of the onset of disability, which on average affects lower socioeconomic group at much earlier ages than higher socioeconomic groups. This is likely to have important consequences for the ability of people from lower socioeconomic groups to be fully productive during their entire working age.

Many diseases contribute to inequalities in morbidity

A recent overview on the basis of health interview survey data from eight European countries found large socio-economic disparities in the prevalence of self-reported chronic diseases. The largest inequalities were observed for stroke, diseases of the nervous system, diabetes mellitus, and arthritis. Somewhat smaller were educational differences in the prevalence of heart disease, hypertension, chronic obstructive pulmonary disease, arthrosis and migraine. This list shows that socioeconomic inequalities in health can be large not only for fatal diseases, but also for diseases that are highly disabling although not fatal. Examples are given in figure 3.

Figure 3. Educational Inequalities in the prevalence of chronic diseases among men in 20 European countries. Source: unpublished analyses of data from national health interview surveys.

A value greater than 1 indicates that low educated men report more often that chronic condition. Values lower than 1 mean higher prevalence rates among high educated. The larger the bar, the larger the inequalities.



No socioeconomic inequalities were observed in the prevalence of self-reported cancer, kidney disease, and skin diseases. Allergy is one of the very few conditions that appeared to be more prevalent in the higher socioeconomic groups. Similar results have been found for, e.g. eczema in children. It has been speculated that aspects of the home environment (e.g. central heating) and hygienic behavior (e.g. contact with pets) may play a role. Clearly, although most health risks are concentrated in lower socioeconomic groups, the social patterning of some others may be quite different, at least temporarily.

The higher prevalence of heart disease in lower socioeconomic groups is due to a higher incidence of heart disease in these groups, as observed in epidemiological

studies. The incidence and prevalence of heart disease is, however, less strongly associated with educational level in the South of Europe as compared to the North or the East. This finding mirrors a North-South gradient that was found for inequalities in heart disease mortality: mortality from ischemic heart disease was higher among lower educational groups in northern countries, but not clearly related to educational level in southern European countries.

Mental health problems are also unequally distributed

Not only physical health problems, but also mental health problems tend to be more common in lower socioeconomic groups. In its most dramatic form, this is illustrated by the higher levels of suicide mortality among lower educational groups in many European countries. Another example is provided a British study on the prevalence of neurotic disorders. Among women, most disorders were more common in lower occupational classes, including depressive disorder, phobias, and panic disorder. No clear class gradients were however observed with regards to obsessive compulsive disorder and anxiety disorders.

In psychiatric epidemiology, there is a long tradition of looking at the possible effects of mental health problems on occupational career and income. The "drift" hypothesis has indeed found some support, for example, in the case of schizophrenia, whose onset usually occurs in adolescence and early adulthood, and which may consequently interfere with early work careers. On the other hand, there is also support for the reverse ("social causation") effect, which perhaps operates through a higher exposure to psychosocial stressors and lack of coping resources among people from disadvantaged socioeconomic backgrounds.

4. Inequalities in mortality at working age

Premature mortality is much higher among lower socioeconomic groups

Although no individual can escape death, it greatly matters at which age death takes its toll. Generally speaking, the burden of mortality is greater to the extent that death

occurs at an earlier age. Mortality among men and women at working age implies not only a loss of productive life, but also considerable loss of potential years of life.

Data on mortality among men aged 30 to 64 years are available for many European countries. In all these countries, mortality at working age appeared to occur more frequently among men in less advantaged socioeconomic positions, regardless whether their SEP is indicated by educational level, occupational class, or measures of income and wealth. The size of mortality inequalities is often substantial, in the order of an excess risk of dying in the lowest socioeconomic groups of 50 or even 150 percent.

From studies that have included women, it has become clear that inequalities in premature mortality exist among women as they do among men. However, at working age (but not at old age) inequalities are smaller among women than among men. The difference between men and women at working age is partly due to differences in cause-of-death pattern: women die more often of cancer than men, and inequalities in cancer mortality tend to be smaller than inequalities in mortality from other causes of death. These data thus suggest that socioeconomic inequalities in mortality among men are a more pressing public health problem than those among women, but the latter should of course not be neglected either.

Relative inequalities in mortality have widened over the last decades

To the surprise of many, mortality differences between socioeconomic groups have widened in many Western European countries during the last three decades of the 20th century. This trend has continued into the 1990s. An overview of trends among middle-aged men and women in six Western European populations showed that the relative risk of dying in lower socioeconomic groups as compared to higher groups increased in each country. The absolute difference in mortality rates however remained approximately stable in most populations.

The widening of the relative gap is generally the result of a difference between socioeconomic groups in the speed of mortality decline. While mortality declined in all groups, the decline has been proportionally faster in the higher groups than in the

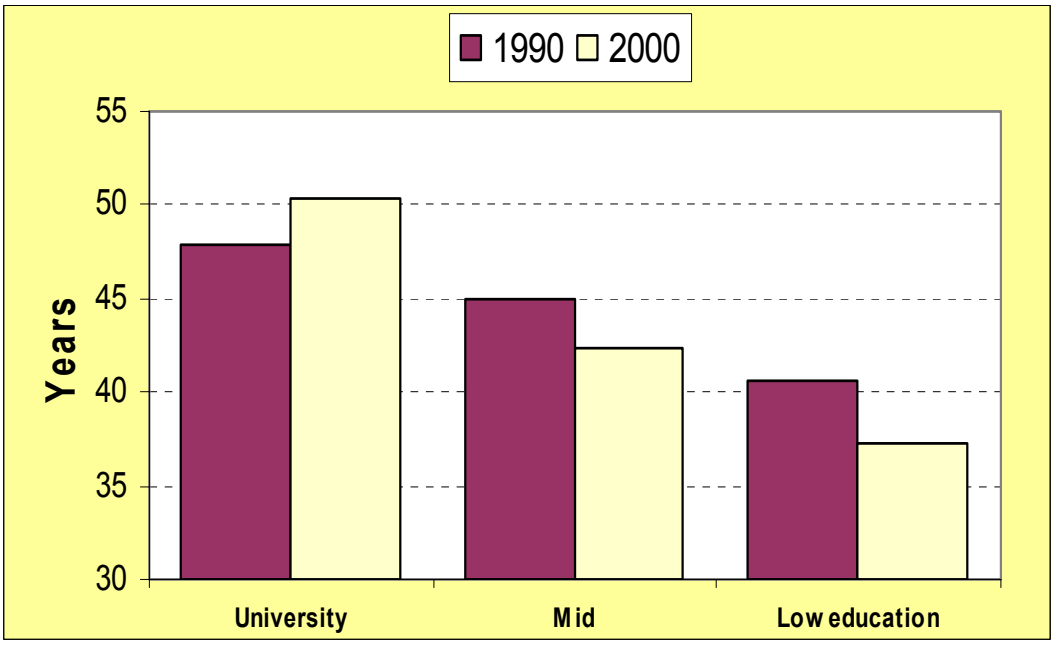
lower socioeconomic groups. This differences in speed of mortality decline occurred especially for cardiovascular diseases. Apparently, improvements that led to the decline in cardiovascular disease mortality (especially life style changes and health care interventions) have brought greater benefits to higher socioeconomic groups than to lower groups.

Inequalities in mortality are relatively large in Eastern Europe

Some comparative studies have tried to assess whether the magnitude of inequalities in mortality at middle age differs systematically between European countries. The range of variations between Western European countries is rather small. For example, a comparative study of eight Western European populations in the 1990s found that the relative excess risk of mortality in people with lower education, as compared to those with higher education, ranged between 22 and 43 percent among men, and 20 and 32 percent among women. It was difficult to determine whether the observed variations were real, as these variations could merely result from poor comparability of data available for different countries.

This is not to say that systematic differences in the magnitude of relative inequalities in mortality do not exist within Europe. Although strictly comparable data have not yet been produced, there are some suggestions that relative inequalities in mortality are rather large in some Eastern European countries. In addition, changes in mortality since the early 1990s have not been equal among all socioeconomic groups in the East. In some countries, such as Estonia and Hungary, a tremendous rise in inequalities in mortality occurred, perhaps as a result of the economic problems following the political change around 1990 (figure 4).

Figure 4. Educational inequalities in life expectancy at 25th birthday among men in Estonia in 1990 and 2000. Source: Leinsalu, Vagerö and Kunst, 2002.

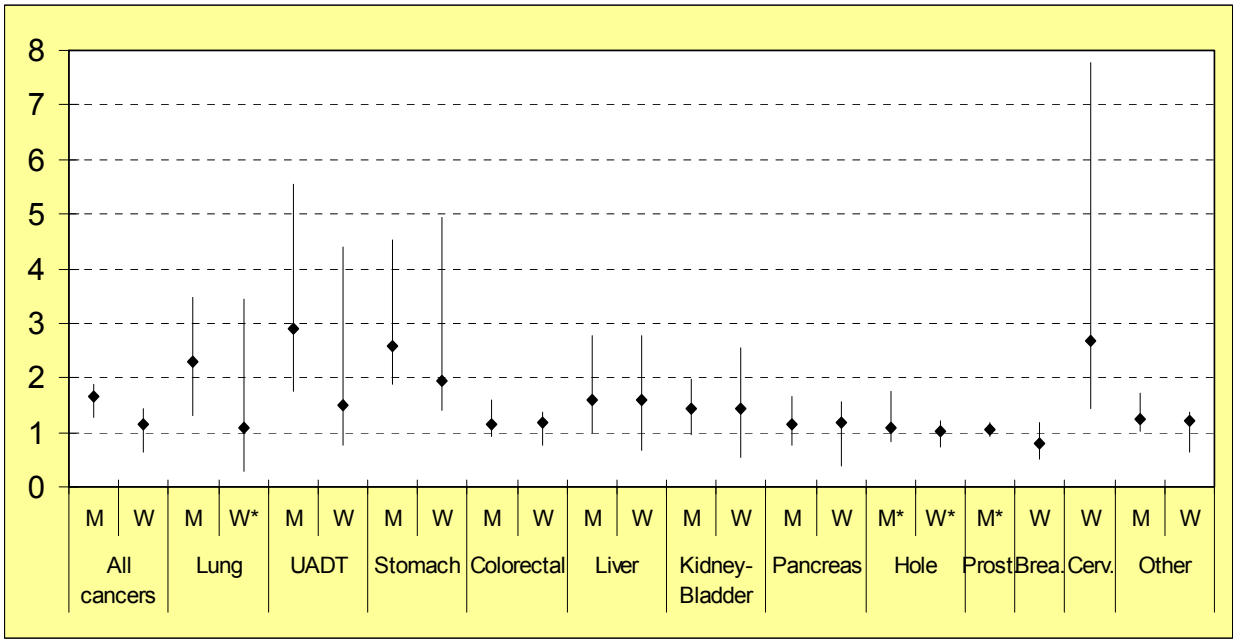


Many causes of death contribute to these inequalities

Not all diseases contribute equally to the excess total mortality in lower socioeconomic groups. In Western Europe, and probably in Eastern Europe too, cardiovascular diseases contribute most to inequalities in mortality. Among men, cardiovascular diseases account for almost 40 percent of the differences in mortality rate between higher and lower educational groups. This contribution is even 60 percent among women. The contribution of the next most important cause of death, cancer, is 24 percent among men, and 11 percent among women. The contribution of cancer is relatively small, especially among women, because of lack of clear socioeconomic gradients in main cancer sites, including those of the breast, colon, and prostate (see figure 5).

Figure 5. Educational inequalities in mortality by cancer site in 12 European populations. Source: unpublished analyses of data from longitudinal mortality studies.

The Y-axis presents Rate Ratios. A value greater than 1 indicates that higher mortality among low educated. Values lower than 1 imply higher mortality among high educated.



There are important differences between countries, however, in the share of specific causes to the excess mortality in lower socioeconomic groups. The most important difference is for ischemic heart disease: this disease is a major contributor to inequalities in mortality in the North, and much less important in the South. Traditionally, Southern European populations, and especially those from lower socioeconomic groups, are protected against ischemic heart disease, thanks to low tobacco consumption, Mediterranean diets and possibly other factors. There is evidence, however, to suggest that this protection is gradually eroding. This may result in increasing deaths rates from ischemic heart disease among lower socioeconomic groups in Southern Europe as well.

This overview shows that effective prevention and treatment of cardiovascular disease among lower socioeconomic groups should be priority for public health policies to tackle inequalities in health. Where needed, increases in cardiovascular disease

mortality should be prevented. Where possible, mortality declines among lower groups should be speeded up.

5. Education, income and health

Health is also related to measures of current income

In the studies referred to above, educational level and occupational class were used as the key socioeconomic indicators. Two complementary and often used indicators of SEP are current income and measures of cumulative wealth, such as house ownership (Grundy, 2001; Lynch, 2000;Krieger, 1997). Whereas educational level emphasizes the cultural and cognitive aspects of SEP, current income and cumulative wealth emphasize the potential role of poverty and material living conditions. Another key difference is that education is a highly stable socioeconomic characteristic throughout adult life, whereas current income is more amenable to change, possibly in response to changes in health.

Strong associations between health and current income have been observed in studies from various European countries. Commonly, health differences in relationship to income level are of the same order of magnitude as health differences by educational level or occupational class. Health and current income are associated across the entire life course, although there is evidence to suggest that the differences become smaller soon after retirement age.

There is some evidence to suggest that poor-rich differences in self-assessed health are smaller in countries with smaller income countries, such as the Nordic countries. Nonetheless, income-related differences in general health are observed in all European countries, and they are found to be persistent over time. A recent European overview of trends in health inequalities showed a general tendency for income-related differences in health to increase between the 1980s and 1990, especially in England/Wales and the Netherlands.

Poor-rich differences in health are in part independent from education

It might be expected that the association between income and health reflects the effects of educational level on income on the one hand, and of education on health on the other hand. Empirical studies showed that, indeed, poor-rich differences in health can in part be attributed to the underlying effects of education, or factors closely associated with educational achievement during adolescence.

However, it has often been found that most of the poor-rich differences in health cannot be explained by control education. Independent associations between income and health have for example been demonstrated in a European overview based on ECHP data for 11 countries. Among middle-aged men, the prevalence of less then "good" health was 69 percent higher in the lower income quintile compared to the highest income quintile. After control for educational level, the difference was still 59 percent, thus leaving most of the differences unexplained. Large independent effects of income were also observed in a European overview of health inequalities in elderly populations, and in some national studies. They underline that the income-health relationship cannot be simply be attributed to the effect of educational level or related factors in early life, but that this relationship is probably determined to a large extent by processes that evolve during adulthood.

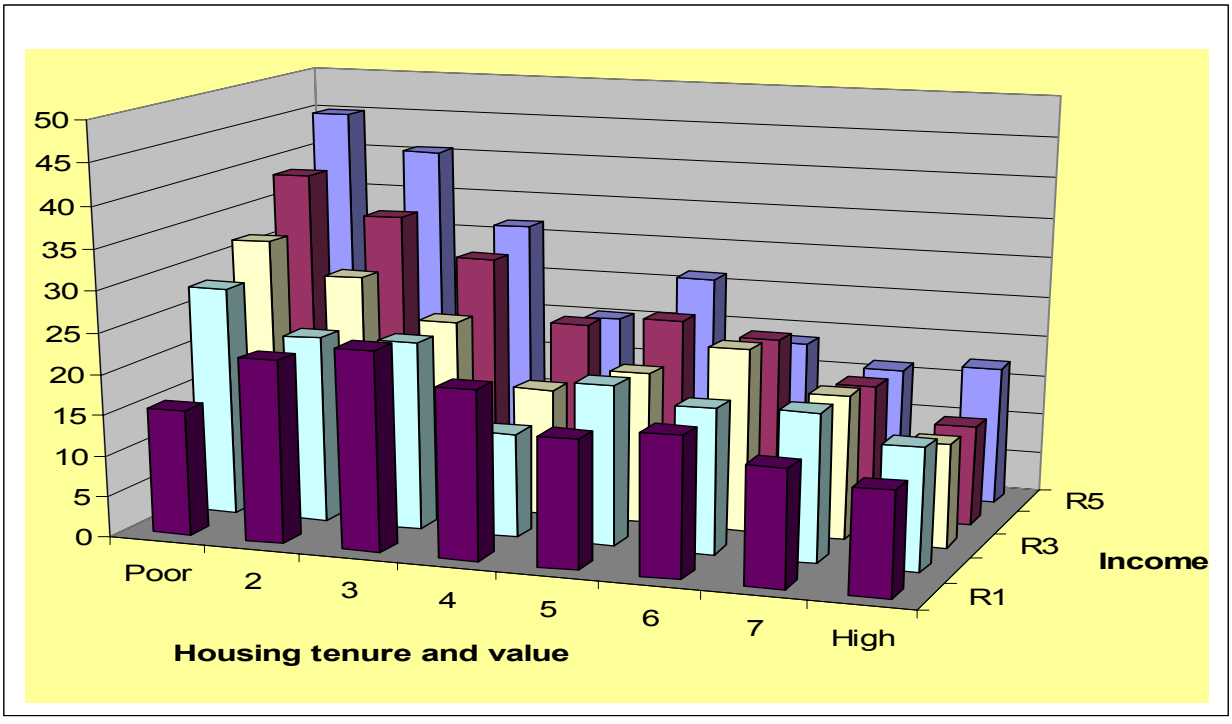
Measures of cumulative wealth are also strongly related to health

Recent studies have explored the associations of health or health-related variables with indicators of long-term wealth or economic deprivation. In this research, it is recognized that the commonly used measures of current income may be inadequate because they cannot directly measure long-term income, let alone the wealth that people accumulate over their life course (Grundy, 2001;Lynch, 2000;Krieger, 1997). Measures of house ownership and housing value could serve this purpose and they have therefore been used in recent European overviews of socioeconomic inequalities in mortality and general health (Dalstra, 2005;Huisman, 2004). Generally, housing-based measures of wealth were associated with health, although the patterns strongly varied between countries, perhaps because of the meaning of housing-based measures strongly depends on the national context.

Another type of measure consists of counting the durable goods (e.g. car, computer, new furniture) and activities (e.g. going abroad with holidays) that people can afford, and using this count to create a "wealth index" or "deprivation index". In on-going analyses of ECHP data for nine European countries, it was found that smoking prevalence rates were strongly related to house ownership as well as this wealth index (table 1). The differences remained substantial after control for educational level, occupation class, and current income. These results, similar to those of a Finnish study (Laaksonen, 2005), underscore the potential importance of using measures of long-term income and accumulated wealth.

Income and measures of wealth appear to be complementary predictors of ill health. For example, we analyzed Dutch data of the prevalence of "poor" self assessed health in relationship to current household income and a wealth measure based on housing characteristics (figure 6). As was expected, "poor" health was more often reported by

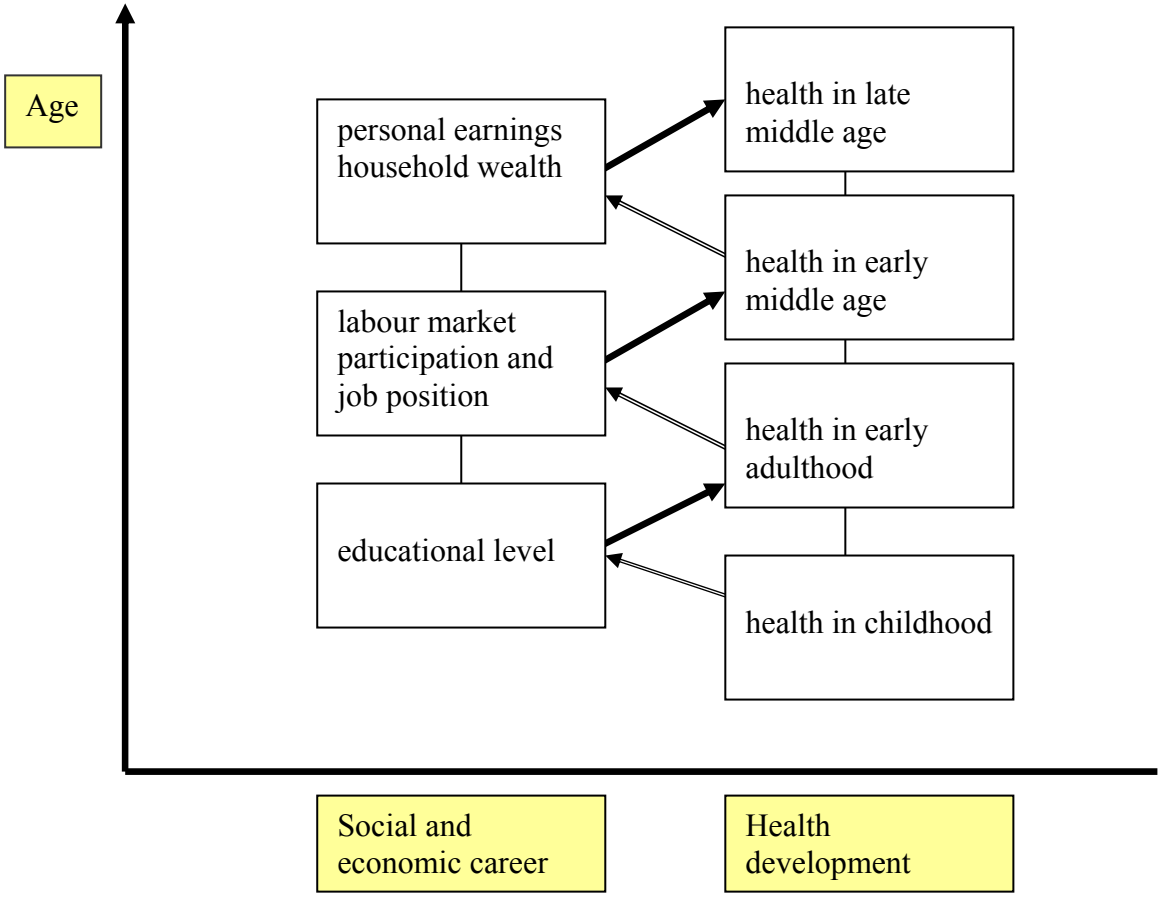
Figure 6. Income and housing characteristics as predictors of less than "good" health in the Netherlands, 2003. Source: unpublished analyses of data of the Dutch national health interview survey.



people with low income, and also by people who lived in cheap rented houses. More importantly, a strong interaction between these two SEP indicators was observed. When people were cross classified according to both indicators, it was found that "poor" health was strongly concentrated among those who lived on a low income and in addition lived in cheap rented houses.

The relationships between education, occupation, income, and health: a conceptual model

The next chapter will assess in more detail the associations between health and income. The particular aim will be to quantify the effect of health on personal income. In order to provide a bridge between the literature on socioeconomic inequalities in health (summarized in this chapter) and the study of health on earnings of individuals (addressed in the next chapter) we present below a conceptual framework that links both fields of research.



The diagram shows the intricate relationships between socioeconomic position and health. These relationships can best be understood from the perspective of a life course, during which social and economic careers develop in continuous interaction with changing health. Socioeconomic inequalities in health are determined by two reciprocal processes: the effects of social and economic position on health during the various life stages ("social causation") and the effects of health on the attainment of social and economic position during childhood and adulthood ("health selection"). The relative importance of these two mechanisms depends on the socioeconomic indicator and phase of the life course.

There is strong evidence to suggest that educational level has important effect on health development during adulthood. Variations between educational groups in health can probably to a large extent be attributed to differences in health related behaviors and psychosocial factors that are formed during childhood and early adulthood, combined with the long-lasting influence of educational level on adult socioeconomic position.

On the other hand, health problem have important effects on labour participation and, through mainly reduced labor participation, can strongly affect personal income of sick persons. As a result, health variations between lower and higher income groups may to an important extent be reflect the effects of health on labour participation and earnings. This may apply especially to that part of income-related health differences that cannot be attributed to the long-lasting effects of educational level. The next chapters will assess in more detail the effects of health on income through an evaluation of international literature, combined with an in-depth analysis of the association between health and income.

6. The population health impact of health inequalities in the Europe Union in 2004: an estimate

The purpose of this final paragraph is to provide an estimate of the impact of health inequalities on the population health of EU-25 in 2004. The estimates are given in the Table 2. Detailed footnotes to the table explain the data sources and estimation procedures that were used.

Estimates of the magnitude of health inequalities

Estimates of the magnitude of inequalities in mortality and self assessed health in EU-25 at large were of critical importance to the final results. Rate ratios comparing lower to higher educational groups were estimated to be 1.36 for mortality (see footnote d) and 1.45 for self assessed health (see footnote e). In the text below, we explain in detail how we arrived at these important estimates.

For mortality, the rate ratio of 1.36 was primarily derived from a study covering 10 western European populations that together can be considered to be representative of EU-15 (37). In this study, rate ratios were presented per 10-year age group for men and women, for the age group 30-39 to 90+ years. We calculated the weighted average of the age-specific rate ratios, with age groups weighted according to the absolute number of deaths in these populations. The average of these rate ratios was 1.307 for men and women together (who were given equal weight). A correction had to be made to take into account the exclusion of new EU-25 member states in Eastern Europe. Taking into account that mortality inequalities are about two times as large in these countries (i.e. a rate ratio of about 1.61) and that these countries represent 17% of the population of EU-25, the rate ratio of 1.307 would have to be increased to about 1.36. The estimates were based on data that applied to the 1990s for western countries, and to about 2000 for eastern countries. We assumed that the rate ratio of 1.36 had not substantially changed between these years and 2004.

For self assessed health, the rate ratio of 1.45 was derived from a re-analysis of unpublished data from national health surveys carried out in the early 2000's. Micro data from these surveys were acquired in the "Eurothine" study. We selected data

from 12 countries with identical survey questions on self assessed health: Sweden, Norway, Denmark, England, Ireland, Belgium, France, Italy, Spain, Portugal, Hungary and the Czech Republic. Together these countries represent different regions of the EU-25 and in addition they represent the different levels of health inequalities that can be observed within the EU-25 (*figure 1 of this appendix*). For each country, we estimated the age-standardised prevalence of "less than good" self assessed health for respondents with at least upper secondary education and for those with lower levels of education. For all countries together, the average prevalence rates were 43.7 and 28.9% for men with low and high educational levels, respectively. The corresponding values for women were 50.6 and 33.9%. These rates implied a prevalence rate ratio of 1.51 for men, and 1.49 for women, the average being 1.50.

Further evaluations showed that this estimate was fairly robust to differences with regards to the choice of data sources or analytical methods. The main problem was that the estimates based on national health surveys exclude children and a substantial part of the elderly population. From explorative calculations we concluded that the inclusion of these age groups, where inequalities in health are relatively small, would reduce estimates of the magnitude of health inequalities by about 10%. We therefore decided to adjust our 1.50 estimate downwards to 1.45.

Interpretation of the results

In the interpretation of the results, a distinction must be made between the lower half of the table (on life expectancy measures) and the upper part of the table. In the upper part of the table, the impact of health inequalities is expressed in terms of the number of events that occur each year (say, 2004), and the weight of these events in terms of length and quality of life. This approach could be pursued as such for mortality: the number of deaths due to health inequalities is estimated to be 707 thousands, and their impact is weighted in terms of number of life years lost. The total number of life years lost is 11,364 thousands, i.e. 11.4 million years.

This approach could not be followed in the same way for morbidity, because of the lack of comprehensive and internationally comparable data on the incidence of general health outcomes. The alternative is to measure the cumulative impact of past

events, as expressed in terms of the current prevalence of health problems. In terms or prevalence rates (instead of incidence rates), the impact of health inequalities amount to 33,468 thousand of cases of fair/poor health in the EU-25 in the year 2004. As the length of the reference period is 1 year, this number of about 33 million cases is equal to about 33 million person years lived with health problems. This number can be subdivided in about 23 million years of "fair" health and about 10 million years of "poor" health.

The lower part of the table presents estimates in terms of life tables. The impact on life expectancy (1.84 years) and healthy life expectancy (5.14 years) illustrate the magnitude of health inequalities in terms readily understandable to a wide audience. In the table, we multiplied these measures with the size of the total EU-25 population, in order to express this impact in terms of the total number of (healthy) life years in the EU-25. These numbers are impressive: 844 million years of life and 2,358 million years of poor health.

It is of interest to compare these numbers with those from the upper part of the table. In the lower part, the impact is about 75 times larger, both for mortality (844 vs. 11 million life years) and for morbidity (2,358 vs. 33 million healthy years). This about 75-fold difference is likely to be due to a difference in reference period. The upper part of the table counts the effects with reference to one single year, in terms of either the incidence of the event (mortality, weighted by impact) or the prevalence of its impact (morbidity). On the other hand, the life table estimates in the lower part count the effects of all events that might occur throughout the life course of all persons in the EU-25, and not only the events/impacts that are actually suffered by these persons during 2004 (or which these persons suffer in 2004). As life courses last about 75 years, a perspective on health events/effects across the entire life course instead of single calendar years will yield estimates that are approximately 75 times years higher.

Table 2. Population health impact of educational differences in mortality and morbidity in the EU-25 in 2004

	Total EU-25 population: observed rates and numbers (1)	Total EU-25: estimates assuming rates of higher educated (those with at least upper secondary education) (2)	Impact of health inequalities (1) – (2)
Death rate [a]	0.01009	0.00855 [d]	0.00154
Absolute number of deaths (* 1000) [b]	4,633	3,926	707
Total years of life lost (* 1000)	n.a.	n.a.	11,364 [g]
Prevalence rate of "fair/poor" health [a]	0.397	0.324 [e]	0.073
Absolute number of cases (* 1000) [b]	182,212	148,745	33,468
- in "fair" health	126,857	45,188	10,167
- in "poor" health	55,356	103,556	23,300
Life expectancy at birth [a]	78.65	80.49 [f]	-1.84
Total number of life years (* 1000) [b]	36,098,226	36,942,737	-844,510
Expectancy of life in poor health [c]	31.22	26.09	5.14
Total number of years in poor health (* 1000) [b]	14,330,996	11,972,462	2,358,533

Notes on data sources and estimation procedures

[a] Most of the observed rates for total EU were obtained from the Eurostat website. For life expectancy, we interpolated estimates available for 2000 and 2005. Crude death rates were obtained from www.census.gov because the Eurostat website presents "standardised" death rates using a standard population that is much younger than the current population of EU-25.

[b] All absolute numbers were obtained by multiplying rates or years per person by the total population size of EU-25 in 2004 (=458,973 thousands).

[c] Estimated by multiplying the life expectancy with the observed prevalence of "fair/poor" health in the European Community Household Panel (ECHP). These values are given in rows above. This simple procedure might underestimate the crude prevalence of "fair/poor" health in a life table population, because this population has an older age structure than the ECHP sample population. This underestimation is however to some extent compensated for by the fact that the ECHP does not include eastern European countries, where the prevalence of "fair/poor" health is much higher than in the west.

[d] Mortality rates for higher educated were derived from an estimate of the mortality rate ratio comparing those with at least upper secondary education to those with lower levels of education. The low/high ratio was estimated to be 1.36 (see text below). When expressed in relationship to the average national mortality rate, the high/average ratio was estimated to be 0.847 (=1/1.18, with 1.18 being the half of 1.36).

[e] Prevalence rates for higher educated were derived from an estimate of the prevalence rate ratio comparing those with at least upper secondary education to those with lower levels of education. The low/high ratio was estimated to be 1.45 (see text below). When expressed in relationship to the average national mortality rate, the high/average ratio was 0.816 (=1/1.225, with 1.225 being the half of 1.45).

[f] Life expectancy estimates for higher educated were derived from an estimate of the differences in life expectancy between those with at least upper secondary education to those with lower levels of education. This difference was estimated to be 3.96 years. We used the same data as described in note [d]. From these data, we estimated age- and sex-specific rate ratios comparing high to low educated for Europe as a whole. These rate ratios were applied to a life table for the total European population, to obtain estimates of life expectancy by educational level for the total European population.

[g] The total years of life lost were estimated by multiplying the total number of deaths due to inequalities (458 thousands) by an estimate of the average number of years of life lost per death. This average number was estimated by means of a cause-elimination life table, with a distinction between "inequalities-related deaths" and "other deaths". The total number of "inequalities related deaths" in the life table population was 12.1%. The total gain in life expectancy by eliminating these causes was 1.84 years. From these figures, we inferred that the average gain in life years per averted death was 15.2 years. This estimate was adjusted upwards (to 16.06 years) to take into account the younger age structure of the EU population compared to the life table population.

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Appendix B.
Literature review of effects of health on economic outcomes

Part A. A review of key findings

The health of a population is positively associated with macro-economic entities. This is not only intuitively obvious, there is also ample empirical evidence for this statement. We only mention here the work of Robert Fogel [Fogel, 1994] and the review of Suhrcke [Suhrcke et al., 2005]. Fogel analyzed historic trends between 1780 and 1980, and concluded that about 30% of economic growth could be attributed to improved nutrition, hygiene and health of the population. In the review of Suhrcke a distinction is made between the impact of health on:

- (hourly) wages, as a proxy for labour productivity
- labour supply or labour force participation (including number of hours worked)
- savings
- education

The first two are the components of total earnings, and can be used to estimate the direct impact of (socio-economic differences in) health on national income. Ill health also has an impact on savings and education, with longterm macro-economic consequences, or consequences further down the causal chain. These indirect effects are considered beyond the scope of this project. We here summarize and update the findings of Suhrcke et al. with respect to the impact on productivity and labour supply, and add a paragraph on the relationship between (socio-economic inequalities in) health and health expenditures.

A.1. The impact of health on labour productivity

Given that health improvements would increase labour supply and income, it can be derived that reducing socio-economic inequalities in health, by means of improving the health of persons with low socio-economic status, will also have a positive impact on welfare. Albeit that estimates of this welfare effect should take account of differences in productivity between persons with different educational careers.

There is considerable evidence that better health is associated with higher hourly wages, and that work absence has a negative effect on wages. Interesting differences appear among subgroups. The effect of self-assessed health on hourly wages appears to be more pronounced in women than in men, as demonstrated by analyses of the British Household Panel Survey [Gambin, 2004]. The same result was found in the US Health and Retirement Survey [Pelkowski, 2004]. In addition, the impact on hourly wages of longlasting health problems appeared to be larger than temporary health conditions. Also disease-specific analyses have been reported, such as for mental health.

Because of the obvious relationship between education and productivity, analyses of the relationship between health and productivity normally adjust for educational level. It may be that the impact of health on productivity is strongly related to the social position, such as job position and lower and higher educated groups. A number of studies report on the impact of ill-health on productivity in specific jobs [e.g. Meerding et al, 2005; Lerner et al, 2003]. However, the abovementioned studies did not report results stratified by educational level, and it is also claimed elsewhere that very little is known on possible variation in the effect of health on employment prospects among groups with different education [McDonough et al., 2001].

A.2. The impact of health on labour supply

Also considerable evidence exists that ill health negatively affects labour supply, measured by hours worked or by labour force participation. In the same study of Pelkowski [2004], permanent illness appeared to have a larger effect on the number of hours worked than temporary illness, and this effect was larger for men than for women. Furthermore, permanent illness starting early in life had a larger impact on the number of hours worked than permanent illness starting later in life.

Using data from the Irish component of the ECHP, Gannon et al [2003] found that persons with a chronic illness or disability had lower probabilities of labour force participation, also when the condition hampered daily activities only to some extent. To solve the problem of reverse causality (work participation also affects health), Riphahn [1998] analyzed the impact of health *shocks* using German longitudinal data.

Health shocks were defined as a drop of at least five points on the health satisfaction scale (range 0-10). Negative health shocks had a large impact on labour participation, and this impact was greater for females than for males. Females were more likely than males to enter part-time jobs after a health shock. Lechner et al [2004] use the same data, but defined health by disability indicators. Persons who became disabled had a 8-9% higher (absolute?) probability of unemployment (in the short term) than those remaining non-disabled. Lastly, in the Netherlands Van der Mheen et al. [1999] used data from the GLOBE panel data, and demonstrated that the probability of unemployment was larger for those in worse health, either measured by self-assessed general health, chronic conditions, or health complaints.

Many studies have been done on a specific component of labour supply, namely early retirement. Bound et al [1999] used Health and Retirement Survey data (US) for men and women aged 50-62 who were employed at the start. They found that poor contemporaneous health, when controlled for lagged health, is associated with labour force exit and with applying for disability insurance. In addition, poor lagged health, when controlled for contemporaneous health, was not associated with labour force exit. They conclude therefore that it is declines in health that help explain early retirement, together with contemporaneous health. In addition, the data indicate that health shocks occurring earlier in life have a different impact, and rather move persons into different jobs (adaptation), compared to health shocks occurring later in life that move persons out of the labour force.

With ECHP data, Jimenez-Martin et al. [1999] finds for the EU as a whole that health is strongly associated with retirement and presents interesting results for couples. Serious health problems in men have a stronger effect on their labour force participation when their spouse is still employed compared to when their spouse is unemployed. For females this is the reverse: their probability of leaving the labour force upon health problems is higher when their spouses had already left the labour force.

Lastly, Disney et al. [2006] used data on persons beyond age 50 from the British Household Panel Survey. To account for health measurement errors, health was expressed as a health stock measure, that is a function of a set of health measures and

personal characteristics (age, education, etc), as in Bound et al. [1999] (see below). They found that both current health and lagged health affect early retirement. There was little support for asymmetry in this relationship: the positive effect of improving (lagged) health on labour force participation was only slightly weaker than the negative effect of deteriorating health on early retirement. The constructed health measure provided a more powerful model of labour force participation and health than direct indicators of functional limitations and specific health problems.

As mentioned before, very little is known on differences in the impact of health on labour supply between lower and higher educated groups [McDonough et al., 2001]. A possible existence of these differences is suggested by the fact that higher educated employees receive more accommodations for their disabilities than lower educated employees, but it is unknown whether this has an impact on keeping the higher educated in the labour force [Burkhauser et al., 1996]. An analysis of US Panel Study of Income Dynamics data indicates that the effect of ill-health was slightly more negative in lower educated young females than in higher educated young females, whereas the converse was found for older males [McDonough et al., 2001].

A.3. The impact of health on health expenditures

It is obvious that health is strongly related to health care consumption. But there are two sides of the coin. Health care can be regarded as an investment in health, and particularly curative health services are aimed at health improvement. Better access to adequate health care is generally associated with better health and higher levels of health care use, notwithstanding the influence of other determinants of health. The other side of the coin is that many conditions lead to disability and need for health services.

A number of questions can then be raised. Does the association between health and health care use vary among different countries and among different socioeconomic groups, and would this association be similar across all types of health services?

As for the first question, is the association similar across countries, there is ample evidence that there are strong differences in the *level* of health care consumption,

partly related to the level of welfare. Much less is known however on international differences in the association between health and health care, adjusted for differences in national welfare. Indicative is that health expenditure patterns by age (as a proxy for health) differ among countries [Seshamani et al., 2003].

As for the second question, there are a number of studies on socioeconomic disparaties in health care use. In Canada, higher income groups have a higher consumption of specialist services, despite their better health [Veugelers, 2003]. A possible interpretation is that their better health is precisely because they have better access to specialist services. In their analysis of Canadian survey data, Dunlop et al found that persons in lower income groups had more family physician consultations, even controlling for health needs [Dunlop et al, 2000]. In contrast, specialist services were used more frequently in higher income group. As for hospital care, no differences are reported among socioeconomic groups when adjusted for health needs in Canada [Newbold, 1995].

A recent study in the Netherlands, based on health survey data, indicated that use of family physician services is 84% higher among lower income groups, but only 6% higher when adjusted for differences in self-reported health [Kunst et al., 2006]. A similar pattern is observed for other types of health services use when controlled for health, with more frequent hospital admissions, and less use of pharmaceuticals and specialist services among lower income groups. The propensity to use preventive health services is more prevalent among higher socioeconomic groups [Black, 1988;Whitehead, 1988].

Part B. Interpretation of the relationship between health and labour participation

When it comes to the empirical analysis of the relationship between health (improvement) and welfare (growth), there are a number of factors that complicate this analysis and the interpretation of results. This also holds for similar analyses stratified by socio-economic groups. In this paragraph, an overview is given of known pitfalls and problems, and their possible influence on the results of the ECHP data analyses (see A2).

Poor health may limit the ability of people to perform tasks required for the job, and may ultimately lead to unemployment (or enrollment in disability benefit schemes) or early retirement. A complicating matter for the analysis of health and work is that health at time t is determined by the health endownment at birth, health shocks throughout life and past decisions concerning health and human capital. This problem can be unravelled in the following issues.

B.1. Lagged association between health and labour participation

Firstly, there is a lagged association between labour participation and health. Bound et al [1999] (see earlier) found that poor lagged health, when controlled for contemporaneous health, was not associated with labour force exit. They conclude therefore that it is declines in health that help explain early retirement, together with contemporaneous health. For Ireland, both current and past disability are demonstrated to be significant determinants of current labour participation [Gannon, 2005]. In an analysis of the Irish data from the ECHP with a dynamic random effects probit model it appeared that current disability had a lower effect on current labour participation when adjusted for past labour participation, and that past disability was not anymore a significant determinant. The author concludes that past disability has an influence on current labour participation through the channel of past labour participation [Gannon, 2005].

B.2. Endogeneity

Secondly, labour participation is influenced by health and vice versa (reverse causality, or endogeneity). In an analysis of Dutch panel data (CERRA), Kerkhofs et al. [1997] even demonstrated that there is a negative effect (!) of employment and labour market history on health. In contrast, an analysis on British household panel survey data indicated that there are strong effects by unemployment on the incidence of disease, whereas employment was related to recovery from these diseases [Bartley et al., 2004]. The same relationship was found specific for mental health [Murphy et al., 1999].

The strategy to derive independent causal effects of health on work and vice versa, is to search for independent variation in one of the variables. A frequently suggested strategy is the modelling of health shocks. This approach has been made by Riphahn [1998] (see earlier). McLellan [1998] found that health shocks were more prevalent among persons with low SES. He further distinguished among different types of health shocks, and demonstrated that major health events had a large impact on retirement decision, a new chronic illness had a smaller impact, and accidents had no impact.

An alternative to analyzing health shocks is to use advanced econometric models with imposed assumptions about the structure of the model (= structure of the error component?). Cai et al. [2006] addressed endogeneity by estimating the health equation and the labour participation equation simultaneously, and by taking into account the correlation between the error terms in the equation. This approach was taken from Stern [1989], and is called the full information maximum likelihood (FIML) method, a very advanced method not available in standard statistical software. Self-assessed health is the dependent variable in het health equation (and exogenous in the labour participation equation), with more objective measures of health considered exogenous. They conclude that better health is positively associated with labour participation, and that this association is stronger for elderly (50-64) and for females. As for the causality effect, they found a positive impact of labour participation on health among older females, and a negative impact among younger males. For older males the impact was also negative but not significant.

Thirdly, both health and labour participation may be influenced by unobservables, such as genetic predisposition, or characteristics of the childhood (social) environment. This problem is also commonly referred to as 'endogeneity', and can be tackled by applying fixed effect regression models that take into account the effect of unobservables that can be considered stable across the lifetime of individuals.

B.3. The measurement of health

For analyses of the relationship between labour participation and health, or between labour productivity and health, health should ideally be measured in a way that it reflects the inability to perform work tasks. In surveys, health is measured in different ways, with a general distinction between objective and subjective measures. In practice however, this distinction is not always clear-cut. Subjective measures are for instance how persons rate their own health, or how they rate their own health compared to a peer group. Examples of objective measures are ADL (e.g. ability to walk 100 metres), IADL (ability to perform household or caring tasks, etcetera), and the presence of chronic conditions. In general, subjective measures of health generate more "noise" when it comes to health status relevant to work tasks, and will as a result lead to underestimating the effect of health on labour participation via classical measurement error.

More complex, it has been demonstrated that subjective measures of health are biased by the labour market position of the respondent [Kerkhofs et al, 1995]. Psychological and economic incentives may affect an individual's response to disability questions, particularly with respect to self-reports of work disability. This means that people who are inactive are inclined to underreport their health status for strategic reasons or to retrospectively rationalize their behavior. This is called "justification bias" or "state-dependent reporting", and leads to overestimating the effect of health on labour participation via differential measurement error. The existence of this bias is subject to debate, because some studies do not provide support for this [Dwyer and Mitchell, 1999].

There is evidence that the use of more objective measures of health leads to a smaller effect of health on work in older workers (as expected) [Lindeboom, 2006]. Anderson and Burkhauser [1985] used future mortality of survey respondents as an objective indicator of health, and demonstrated that the health effects on work were four times larger when a subjective measure was used. Bound [1991] produced a more elaborate analysis of labour supply (i.e. early retirement), health and wages, and demonstrated that each solution of the health measurement problem creates its own bias although in opposite directions. Subjective health leads to an overestimate of the effect on labour supply. Assuming that health reporting depends on wages, future mortality leads to an underestimate of the effect of health on work, and an overestimate of the effect of financial incentives. In this model, future mortality was made instrumental to subjective health (i.e. seen as a proxy measure). As a result, the effect of health on labour is underestimated because future mortality is an imperfect proxy for current health status relevant for work ability with resulting measurement error.

Kreider [1999] and O'Donnell [1999] use number of chronic conditions as objective indicator, Kerkhofs & Lindeboom [1995] use a medical test score as objective indicator. Baker et al [2004] used objective medical records and demonstrate bias in self reporting of chronic conditions (the classification error was larger in the group out of work than in workers). An alternative solution to this self reporting problem is provided by King et al [2004], who use vignettes with health state descriptions for hypothetical persons. Respondents are requested to rate the health of these hypothetical patients, and these evaluations are subsequently used to "anchor" the subjective health reports of the respondents.

A statistical solution for the health measurement problem is provided by Bound et al [1999] who operationalized health as a latent variable that is dependent on observed health measures and exogenous variables (age, education, etc.).

B.4. Financial incentives

Particularly for early retirement decisions, there is evidence that these are not only determined by health perceptions but also by financial incentives. The incentive is determined by the difference between the current wage and the benefits in case of

retirement. Persons with low wages and with high retirement benefits (or disability benefits) have a higher incentive to retire early. As a result, analyses of the impact of health on early retirement should also account for possible financial incentives.

Bound et al [2005] investigated the contributions of health and financial incentives on early retirement decisions. They used a latent variable model for health (see also [Bound, 1999]), where latent true health depends on a number of health indicators, and whereby it is assumed that these health indicators are exogenous to labour market choices (so justification bias cannot be excluded). They find that for those in good health, the availability of financial resources play a prominent role in the early retirment decision, whereas those in poor health are more likely to retire regardless of their financial resources.

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Appendix C.

New estimates of effects of health on economic outcomes in Europe: analyses of the European Community Household Panel

1. Background

Previous studies have convincingly shown that health of persons has a significant impact on their labour market participation, productivity and gained income. While these insights are important to support the idea that population health and health inequalities are important determinants of macro-economic trends, published were not sufficiently detailed for quantifying the possible macro-economic impact.

The general objective of our analysis of the data of the European Community Household Panel (ECHP) was to provide relevant empirical input for models that estimate the macro-economic impact of socio-economic inequalities in health. More specifically, the analyses aimed to estimate the relationship between health and outcome parameters, including labour market participation, earnings, social benefits, and the utilisation of health care services. These estimates had to be representative for the European Union and its individual member states.

A main challenge was to obtain precise quantitative estimates of the extent to which health affects earnings, labour force participation, productivity and other relevant economic parameters. It is essential to quantify the impact of health on economic outcomes, if possible independently from the reverse effects of earnings on health. These estimates in addition need to take into account lag times between health (occurring first) and earnings or other economic outcomes (formed at a later moment). Finally, in order to evaluate the macro-economic impact of socioeconomic inequalities in health, such quantitative estimates need to be made for lower socioeconomic groups in particular, or at least be tested for differences compared to higher socioeconomic groups.

2. Methods

2.1. General approach

We applied descriptive approaches that would directly produce the quantitative estimates that can be used as input to the models that will be used for estimating the macroeconomic impact of health inequalities (see Appendix D). Our estimates will be evaluated in view of previous studies. Of particular importance are studies that used more sophisticated economic models with the specific aim to separate effects of health on economic outcomes from the reverse effects of economic variables on health. Where necessary, the results from these specific studies will be taken into account when defining the quantitative input for the models used in the next chapter.

The ECHP study was analysed longitudinally. We measured health at a time preceding the measurement of income and economic variables. Different lag times (0, 2 and 4 years) were analysed and compared. We expected that economic outcomes are determined by the health history rather than health at any single moment in time. Therefore, we expected to observe independent effects of health measured at different lag times.

A key outcome parameter in our analysis was personal earnings, measured by personal income gained through work (including wages and salaries, excluding transfer payments and capital returns). This measure was central to the analyses because, in later analyses, it can be aggregated from the individual level towards the societal level in models that evaluate the effect of health inequalities on national incomes. We therefore first analysed the effect of health on personal income, and we supplemented this analyses by studying the effect of health on labour market participation, number of hours worked, and hourly income. These three variables were considered as key components that together help to understand the effects of health on personal income.

In addition to personal income and its constituents, we analysed the relationship of health with income of the partner, the uptake of social benefits (disability and unemployment benefits) and with key components of health care utilization (GP visits, specialist visits, and hospitalization).

2.2. Data

We analysed data of the European Community Household Panel (ECHP) conducted by Eurostat. The ECHP is a survey based on a standardised questionnaire that involves annual interviewing of a representative panel of households and individuals of 16 years and older in each EU member state. National Statistical Institutes or research centres collected the data, while data checks, weightings and imputations are done centrally by Eurostat. All surveys are based on a non-stratified random sampling design. The target population is made up of all national private households. All persons in the panel households are individually interviewed. The data collection was carried out in most countries by paper-and-pencil interviewing, but in four countries (UK, The Netherlands, Portugal and Greece) by computer-assisted personal interviewing.

We used data from the first to fifth wave, held in 1993 to 1997. Countries involved are UK Ireland, Denmark, Germany, Netherlands, Belgium, France, Italy, Spain, Portugal, Greece. Outcome measures (personal income, labour force participation etc) were taken from the fifth wave, while health variables were measured for waves 1, 3 and 5 respectively.

We analyzed personal income in persons aged 16 to 64 years, excluding students, self employed workers, and unpaid family workers, and including those with zero income. Personal earnings was measured as gross monthly income, including salaries and wages, but not taking into account incomes from capital returns and social benefits. For those who were economically active (with a minimum of 8 hours work per week), we analyzed the number of hours worked per week and the hourly income.

Labour force participation and utilization of unemployment benefits and disability benefits was analyzed in men and women in the age group 16 to 64 years, excluding students. We measured the rate of labour force participation, considering as economically inactive those who worked less than 8 hours per week (generally these are housewives, long-term unemployed, work-disabled and early retired). No distinction was made according to reason of economic inactivity, among others because of problems of international comparability. Health care utilization (GP visits, specialist visits, and nights in hospital, all counted in the past 12 months) was analyzed in all persons of 16 years and older.

Health was measured by self assessed general health, with 5 levels: very poor, poor, fair, good, and very good. In addition to this subjective measure of health, we applied two more objective measures in order to check whether the same results would be found across a broader set of health indicators. These two additional health measures asked respondents whether they had any long standing health problem that restricted their daily activities (with answers "no" or "yes") and whether in the past 14 days they had to cut down their daily activities due to health problems (with answers "no" or "yes")

Education was used as the key indicator of socioeconomic position. The advantage of this socioeconomic indicator is that it is established early in life and stable over time. Education level may therefore have potentially large effects on health (and partly through health on economic variables) while reverse effects (of health or income on education) are likely to be minimal.

2.3. Statistical analyses

Analyses are performed for the entire set of countries. Key results were also produced per country, for men and women separately, and according to age (16-44, 45-54 and 55-64 years). In the analysis of health care utilisation, we also distinguish the age group 65+ years.

The relationship between health and the outcome variables was analysed both in absolute and relative terms. Absolute effects were described by calculating age-standardised rates, while relative effects were described by means of regression-analyses. We used loglinear regression models with control for 5-year age group, sex and their interaction. In addition, we controlled for country and for marital status, which both may confound estimates of the effect of health on economic outcomes.

Specific statistical tests were carried out to test for interaction between health and education in their effect on economic variables.

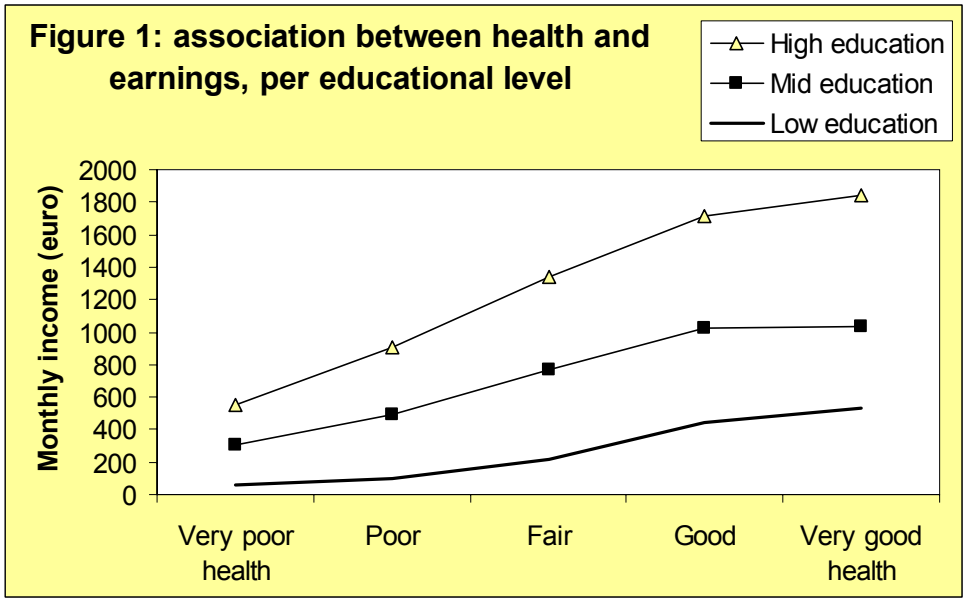
3. Results

Personal earnings

We observed large differences in the level of personal earnings according to the general health of people. Persons with "very good" or "good" health had about 4 times higher earnings than those with "poor" and "very poor" health (unadjusted for confounders). People with "fair" health had intermediate levels of personal earnings (see table 1, first column).

The effects of poor health on personal earnings were stronger for those with low educational level than those with a high educational level (see next columns). A summary measure of relative effect showed a 19% increase in income for each higher level of general health. This effect was much larger among lower educated (28 %) than among middle and higher educated (14 %) (see lower row of table 1).

In absolute terms, health had a greater impact on income among the higher educated, because of the higher overall levels of personal income of higher educated compared to lower educated (figure 1).



The main components of earnings

Health was related to the different components of personal earnings (table 2). The strongest association was observed with labour force participation. In addition, among those who were economically active, poorer health was associated with a few less hours worked per week, and with an about 15 percent lower hourly income.

For each of the three components of personal income, the effect of health was greater among low educated (table 3). The effect of health on labour force participation and number of hours worked was about two times greater among low educated as compared to high educated. The difference is smaller with regards to effect of health on hourly income.

Lag times in the relationship

The effect of health on income could in part be attributed to health in earlier years. Control for health in 1994 and 1996 reduces the effect of health in 1998 on earning in 1998 from 18.5 to 11.1 % (table 4a, first column). Health in each of the three years was independently associated with income in 1998. The effect was largest for health in 1998, thus with no lag. The joint effect of health in the three lag times is estimated to be 25.5%, which is slightly larger than the 18.5% effect estimated in the model with health in 1998 only.

Similar patterns are observed within each educational level (table 4a, next columns). Important is to note that, whatever lag time is chosen, the effect of health on income is greater among the low educated than among the high educated.

Similar lag-time patterns are observed with regards to labour participation (table 4b).

Other health variables

The patterns described above are also observed with the two other health indicators available from the ECHP. This is illustrated in tables 5a and 5b. A favourable score on these health indicators is associated with higher personal income and higher labour force participation. The largest effects are observed with restrictions in daily activities due to long-standing health

problems: not having such restrictions is associated with 50% more income (table 5a). Even greater is the cumulative effect of this health variables measured in three lag periods: 88%.

The effect of these health variables on income and labour force participation is largest among low educated people. In most cases, the effects are two times larger among low educated as compared to high educated (tables 5a and 5b).

Variations by gender, age and country

The effect of health on personal income is about equally large for men and women (table 6a, upper rows). This effect is much larger for persons 55-64 years than for younger age groups, especially as compared to persons younger than 45 years (table 6a, next rows). For low educated, however, poor health has a large impact on income at age 45-54 years as well as at 55-64 years.

Similar patterns were also observed in each individual country, although with some variations between countries in the magnitude of effects (lowest rows). The effect of health on personal earnings (both for the total population and among low educated) was relatively large in the included northern countries (UK, Ireland, Denmark) and in the most southern countries (Spain, Portugal, Greece). In contrast, these effects were smaller than average in France, Germany, Belgium and the Netherlands, and smallest in Italy.

In all countries, the effect of health on income are larger for lower educated people than for the higher educated people.

Very much the same patterns are observed for labor force participation (table 6b). For example, the effects of health on labour force participation are especially large at ages 55 years and over, and for the lower educated at ages 45 years and over. This similarity in patterns suggest that the effects of health on personal income is to a large extent mediated through the effect of health on labour force participation.

Health and partner income

The analyses carried out thus far assessed the association between health and economic outcomes at the individual level. However, ill health may have spillover effects (positive or negative) on the labour participation and earnings of other household members, and herewith household income. We therefore performed additional analyses to assess whether the health status of an individual is related to the income earned by the partner.

The results are presented in table 7. A good health is associated with a higher income earned by the partner. The effects are smaller than the effects on own personal income, e.g. 7% versus 19% in the total population (cf. table 1, lower left cells). The results clearly support the existence of positive instead of negative spillover effects.

Health and the receipt of benefits

The receipt of benefits are analysed separately because of their different macro-economic implications (see Appendix D). We distinguish between disability benefits (table 8a) and unemployment benefits (table 8b).

As expected, poorer health is associated with receipt of more disability benefits. The variations according to health status are extremely large: people with "very poor" health receive on average about 20 times more disability benefits than those with "very good" health. The same associations were observed for both higher and lower educational groups. Among lower educational groups, the effect of health on disability benefits is slightly smaller in relative terms. Similar patterns were observed among both men and women, and in all European countries included in this study.

The association between poorer health and receipt of unemployment benefits was much weaker and less consistent. In general, those with poor health received more unemployment benefits, although this association is very weak among low educated people. When comparing countries, it was found that poorer health was related with more employment benefits in the northern countries, while the opposite association was observed in France and most southern countries.

Health care utilisation

As may be expected, poor health was consistently related to GP visits, specialist visits and hospitalization rates (tables 9a-9c). Virtually identical associations were observed within both higher and lower educational groups. Also when the analysis was stratified by gender, age group or country, we consistently observed that the association between health and health care utilization was about equally strong for higher and lower educational groups.

4. Evaluation

These results can serve as an empirical input to models that estimate the macroeconomic impact of health inequalities (see next chapter). Basically, the data as given in table 1 can be used for the key calculations of macroeconomic impact. Before defining the final empirical input, however, these results will need to be evaluated.

A key question is to what extent the observed association between health and economic outcomes can be assumed to reflect the causal effect of health on these outcomes, instead of the reverse effect. The relative importance of the former effect compared to the latter effect can be assessed on the basis of a review of the previous studies that concentrated on this issue (see previous chapter). Additional considerations are:
- we controlled for confounding by a number of "third factors", including educational level, which takes away some of the reverse "social causation" effect
- most of the association between health and income seem to operate via an effect on labour force participation, which supports the presumed causal effect of poor health on low income (via reduced labour participation) instead of the other way aroud.
By and large, a rough estimate is that between 25 and 50% of the observed differences are due to the social causation effect instead of the effect of health on income.

A related question is whether the observed associations may under- or overestimate the true effect of health on income for other reasons. Underestimation is more likely, because:
- the reliance on only one lag time: taking into the full age structure would show larger effects of health history on current income (cf table 4);

- imperfect and incomplete measurement of health: this is a broad and varied construct whose effects cannot be captured by a single indicator (cf table 5);
- spillover effects of health on the earnings of the partner: according to our analyses, these effect are clearly positive instead of negative (cf. table 7).

Given these considerations, the true effect of health on earnings is likely to be at least 25% percent larger, and probably at least 50% larger, than estimated in table 1.

The two previous points taken together imply that the observed associations in table 1 may represent the best point estimates of the effect of health on income, but that these estimates should be presented together with (possibly wide) uncertainty intervals later on.

Table 1.
Effect of health status on personal income (current wage and salary earnings - gross - monthly) for different educational levels
(all 16-64 years, excl. students, self-employment and unpaid work; 11 countries)

	Total population			Lower educational level			Middle educational level			Upper educational level		
Overall income (a)	744			331			937			1656		
Means by health status (a)												
very poor	116			64			309			556		
poor	183			99			495			902		
fair	407			217			769			1344		
good	734			439			1023			1719		
very good	827			530			1030			1838		
Prevalence rate ratios (95% CI) (b)												
very poor	0.36	*0.32*	*0.40*	0.29	*0.25*	*0.34*	0.41	*0.34*	*0.48*	0.41	*0.33*	*0.52*
poor	0.59	*0.56*	*0.61*	0.50	*0.47*	*0.53*	0.66	*0.61*	*0.71*	0.66	*0.60*	*0.73*
fair	0.85	*0.83*	*0.87*	0.79	*0.76*	*0.81*	0.89	*0.86*	*0.92*	0.89	*0.85*	*0.93*
good	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*
very good	1.08	*1.06*	*1.10*	1.12	*1.08*	*1.16*	1.06	*1.02*	*1.09*	1.09	*1.05*	*1.13*
Summary measure of effect with 95 CI (c)	1.19	*1.17*	*1.20*	1.28	*1.25*	*1.30*	1.14	*1.12*	*1.16*	1.14	*1.12*	*1.17*
Test (p-value) for interaction with education (d)	<0.0001											

(a) weighted by sample size by country
(b) estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as a nominal variable, with 'good' as the reference category.
(c) as note (b), but with health status included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').
(d) interaction between education (as 3-level nominal variable) and health (measured as the interval variable of note (c)).
estimated with a loglinear regression model with control for age*gender, cohabitation status and country, and health.

Table 2.
Effect of health status on personal income and its different components
(all 16-64 years, excl. students; 11 countries)

	Personal income (gross, per month, excl self employed and unpaid)			Labour force participation (% of total population)			Number of hours worked / week (all active, excl. self employed etc)			Hourly income (all active, excl. self employed and unpaid work)		
Overall level (a)	744			57.48			39.91			8.02		
Means by health status (a)												
very poor	116			31.76			37.08			7.13		
poor	183			49.24			38.19			5.73		
fair	407			64.19			39.83			6.93		
good	734			70.09			39.80			7.97		
very good	827			72.13			40.32			7.66		
Prevalence rate ratios (95% CI) (b)												
very poor	0.36	*0.32*	*0.40*	0.83	*0.81*	*0.86*	0.94	*0.90*	*0.97*	0.92	*0.86*	*0.98*
poor	0.59	*0.56*	*0.91*	0.90	*0.92*	*0.96*	0.94	*0.97*	*0.92*	0.89	*0.94*	*0.73*
fair	0.85	*0.83*	*0.97*	0.97	*0.98*	*1.00*	0.99	*1.00*	*0.98*	0.96	*0.99*	*0.93*
good	1.00	*1.00*	*1.01*	1.00	*1.01*	*1.00*	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*
very good	1.08	*1.06*	*1.10*	1.00	*1.00*	*1.00*	1.01	*1.00*	*1.02*	1.04	*1.02*	*1.05*

(a) weighted by sample size by country
(b) estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as a nominal variable, with 'good' as the reference category.

Table 3.
Educational differences in the effect of health status on personal income and its different components
(all 16-64 years, excl. students; 11 countries)

	Personal income (gross, per month, 16-64 years, excl self employed and unpaid)			Labour force participation (% of population 16-64 yrs)			Number of hours worked / week (all active, excl. self employed etc)			Hourly income (all active, excl. self employed and unpaid work)		
Summary measure of effect, with 95% CI (a)												
- Low educated	1.280	(1.250	1.300)	1.046	(1.041	1.051)	1.019	(1.012	1.025)	1.041	(1.031	1.052)
- Mid educated	1.140	(1.120	1.160)	1.030	(1.024	1.037)	1.007	(1.000	1.013)	1.025	(1.014	1.037)
- High educated	1.140	(1.120	1.170)	1.023	(1.014	1.031)	1.009	(1.001	1.018)	1.030	(1.014	1.046)
Test (p-value) of interaction (b)	<0.0001			<.0001			0.0011			<0.0001		

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').
(b) interaction between education (as 3-level nominal variable) and health (measured as the interval variable)
estimated with a loglinear regression model with control for age*gender, cohabitation status and country, and health.

Table 4a.
Effect of health status on personal income for different lag times
(all 16-64 years, excl. students, self-employment and unpaid work; 11 countries)

Personal income in 1998	Summary measure of effect (a)			
	Total population	Lower educational level	Middle educational level	Upper educational level
.. and health in 1998				
- no other health variables	1.185	1.280	1.140	1.140
- control for health in 1996	1.129	1.180	1.100	1.110
- control for health in 1994	1.142	1.210	1.110	1.110
… and 3 health variables simultaneously				
- health in 1998	1.111	1.160	1.090	1.090
- health in 1996	1.079	1.130	1.060	1.050
- health in 1994	1.065	1.090	1.050	1.050
Sum effect of 3 health variables	1.255	1.380	1.200	1.190

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 4b.
Effect of health status on labour force participation for different lag times
(all 16-64 years, excl. students; 11 countries)

Labour participation in 1998	Summary measure of effect (a)			
	Total population	Lower educational level	Middle educational level	Upper educational level
.. and health in 1998				
- no other health variables	1.025	1.046	1.030	1.023
- control for health in 1996	1.015	1.026	1.019	1.016
- control for health in 1994	1.018	1.031	1.014	1.017
… and 3 health variables simultaneously				
- health in 1998	1.013	1.021	1.018	1.015
- health in 1996	1.011	1.018	1.016	1.007
- health in 1994	1.008	1.012	1.011	1.003
Sum effect of 3 health variables	1.031	1.051	1.045	1.025

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 5a.
Effect on personal income of two other health variables
(all 16-64 years, excl. students, self-employment and unpaid work; 11 countries)

	Summary measure of effect (a)			
	Total population	Lower educational level	Middle educational level	Upper educational level
Restriction of daily activities				
- health in 1998	1.50	1.86	1.39	1.37
- sum effect of health in 1998, 1996 and 1994	1.88	2.33	1.70	1.63
Having to cut down daily activities in past 2 weeks				
- health in 1998	1.20	1.34	1.19	1.11
- sum effect of health in 1998, 1996 and 1994	1.49	1.86	1.45	1.29

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as a dichotomous variable with values 0 (for those with the health problem) and 1 (those without).

Table 5b.
Effect on labour force participation of two other health variables
(all 16-64 years, excl. students, self-employment and unpaid work; 11 countries)

	Summary measure of effect (a)			
	Total population	Lower educational level	Middle educational level	Upper educational level
Restriction of daily activities				
- health in 1998	1.096	1.324	1.195	1.094
- sum effect of health in 1998, 1996 and 1994	1.141	1.332	1.247	1.153
Having to cut down daily activities in past 2 weeks				
- health in 1998	1.045	1.272	1.073	1.040
- sum effect of health in 1998, 1996 and 1994	1.100	1.381	1.134	1.086

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as a dichotomous variable with values 0 (for those with the health problem) and 1 (those without).

Table 6a.
Effect of health status on personal income by gender, age and country
(all 16-64 years, excl. students, self-employment and unpaid work; 11 countries)

Sub-group	Summary measure of effect (95 % CI) (a)											
	Total population			Lower educational level			Middle educational level			Upper educational level		
Total population	1.19	(1.17	1.20)	1.28	(1.25	1.30)	1.14	(1.12	1.16)	1.14	(1.12	1.17)
Men only	1.19	(1.18	1.21)	1.30	(1.27	1.32)	1.14	(1.12	1.16)	1.15	(1.12	1.18)
Women only	1.17	(1.15	1.19)	1.24	(1.21	1.28)	1.13	(1.10	1.16)	1.13	(1.10	1.16)
16-44 years	1.12	(1.11	1.14)	1.20	(1.17	1.23)	1.09	(1.07	1.11)	1.09	(1.06	1.11)
45-64 years	1.27	(1.25	1.29)	1.37	(1.34	1.40)	1.23	(1.19	1.26)	1.21	(1.17	1.25)
UK	1.25	(1.21	1.28)	1.31	(1.25	1.36)	1.21	(1.14	1.29)	1.20	(1.14	1.27)
Ireland	1.30	(1.24	1.37)	1.60	(1.48	1.73)	1.20	(1.11	1.29)	1.11	(1.01	1.23)
Den mark	1.23	(1.19	1.27)	1.42	(1.30	1.54)	1.18	(1.12	1.24)	1.21	(1.15	1.27)
Germany	1.16	(1.13	1.19)	1.16	(1.10	1.23)	1.13	(1.09	1.17)	1.20	(1.14	1.26)
Netherlands	1.18	(1.14	1.22)	1.35	(1.24	1.47)	1.18	(1.13	1.23)	1.11	(1.04	1.19)
Belgium	1.18	(1.13	1.23)	1.33	(1.21	1.46)	1.21	(1.12	1.31)	1.07	(1.01	1.14)
France	1.12	(1.09	1.16)	1.23	(1.16	1.30)	1.11	(1.06	1.16)	1.08	(1.02	1.14)
Italy	1.06	(1.03	1.10)	1.11	(1.06	1.16)	1.01	(0.96	1.05)	1.08	(0.98	1.19)
Spain	1.23	(1.19	1.27)	1.31	(1.26	1.37)	1.16	(1.07	1.26)	1.10	(1.03	1.18)
Portugal	1.33	(1.28	1.38)	1.40	(1.35	1.46)	1.11	(1.00	1.23)	1.09	(0.94	1.27)
Greece	1.21	1.16	1.27	1.30	1.22	1.38	1.20	1.09	1.32	1.07	0.97	1.18

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 6b.
Effect of health status on labour force participation by gender, age and country
(all 16-64 years, excl. students, self-employment and unpaid work; 11 countries)

Sub-group	Summary measure of effect (95 % CI) (a)											
	Total population			Lower educational level			Middle educational level			Upper educational level		
Total population	1.03	1.02	1.03	1.05	1.04	1.05	1.03	1.02	1.04	1.02	1.01	1.03
Men only	1.03	1.02	1.04	1.05	1.04	1.06	1.03	1.02	1.04	1.02	1.01	1.03
Women only	1.03	1.03	1.04	1.14	1.12	1.16	1.06	1.04	1.07	1.03	1.02	1.04
16-44 years	1.02	1.02	1.03	1.06	1.05	1.07	1.03	1.02	1.03	1.01	1.01	1.02
45-54 years	1.06	1.05	1.06	1.11	1.10	1.13	1.06	1.04	1.07	1.03	1.02	1.04
55-64 years	1.11	1.10	1.13	1.08	1.07	1.10	1.14	1.09	1.19	1.10	1.05	1.15
UK	1.05	1.04	1.06	1.10	1.08	1.12	1.06	1.03	1.09	1.04	1.02	1.06
Ireland	1.05	1.03	1.08	1.22	1.16	1.29	1.03	1.00	1.07	1.02	0.96	1.09
Denmark	1.06	1.04	1.08	1.12	1.06	1.19	1.05	1.01	1.09	1.05	1.01	1.09
Germany	1.03	1.02	1.04	1.05	1.02	1.08	1.05	1.04	1.07	1.02	1.00	1.05
Netherlands	1.04	1.02	1.06	1.05	1.02	1.09	1.05	1.03	1.08	1.03	0.99	1.08
Belgium	1.03	1.01	1.05	1.14	1.08	1.20	1.05	1.01	1.09	1.01	0.97	1.05
France	1.03	1.02	1.04	1.08	1.05	1.11	1.03	1.01	1.05	1.02	0.98	1.05
Italy	1.01	1.00	1.02	1.05	1.03	1.07	1.00	0.99	1.01	1.02	0.94	1.10
Spain	1.04	1.02	1.05	1.09	1.07	1.12	1.06	1.02	1.11	1.03	0.99	1.07
Portugal	1.04	1.02	1.05	1.06	1.04	1.08	1.03	0.98	1.08	1.02	0.83	1.25
Greece	1.05	1.03	1.07	1.12	1.08	1.15	1.06	1.02	1.10	1.01	0.94	1.10

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 7.
Effect of health status on monthly income of the partner
(all 16-64 years, excl. students, self-employment and unpaid work and persons without a partner; 11 countries)

	Total population			Lower educational level			Middle educational level			Upper educational level		
Overall income (a)	818			411			1038			1425		
Means by health status (a)												
very poor	275			178			526			942		
poor	294			157			729			892		
fair	518			311			834			1141		
good	880			540			1101			1433		
very good	1045			609			1173			1508		
Prevalence rate ratios (95% CI) (b)												
very poor	0.75	*0.65*	*0.87*	0.81	*0.66*	*0.99*	0.66	*0.52*	*0.83*	0.84	*0.57*	*1.25*
poor	0.80	*0.75*	*0.87*	0.68	*0.61*	*0.76*	0.92	*0.82*	*1.02*	0.85	*0.70*	*1.02*
fair	0.92	*0.88*	*0.95*	0.85	*0.80*	*0.91*	0.93	*0.88*	*0.99*	0.96	*0.89*	*1.04*
good	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*
very good	1.02	*0.99*	*1.06*	1.02	*0.95*	*1.09*	1.00	*0.94*	*1.06*	1.05	*0.98*	*1.12*
Summary measure of effect with 95 CI (c)	1.07	*1.05*	*1.09*	1.12	*1.08*	*1.15*	1.05	*1.02*	*1.08*	1.05	*1.01*	*1.09*
Test (p-value) for interaction with education (d)	0.0031											

Notes: see table 1

Table 8a.
Effect of health status on disability benefits by gender, age and country
(all 16-64 years, excl. students; 11 countries)

Sub-group	Summary measure of effect (95 % CI) (a)											
	Total population			Lower educational level			Middle educational level			Upper educational level		
Overall level	289			338			263			193		
Total population	0.36	0.35	0.36	0.39	0.38	0.40	0.32	0.31	0.33	0.30	0.29	0.31
Men only	0.36	0.35	0.37	0.40	0.39	0.41	0.32	0.30	0.33	0.29	0.28	0.31
Women only	0.36	0.36	0.37	0.41	0.40	0.42	0.32	0.31	0.33	0.29	0.28	0.31
16-44 years	0.31	0.31	0.32	0.37	0.36	0.38	0.26	0.25	0.27	n.a.		
45-64 years	0.38	0.37	0.39	0.42	0.41	0.43	0.35	0.33	0.37	0.30	0.28	0.32
Ireland	0.38	0.36	0.40	0.40	0.38	0.43	0.37	0.33	0.41	0.32	0.29	0.34
Den mark	0.36	0.34	0.39	0.38	0.35	0.41	0.29	0.25	0.32	0.13	0.10	0.18
Germany	0.40	0.38	0.43	0.51	0.45	0.57	0.29	0.27	0.32	0.39	0.35	0.44
Netherlands	0.38	0.36	0.40	0.49	0.44	0.55	0.34	0.32	0.37	0.35	0.30	0.40
Belgium	0.36	0.34	0.38	0.47	0.42	0.52	0.32	0.30	0.34	0.28	0.24	0.32
France	0.33	0.31	0.36	0.40	0.36	0.46	0.30	0.26	0.34	0.22	0.20	0.25
Italy	0.36	0.34	0.37	0.42	0.39	0.45	0.30	0.28	0.32	0.28	0.25	0.31
Spain	0.26	0.25	0.27	0.26	0.25	0.28	0.23	0.20	0.25	1.68	1.34	2.10
Portugal	0.34	0.33	0.36	0.38	0.36	0.40	0.26	0.23	0.29	0.18	0.16	0.21
Greece	0.38	0.35	0.40	0.35	0.33	0.38	0.69	0.54	0.87	n.a.		

n.a. not available due to small number of cases
(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 8b.
Effect of health status on unemployment benefits by gender, age and country
(all 16-64 years, excl. students; 11 countries)

Sub-group	Summary measure of effect (95 % CI) (a)											
	Total population			Lower educational level			Middle educational level			Upper educational level		
Overall level	259			223			317			261		
Total population	0.87	0.85	0.88	0.90	0.88	0.93	0.86	0.83	0.90	0.76	0.72	0.80
Men only	0.85	0.82	0.87	0.88	0.85	0.92	0.88	0.83	0.93	0.69	0.64	0.74
Women only	0.87	0.84	0.89	0.91	0.87	0.94	0.85	0.81	0.89	0.86	0.80	0.93
16-44 years	0.83	0.80	0.85	0.83	0.80	0.87	0.83	0.80	0.87	0.78	0.72	0.84
45-64 years	0.88	0.86	0.91	0.94	0.90	0.97	0.90	0.85	0.95	0.74	0.69	0.80
UK	0.78	0.72	0.83	0.73	0.66	0.80	0.93	0.78	1.10	0.84	0.73	0.96
Ireland	0.77	0.72	0.83	0.78	0.71	0.85	0.80	0.69	0.92	0.40	0.31	0.51
Den mark	0.77	0.71	0.83	0.78	0.68	0.89	0.81	0.70	0.93	0.69	0.59	0.80
Germany	0.83	0.79	0.88	0.89	0.81	0.99	0.80	0.75	0.86	0.82	0.72	0.94
Netherlands	0.85	0.78	0.93	1.21	1.01	1.46	0.82	0.73	0.92	0.57	0.48	0.68
Belgium	0.82	0.75	0.89	0.79	0.69	0.90	0.85	0.73	0.99	0.90	0.74	1.08
France	1.19	1.10	1.28	1.11	0.99	1.25	1.23	1.08	1.39	0.80	0.67	0.95
Italy	1.19	1.10	1.28	1.31	1.19	1.44	0.85	0.74	0.97	0.95	0.72	1.24
Spain	1.08	1.01	1.15	1.14	1.05	1.22	0.92	0.77	1.10	0.86	0.71	1.06
Portugal	0.87	0.80	0.95	0.92	0.84	1.01	0.63	0.46	0.87	0.00	0.00	0.00
Greece	1.12	1.03	1.23	1.30	1.16	1.46	1.70	1.29	2.25	0.34	0.29	0.39

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 9a.
Effect of health status on GP visits by gender, age and country
(all 16-64 years, excl. students; 11 countries)

Sub-group	Summary measure of effect (95 % CI) (a)											
	Total population			Lower educational level			Middle educational level			Upper educational level		
Overall level	3.6			4.3			2.9			2.5		
Men only	0.56	0.55	0.57	0.57	0.56	0.58	0.55	0.53	0.56	0.56	0.54	0.58
Women only	0.61	0.60	0.62	0.61	0.60	0.62	0.61	0.59	0.62	0.61	0.59	0.62
16-44 years	0.57	0.56	0.57	0.55	0.54	0.56	0.59	0.57	0.60	0.58	0.56	0.60
45-64 years	0.55	0.54	0.56	0.55	0.54	0.56	0.53	0.52	0.55	0.58	0.56	0.60
UK	0.66	0.64	0.67	0.66	0.65	0.68	0.64	0.61	0.68	0.64	0.62	0.67
Ireland	0.54	0.52	0.55	0.54	0.52	0.57	0.52	0.49	0.55	0.56	0.50	0.62
Den mark	0.62	0.60	0.65	0.65	0.61	0.70	0.61	0.58	0.65	0.59	0.56	0.64
Germany	no data											
Netherlands	0.55	0.53	0.56	0.52	0.49	0.55	0.56	0.54	0.59	0.57	0.52	0.61
Belgium	0.59	0.57	0.61	0.60	0.57	0.63	0.60	0.57	0.64	0.55	0.52	0.59
France	no data											
Italy	0.58	0.56	0.59	0.57	0.56	0.59	0.59	0.56	0.61	0.61	0.55	0.68
Spain	0.60	0.59	0.61	0.61	0.59	0.63	0.56	0.52	0.60	0.51	0.47	0.55
Portugal	0.56	0.54	0.57	0.56	0.54	0.57	0.51	0.45	0.57	0.51	0.41	0.63
Greece	0.65	0.63	0.66	0.66	0.64	0.68	0.60	0.56	0.64	0.57	0.52	0.62

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 9b.
Effect of health status on specialist visits by gender, age and country
(all 16-64 years, excl. students; 11 countries)

Sub-group	Summary measure of effect (95 % CI) (a)											
	Total population			Lower educational level			Middle educational level			Upper educational level		
Overall level	1.43			1.49			1.33			1.38		
Men only	0.51	0.50	0.51	0.50	0.49	0.51	0.48	0.46	0.50	0.58	0.56	0.61
Women only	0.56	0.55	0.57	0.57	0.56	0.58	0.52	0.50	0.54	0.59	0.56	0.61
16-44 years	0.55	0.54	0.56	0.55	0.54	0.57	0.52	0.50	0.54	0.58	0.55	0.61
45-64 years	0.51	0.50	0.52	0.58	0.55	0.61	0.47	0.45	0.49	0.51	0.50	0.52
UK	1.09	1.08	1.10	1.09	1.08	1.10	1.09	1.07	1.12	1.08	1.06	1.10
Ireland	0.45	0.42	0.47	0.46	0.43	0.49	0.43	0.39	0.47	0.39	0.34	0.46
Den mark	0.59	0.56	0.62	0.61	0.54	0.68	0.61	0.55	0.67	0.53	0.49	0.59
Germany	no data											
Netherlands	0.43	0.41	0.45	0.45	0.41	0.49	0.42	0.40	0.44	0.44	0.39	0.49
Belgium	0.52	0.50	0.55	0.52	0.48	0.56	0.52	0.47	0.56	0.53	0.49	0.58
France	no data											
Italy	0.47	0.46	0.49	0.46	0.44	0.48	0.50	0.47	0.52	0.49	0.43	0.56
Spain	0.53	0.51	0.54	0.53	0.51	0.54	0.50	0.46	0.55	0.57	0.52	0.62
Portugal	0.50	0.48	0.52	0.50	0.48	0.52	0.51	0.44	0.60	0.45	0.36	0.57
Greece	0.48	0.47	0.50	0.49	0.48	0.51	0.47	0.44	0.49	0.45	0.41	0.50

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 9c.
Effect of health status on hospitatlisation by gender, age and country
(all 16-64 years, excl. students; 11 countries)

Sub-group	Summary measure of effect (95 % CI) (a)											
	Total population			Lower educational level			Middle educational level			Upper educational level		
Overall level	1.23			1.44			1.08			0.92		
Men only	0.38	0.37	0.39	0.38	0.37	0.39	0.39	0.38	0.41	0.36	0.34	0.38
Women only	0.39	0.38	0.40	0.39	0.38	0.40	0.40	0.38	0.41	0.39	0.37	0.41
16-44 years	0.36	0.35	0.37	0.35	0.34	0.37	0.37	0.36	0.39	0.38	0.36	0.40
45-64 years	0.35	0.34	0.36	0.35	0.34	0.36	0.37	0.35	0.39	0.32	0.30	0.34
UK	0.36	0.34	0.37	0.36	0.34	0.38	0.35	0.31	0.39	0.36	0.33	0.39
Ireland	0.34	0.32	0.36	0.39	0.36	0.42	0.33	0.29	0.36	0.18	0.15	0.22
Den mark	0.52	0.48	0.55	0.46	0.41	0.53	0.67	0.59	0.75	0.55	0.49	0.61
Germany	0.41	0.39	0.43	0.42	0.39	0.46	0.42	0.40	0.45	0.35	0.32	0.39
Netherlands	0.39	0.36	0.41	0.41	0.36	0.46	0.42	0.39	0.46	0.24	0.20	0.28
Belgium	0.36	0.33	0.38	0.48	0.43	0.53	0.24	0.21	0.00	0.41	0.36	0.47
France	0.39	0.37	0.41	0.39	0.36	0.41	0.42	0.39	0.45	0.35	0.31	0.38
Italy	0.36	0.34	0.37	0.34	0.32	0.36	0.38	0.35	0.41	1.17	0.89	1.54
Spain	0.40	0.38	0.42	0.41	0.39	0.43	0.33	0.29	0.36	0.38	0.33	0.43
Portugal	0.28	0.27	0.30	0.27	0.25	0.29	0.59	0.43	0.82	0.33	0.21	0.51
Greece	0.36	0.34	0.37	0.38	0.36	0.40	0.34	0.32	0.37	0.31	0.28	0.35

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Table 8b.
Effect of health status on unemployment benefits by gender, age and country
(all 16-64 years, excl. students; 11 countries)

Sub-group	Summary measure of effect (95 % CI) (a)											
	Total population			Lower educational level			Middle educational level			Upper educational level		
Overall level	259			223			317			261		
Total population	0.87	0.85	0.88	0.90	0.88	0.93	0.86	0.83	0.90	0.76	0.72	0.80
Men only	0.85	0.82	0.87	0.88	0.85	0.92	0.88	0.83	0.93	0.69	0.64	0.74
Women only	0.87	0.84	0.89	0.91	0.87	0.94	0.85	0.81	0.89	0.86	0.80	0.93
16-44 years	0.83	0.80	0.85	0.83	0.80	0.87	0.83	0.80	0.87	0.78	0.72	0.84
45-64 years	0.88	0.86	0.91	0.94	0.90	0.97	0.90	0.85	0.95	0.74	0.69	0.80
UK	0.78	0.72	0.83	0.73	0.66	0.80	0.93	0.78	1.10	0.84	0.73	0.96
Ireland	0.77	0.72	0.83	0.78	0.71	0.85	0.80	0.69	0.92	0.40	0.31	0.51
Den mark	0.77	0.71	0.83	0.78	0.68	0.89	0.81	0.70	0.93	0.69	0.59	0.80
Germany	0.83	0.79	0.88	0.89	0.81	0.99	0.80	0.75	0.86	0.82	0.72	0.94
Netherlands	0.85	0.78	0.93	1.21	1.01	1.46	0.82	0.73	0.92	0.57	0.48	0.68
Belgium	0.82	0.75	0.89	0.79	0.69	0.90	0.85	0.73	0.99	0.90	0.74	1.08
France	1.19	1.10	1.28	1.11	0.99	1.25	1.23	1.08	1.39	0.80	0.67	0.95
Italy	1.19	1.10	1.28	1.31	1.19	1.44	0.85	0.74	0.97	0.95	0.72	1.24
Spain	1.08	1.01	1.15	1.14	1.05	1.22	0.92	0.77	1.10	0.86	0.71	1.06
Portugal	0.87	0.80	0.95	0.92	0.84	1.01	0.63	0.46	0.87	0.00	0.00	0.00
Greece	1.12	1.03	1.23	1.30	1.16	1.46	1.70	1.29	2.25	0.34	0.29	0.39

(a) Estimated with a loglinear regression model with control for age*gender, cohabitational status and country.
Health status is included as an interval variable with 1 (for 'very bad') and 5 (for 'very good').

Appendix D.
Estimates of the economic impact of health inequalities in the EU-25 in 2004

1. Introduction

While some studies aimed to estimate the macro-economic impact of national levels of health, no study has aimed to estimate the impact of health variations according to socio-economic group. We estimated to what extent a hypothetical elimination of socioeconomic inequalities in health would improve national levels of earnings and its constituent components (labour market participation, hours worked, hourly income), social benefits, and the utilisation of health care services. This estimate can be interpreted as a measure of the macro-economic impact of socioeconomic inequalities in health in Europe. This appendix presents the methods that we have developed.

2. Methods

Validity checks

The empirical input for these models was obtained from the results of the statistical analyses of the ECHP data (see part A2). The validity and representativeness of the ECHP data were checked with aid of international statistics and data from national health interview surveys.

The percentage of the population aged 25 to 64 having completed at least upper secondary education was 58.2% in the 11 ECHP-countries in 1998, compared to 59.1% in 1999 in the joint UIS/OECD/Eurostat questionnaires on education statistics. For the EU-25 this was 62.9%. The employment rate was 57.5% in the ECHP-sample in 1998 (age 16-64, excluding students, economically active are those working at least 8 hours per week), compared to 61.0% (age 15-64, no lower limit on number of work hours per week) in the EU Labour Force Survey (weighed average for the 11 countries in the ECHP). For the EU-25 this was 61.2% in 1998. Gross monthly

personal income was underreported in the ECHP compared to available statistics from the Earnings Survey 2002. The weighed average gross monthly income for fulltime employees was €1637 in the ECHP (year 1998) compared to €2451 (year 2002) in the Earnings Survey for the 15 EU member states in 2002. The level of underreporting differred per country, and was slightly higher for higher educated persons.

Use of unemployment and disability benefits is overreported in the ECHP. When average monthly benefits of €259 (unemployment) and €289 (disability) are multiplied with population numbers, the total amount is much higher than in the official statistics.

As for health care consumption, the number of physician visits (average 5.0 visits) is lower in the ECHP compared to the OECD Health Data (average 6.5 visits in the 11 ECHP countries; data from insurance databases and Health Interview Surveys). This is likely due to recall bias (visits in the past 12 months). The mean number of hospital nights corresponds well with the OECD Health Data.

Given the discrepancies between ECHP data and official statistics, we used the ECHP data only to estimate the impact of health on economic measures in relative terms (e.g. 3%). In a next step, these relative impact estimates are multiplied with absolute values of the economic measures as given in official statistics, in order to yield estimates of the absolute macroeconomic impact of health inequalities that are consistent with official statistics.

Modelling

Models were set up using Excel. The input consists of estimates of personal gross monthly income (current wage and salary earnings, excluding employers' social contributions), labour participation, and other outcome variables, in relation to health and educational level (see Table 1). The distribution of economic variables according to educational level was estimated using ECHP data.

The distribution of each outcome measure (e.g. personal income) by level of general health *within* each educational group was calculated such that it was in agreement

with the association between health and economic measure, while at the same time keeping the absolute mean of each economic measure by educational level constant. Within each educational level, the distribution of economic measures according to health was estimated using the outcome of the regression analyses presented in Appendix C. To adjust for confounders, we took the regression coefficients from a loglinear regressions model that included control for confounders.

We also took into account the effect of past health (in addition to current health) on current personal income and other outcome measures, respectively. This was done by multiplying the regression coefficients for current health by an adjustment factor. This factor was calculated as the ratio of the coefficient of the summary measure of effect of the 3 health variables (1994, 1996 and 1998) over the coefficient of the summary measure of effect of the 1998 health variable only.

The resulting distributions of each outcome measure by level of health represent only the impact of past and current health on each outcome measure, adjusted for confounders, and separately for each educational group. This baseline distribution was used to model the macroeconomic impact of health inequalities using different scenarios. The basic scenario reflects the observed association between educational level and health outcomes according to the ECHP analysis. This is the "inequality" scenario reflecting current health inequalities. Departing from this basic scenario, we modelled the hypothetical situation under two "equality" scenarios. These alternative scenarios assume:

1. complete equality by "levelling up": all educational groups have the same health distribution as those with the highest educational level;
2. complete equality by "redistribution": all educational groups have the same health distribution as the population at large.

As the first scenario is commonly aimed for in policies to reduce socioeconomic inequalities in health, it was given greater weight in the presentation and interpretation of the results. This first scenario is computationally identical to the Population Attributable Risk approach discussed in the main text.

3. Earnings and GDP

Proportional effects on earnings

Under the basic scenario, the average gross monthly income from wage and salary earnings was estimated to be 726 euro (Table 2). This average was calculated for the total ECHP population in the age group 16-64 years, including all economically active and inactive people, except for students, the self employed and unpaid family workers.

Under the "levelling up" equality scenario, this average increases with 2.77 percent, to 746 euro per person. This increase is brought about as follows. Of all people with low educational level, 20 percent would move from "(very) poor" or "fair" health to "good" or "very good" health if health inequalities were to be eliminated. This improvement in health would be associated with a substantial increase in earnings: from 331 euro under the basic scenario to 368 euro under the "levelling up" scenario. By definition, the middle and high educated would show no health improvement in the "levelling up" scenario.

Under the "redistribution" scenario, the average monthly income would not increase but it would reduce by 1.5 percent, to 714 euro. This small reduction is due to the fact that a hypothetical redistribution of health would imply a shift from "good" to "poor" health among high educated people. The corresponding loss in earnings of high educated people would be slightly greater (in absolute terms) than the increase in earnings among low educated people. This preliminary result underlines the importance of reducing health inequalities by "levelling up" instead of health "redistribution".

In addition, table 2 demonstrates the more equal income distribution across educational groups under the "levelling up" scenario compared to the original scenario. The income ratio comparing high to low educated reduces from 5.00 to about 4.50 under both equality scenarios, i.e. a reduction of 10 percent.

Evaluation

In these models, the increase in earnings was estimated on the basis of the observed association between health and earnings. We thereby assumed that this observed association entirely reflected a causal effect of health on earnings. In reality, part of this association, say 25-50%, may be due to other effects, such as the reverse effect of earnings on health.

In contrast, there are several arguments that the observed effects of health on average personal income will be an underestimate of the true effect. Measurement error in the measurement of health leads to an underestimate of the association between health and income in the ECHP-analyses. Also, there are spillover effects of health on the earnings of the partner: according to our analyses, the effect of health on partner's income is positive although smaller than in the case of personal income (Appendix C).

Taking these considerations together, we assume that the observed association of health with personal income and its underlying constituents represents the best estimate of the true effect of health on income, although with considerable margins of uncertainty.

Translation to GDP

The impact of both scenarios for reducing socio-economic inequalities in health on personal gross earnings from the ECHP data analysis can be directly translated towards GDP. In the National Accounts, GDP can be calculated by three different approaches: production, consumption, and earnings. In the GDP Income approach, GDP consists of three components (see Table 3):

1. compensation of employees (gross earnings + employers' social contributions)
2. gross operating surplus and mixed income (among which firm profits and earnings from self-employed persons)
3. taxes less subsidies on production and imports

ad. 1. When only the impact of the "levelling up" scenario on gross earnings of employees is counted, the impact on total GDP will be 39% (share of total wages and

salaries in GDP) times 2.77% (the relative impact of health inequalities on earning), which amounts to 1.1% of the GDP. A more conservative estimate, assuming a 25% smaller effect, is 0.8%.

ad 2. Part of the added value of employees is included in firm profits which is included in the second GDP component. This component also includes mixed income of self-employed persons, and depreciation of capital goods. The income distribution among self-employed persons is more skewed compared to the income distribution among employees, and health improvements may therefore have a smaller impact on personal income of self-employed. We assume that the impact of the "levelling up" scenario on the gross earnings of self-employed persons will be 50% of the impact on employees' gross earnings. We also assume that 50% of firm profits can be ascribed to the employees.

We do not have detailed statistics on the share of depreciation of capital goods in the "gross operating surplus and mixed income" component for Europe at large. We assume this share at 50%.

The "levelling up" scenario will then result in a 0.7% (2.77 times 50% effect, times 50% of the share of firm profits and earnings of self-employed persons within the second GDP component) effect on the second component of GDP. The share of this income component in total GDP is 38%, and effect of health inequalities on total GDP through the second component will therefore be about 0.3%.

ad 3. We assume no effects of the "levelling up" scenario on employers'social contributions (which are the result of wage bargainings), and on taxes less subsidies on production and imports.

As a result, the impact of health inequalities according to the "levelling up" scenario on earnings amounts to 1.1% of GDP through the first component, and 0.3% through the second component, which add up to 1.4% of the GDP. The total value of the GDP of the EU-25 in 2004 is 10,451 billion euro. The impact of health inequalities of 1.4% thus amounts to 141 billion euro.

4. Social security benefits

Under the basic scenario, the average amount of unemployment benefits and disability benefits was estimated to be 259 euro and 289 euro, respectively. This average was calculated for the total ECHP population in the age group 16-64 years, except for students. Under the "levelling up" equality scenario, the level of unemployment benefits would decrease with 2.7 percent. The decrease in the average disability benefits is much larger, namely 24.7%.

The total amount of disability and unemployment benefits in the EU-25 was 222 and 178 billion euro in 2004, respectively (source: Eurostat). The impact of health inequalities on social benefits for all EU-25 countries taken together, then amount to about 5 billion euro (unemployment benefits) and 55 billion euro (disability benefits).

Our estimate of the impact of health on the use of benefits, particularly disability benefits, may be overestimated due to "justification bias". This is the phenomenon that in self-response surveys, respondents with disability benefits are inclined to underreport their general health.

5. Health care utilization

A "levelling up" scenario would decrease the number of GP visits and the number of specialist visits with 16.4%, in all persons aged 16 years and older. The decrease in hospitalization days is even larger, namely 22.1%.

The absolute impact on health expenditures was estimated as follows (Table 5). Based on the OECD Health Data, we estimated the costs for health expenditures in total GDP at 8.5% in 2003 (data available for 18 of 25 EU member states). Similarly, we estimated the share of hospital services and physician services in total health expenditures at 30.1% and 17.7%, respectively (data available for 8 of 25 EU member states). Assuming that these percentages also apply to the EU-25 in 2004, and assuming that the decrease in health care utilization is similar for children below 16

years, the impact of health inequalities on health expenditure are estimated at 26 billion euro (16.4% x 157 billion) for physician services, and 59 billion euro (22.1% times 267 billion) for hospital services.

Physician services and hospital services are only about half of total health expenditures. Analyses of utilization of other health services (e.g. physical therapy, home care, mental health services) in the Netherlands demonstrated that an identical or even stronger association exists with general health, compared to utilization of physician and hospital services. If the empirical results for physician visits and hospitalizations were extrapolated to total health care, the total impact according to the "levelling up" scenario would be 177 billion euro.

Table 1 Effect of health status on personal gross monthly income in 1998 (all 16-64 years, excl. students, self-employment and unpaid work; 11 countries)

education	self reported health					Mean
	very poor	poor	fair	good	very good	
	Personal income					
low	64	99	217	439	530	331
mid	309	495	769	1023	1030	937
high	556	902	1344	1719	1838	1656
mean	116	183	407	734	827	744
	Personal income, only accounting for the effect of education and health*					
low	63	138	269	382	449	331
mid	272	541	832	979	1059	937
high	484	935	1420	1675	1883	1656
mean	183	372	636	803	895	744

* Distribution of personal income across levels of self-reported health is similar to the prevalence rate ratios from the loglinear regression model with control for age x gender, cohabitational status and country. The mean personal income per educational group was kept equal to the original mean.

Table 2 Main results: Distribution of personal gross monthly income in 1998 (16-64 years, excluding students, self-employed and unpaid family members) under different scenarios

Education	Observed inequalities	"Levelling up" scenario	Redistribution scenario
Low	331	368	348
Mid	937	937	910
High	1656	1656	1580
Mean	726	746	715
High/low	5.00	4.49	4.54
% increase	ref.	+2.77%	-1.49%

Table 3 Total GDP and components of GDP by income approach, year 1998 (billion euro): ECHP countries, EU-15, EU-25

	Gross domestic product at market prices	Compensation of employees	Wages and salaries	Employers' social contributions	Gross operating surplus and gross mixed income*	Taxes on production and imports less subsidies
	A+B+C	A=A1+A2	A1	A2	B	C
eu25	8074	4009	3167	843	3084	981
eu15	7751	3868	3051	817	2939	943
be	228	115	85	30	85	27
dk	155	83	77	6	49	23
de	1952	1027	825	201	732	194
gr	109	36	28	8	60	13
es	537	266	208	58	221	50
fr	1316	673	490	184	456	187
ie	78	33	31	2	37	8
it	1087	431	310	121	505	151
nl	360	183	147	36	139	38
pt	106	48	34	14	39	13
uk	1273	689	601	88	418	165
12 ECHP	7201	3584	2836	748	2740	871
countries	100.0%	49.8%	39.4%	10.4%	38.1%	12.1%

Source: Eurostat

* Includes value reduction of capital goods, firm profits and earnings of self-employed persons. Because detailed statistics are lacking, it is assumed that the share of firm profits and earnings of self-employed persons together is 50% (possibly a conservative estimate since in the Netherlands this share is 63%).

Note: For Portugal there is a statistical discrepancy of more than 5 billion.

Table 4 Health expenditures in EU-25 member states, 2003 (euro)

	Total health expenditures per capita		Total expenditures on hospital care per capita *		Total expenditures on physician services per capita **	
	total	% of GDP	total	% of health expenditures	total	% of health expenditures
Austria	--	--	--	--	--	--
Belgium	2678	10.1%	--	--	--	--
Cyprus	--	--	--	--	--	--
Czech Republic	593	7.5%	--	--	--	--
Denmark	3141	8.9%	994	31.6%	586	18.7%
Estonia	--	--	--	--	--	--
Finland	2048	7.3%	613	30.0%	556	27.1%
France	2756	10.4%	1081	39.2%	331	12.0%
Germany	2831	10.8%	870	30.7%	330	11.6%
Greece	1462	10.4%	--	--	--	--
Hungary	604	8.2%	--	--	--	--
Ireland	2503	7.2%	--	--	--	--
Italy	1953	8.4%	--	--	--	--
Latvia	--	--	--	--	--	--
Lithuania	--	--	--	--	--	--
Luxembourg	4418	7.8%	1216	27.5%	842	19.1%
Malta	--	--	--	--	--	--
Netherlands	2686	9.1%	--	--	--	--
Poland	315	6.3%	91	29.0%	52	16.6%
Portugal	1221	9.3%	313	25.7%	0	
Slovak Republic	320	5.9%	--	--	--	--
Slovenia	--	--	--	--	--	--
Spain	1462	7.8%	361	24.7%	383	26.2%
Sweden	2808	9.3%	--	--	--	--
United Kingdom	2120	7.9%	--	--	--	--
EU-25 average		**8.5%**		**30.1%**		**17.7%**

* Hospital care includes curative and rehabilitative inpatient and day care; clinical laboratory expenditures, and expenditures on diagnostic imaging

** Includes primary care and specialist consultations

Source: OECD Health Data

Appendix E.
Effects of policies to reduce health inequalities: the example of smoking inequalities and tobacco control

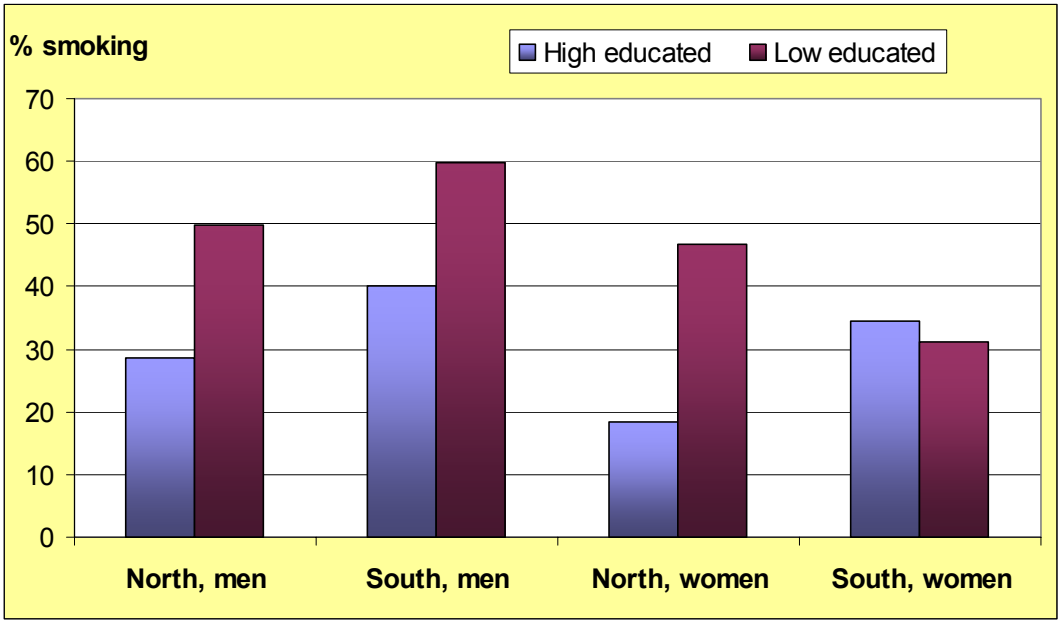
Tobacco smoking and smoking related diseases are not only important causes of premature death, but also have a large impact on socio-economic inequalities in health in European countries. Socio-economic inequalities in smoking have been extensively documented for Western European countries(1-4). The prevalence of smoking is considerably higher among men and women who have lower education, lower income and lower occupational class. In addition, specific disadvantaged groups, such as lone mothers and the unemployed, smoke more often and in greater quantities (5-7).

The objective of this appendix is to provide an overview of socioeconomic inequalities in smoking prevalence within the European Union, and of the actions that can be taken to reduce such inequalities. Using this information, we prepare tentative estimates of the extent to which socioeconomic inequalities in health could be reduced by actions on specific determinants. This information is used in the main text of this report to estimate the extent to which the economic impact of health inequalities could be reduced through tobacco control policies and through interventions that aim to reach lower socioeconomic groups in particular.

1. Overview of socioeconomic inequalities in smoking prevalence in Europe

Among men, the habit of smoking and the amount of cigarettes smoked is concentrated among lower socio-economic groups (2-4). In northern European countries, including Ireland, the United Kingdom, the Netherlands and the Scandinavian countries, about 50% of all low educated men 25-39 years smoke regularly, compared to about 30% of high educated men. Inequalities are about as large in more southern populations: 60 % compared to 40 % (see Figure 1). In addition, regular smokers with low education smoke on average about 3 more cigarettes per day compared to smokers with high education.

Figure 1. Educational differences in smoking prevalence among men and women in northern and southern European countries. Source: unpublished analyses of the European Community Household Panel, 1998.



Among women, large inequalities were observed in northern countries (2-4). For example, more than 45% of all low educated women 25-39 years smoke, compared to less than 20% of all women with high education. In contrast, no inequalities in smoking were observed in the southern fringe of the European Union, including southern Italy (12), Greece and Portugal. In-between the north and the very south of the EU is a zone of countries such as Belgium, Germany, Austria and northern Italy, where inequalities in smoking among women existed but were small around the year 2000. The north-south pattern is summarised in the right part of Figure 1.

According to the fourth-stage model of the smoking epidemic, smoking was more common in upper social groups during the first stages, when the epidemic was on its rise (13, 14). In later stages prevalence rates started to decline, first among upper social groups, but not yet among the lower groups. As a consequence, during the third stage of smoking epidemic smoking became a behaviour that was more common in lower groups. Smoking inequalities further widened and persisted during the fourth

stage of the smoking epidemic. These trends first occurred among men, whereas women followed with a delay of one or two decades.

Trends in smoking inequalities until the year 2000 within the European Union largely agree with the predictions based on the smoking epidemic model. Between about 1985 and 2000, educational differences in smoking prevalence among men persisted at similar levels in most countries (2). In a few countries, however, these inequalities tended to widen over time. For example, in Italy, smoking declined among men with higher educational levels, while they remained at the same high levels among low educated men. Among women, smoking inequalities considerably increased in most European countries. In southern countries such as Spain and Italy, inequalities in smoking emerged and widened due to much more favourable trends in smoking among high educated women (usually a decrease) than among low educated women (usually an increase). Recent evidence from eastern European countries also suggests that inequalities in smoking changed over time in line with the smoking epidemic model (Schaap, 2007, personal communication). This agreement with the smoking epidemic model implies that the observed trends in smoking inequalities in EU member states are following a long-term trend that is common to all countries. Despite variations between countries in timing of these trends, inequalities in smoking appear to constitute a problem whose roots are common to all European countries.

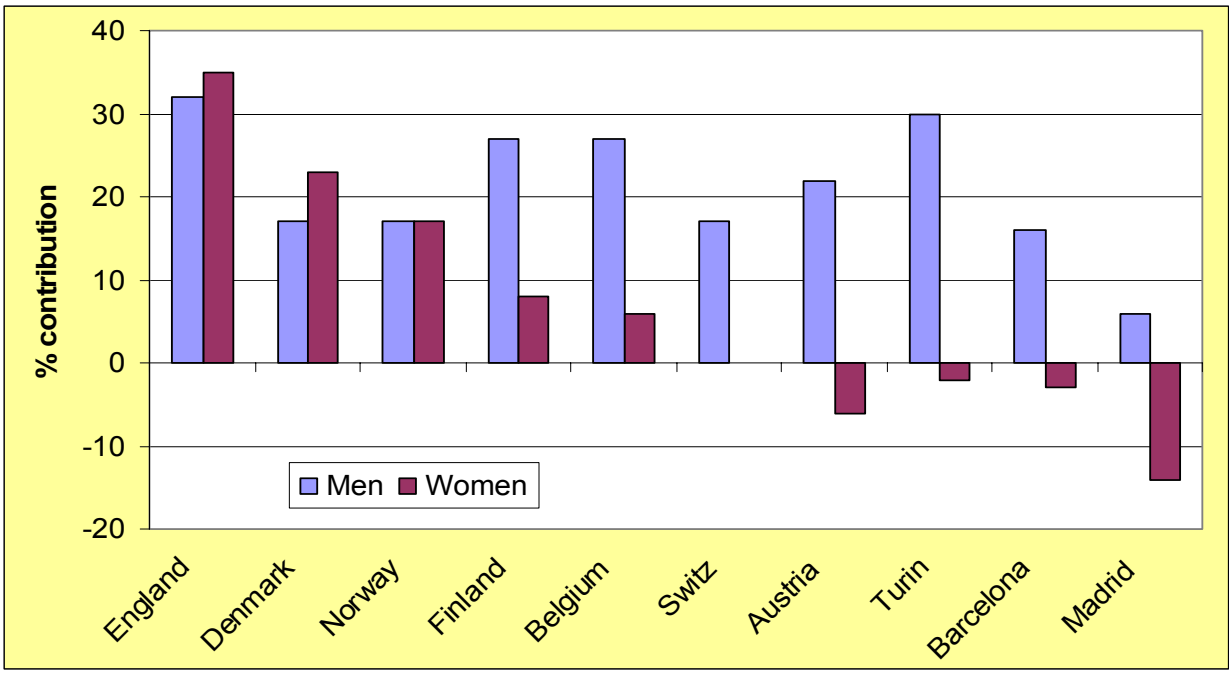
To conclude, smoking inequalities are substantial in many parts of the EU, while they are likely to become so in the near future in most other parts. The magnitude of smoking inequalities varies between countries. A general estimate is that rates of smoking prevalence are about 50% higher in lower socioeconomic groups as compared to upper groups.

2. The contribution of smoking to health inequalities

In many western countries, smoking is identified as the largest single contributor to socio-economic inequalities in premature mortality, especially among men (15). An overview of western European populations in the 1990s estimated that smoking contributed to about 20 percent of the educational differences in premature mortality

among men in most European populations, with the exception of Madrid (16). Among women, smoking also made a large contribution to mortality inequalities in northern European countries, but not in other parts of Europe (figure 2).

Figure 2. The contribution of smoking to educational differences in mortality among men and women in northern and southern European countries during the 1990s. Source: Mackenbach et al (16).



For the purposes of macro-economic assessments, it is important to have such estimates not only for mortality, but also for indicators of general health and disability. For national populations at large, the relative contribution of smoking to the burden of ill health is likely to be smaller than its contribution to the burden of mortality, because inequalities in morbidity are also determined by a wide array of non-fatal diseases for which smoking is not a main risk factor (e.g. mental and musculoskeletal diseases). In the Eurothine project, estimates were made of the contribution of smoking to educational differences in self assessed health in 18 countries from northern, southern and eastern parts of the EU after the year 2000. On the average, the contribution was about 10 percent for men and 4 percent for women. A strong north-south contrast was observed for both men and women, with contributions ranging from about 25% in some northern countries to about 0% in

southern countries. Eastern European countries were in-between northern and southern Europe (Roskam, 2007, personal communication).

It is important to view these patterns from the perspective of the smoking epidemic and the widening of smoking inequalities in countries where this epidemic is less advanced. As trends in smoking-related diseases will follow trends in smoking only with some delay, smoking-related diseases may become increasingly more concentrated among men and women from lower socio-economic groups. In the near future, the contribution of smoking to socioeconomic inequalities in mortality is likely to about 20 percent across most of Europe, while the contribution to inequalities in morbidity is likely to be somewhere between 10 and 15 percent. Although these estimates remain tentative, they do indicate that reducing smoking prevalence in lower socio-economic groups is of key importance to policies that aim to reduce the macroeconomic impact of health inequalities by improving the health situation of lower socio-economic groups.

3. Overview of the potential impact of tobacco control policies

Many intervention strategies have been shown to effectively reduce tobacco consumption in national populations. Interventions with demonstrated cost effectiveness include (1) comprehensive bans on the advertising and promotion of tobacco products, (2) bans or restrictions on smoking in public and work places, (3) price increases through higher taxes, (4) better consumer information, including public information campaigns, (5) large health warning labels on cigarette boxes and other products, and (6) treatment to help dependent smoking stop, including medication and counselling.

There are wide variations between European countries in the extent to which effective interventions have been implemented at national levels (Joossens and Raw, 2006). A recent overview concluded that only four European countries have implemented comprehensive tobacco policies to a reasonably full degree (with implementation scores higher than 70, on a scale from 0 to 1000). These countries are Ireland, UK, Norway and Iceland. At the other extreme are a number of countries where

implementation of tobacco control policies is yet highly fragmentary (with scores of about 30 or lower). This group of countries includes Spain, Austria and Romania. For the large majority of European countries, measures of demonstrated cost effectiveness still have to be implemented at large scale.

Given this situation, there is still considerable room for improvement with regards to tobacco control. For example, in the Netherlands, where national prevalence rates were almost 30% in 2005, a comprehensive tobacco control plan was adopted with the aim to reduce tobacco prevalence in the year 2010. It was estimated that smoking prevalence rates would decrease to less than 20% decrease by the full implementation of a set of policies including further price increases and better support for dependent smokers who wish to quit. Even though it may be unrealistic to assume such a large reduction to be achieved within 5 years, a one third reduction might be a realistic target for a longer term. Recent decreases in levels of tobacco consumption have been of similar magnitude. In addition, the situation in Sweden, with smoking prevalence rates below 20 percent, demonstrates that national levels may become much lower than the current European average of about 30 percent.

An important question is whether –and how- national tobacco control policies could be effective in reducing tobacco consumption among lower socioeconomic groups in particular. A pessimistic view may point to the experience with tobacco control measures in the northern European countries in the 1970s and 1980s, where the higher socioeconomic groups were the first to benefit from the new policies and campaigns against tobacco. These first tobacco control measures thus had the unintended consequence to widen socioeconomic inequalities in smoking. It is uncertain, however, whether this still applies to Europe today. A study from the Eurothine project assessed educational inequalities in smoking cessation in countries with different levels of tobacco control policies development (Schaap, 2007, personal communication). It was found that countries with more developed policies had lower cessation rates, among lower groups as well as among higher groups. Price policies and advertisement bans were most strongly associated with higher quit ratios among lower educational groups.

Firm evidence on the reach and effectiveness of specific tobacco control measures among lower socioeconomic groups should come from controlled evaluations of planned interventions and policies. Unfortunately, there is little published evidence on the extent to which tobacco control measures could be more effective among lower socioeconomic groups than among higher groups. Evaluations of tobacco control measures seldom make distinctions according to socioeconomic group (Platt et al, 2002, Giskes et al, in press). A few positive examples are however available, mainly from the UK. These examples illustrate the different possible levels of action, and the corresponding differences in evaluation methods.

- At the national level, the effect of national policies in the 1970s and 1980s were evaluated by means of a time series analysis of trends in smoking consumption levels (Townsend, 1994). The findings suggested that price policies had greater effects among lower social classes, whereas publicity campaigns had greater effects among upper classes.
- At the local level, the main interest in the UK is currently with a new program of smoking cessation services for deprived areas (8). It was found that people with low SEP used the new local services more often, thanks to a variety of measures that aimed to make the cessation services more accessible, affordable and acceptable to these people.
- Finally, at the level of individual smokers, the main interest is with the effectiveness of different forms of counseling, therapy or medication. An interesting example is an intervention study that developed a new cognitive behavioral therapy for smokers living in deprived neighborhoods in London [Sykes, 2001 #47]. In that study, the new method was found to be effective among smokers living in deprived areas, including the smokers with the lowest SEP.

Even though there is yet only fragmentary evidence on the extent to which effectiveness tobacco control measures could be effective among lower groups, the examples from the UK are encouraging. Moreover, lessons from the past can be used to ensure that future tobacco control policies will be effective especially among lower socioeconomic groups. For example, in countries where tobacco prices are low, increasing taxes are likely to be an effective single measure to reduce tobacco consumption among lower socio-economic groups (41). On the other hand, in

countries with relatively high tobacco prices, further increases in taxes remain an important policy measure, but experience from the UK tells that additional measures should be taken to counterbalance side effects among poor smokers. For poor smokers who find it difficult to quit, further increases in tobacco prices would decrease the amount of money available to purchase the essentials of daily life (7, 42). Therefore, extra tax revenues could be hypothecated to pay for smoking cessation services aimed to support poor smokers to quit.

In the implementation of tobacco control policies, reach and effectiveness among lower groups may increase by measures such as (a) strict enforcement of laws and agreements, (b) removal of financial barriers, (c) geographic targeting of services, and (d) tailoring of communication approaches. Mass media and public education approaches may achieve greater effects among lower socio-economic groups by tailoring their messages, materials and channels according to the needs of these groups (48). This applies both to national mass media campaigns, school-based or area-based health promotion programs, and self-help materials for smoking cessation. Tailored approaches should take into account the troubles in life experiences by poor smokers, and understand that many of them perceive that smoking relief them from stress. Anti-smoking messages should avoid referring to existent feelings of guilt and powerlessness, but instead highlight the possibility of success and instil a sense of optimism.

Given the potential for future tobacco control measures to reach lower socioeconomic groups, it may be expected that tobacco control policies could in principle achieve important reductions in smoking among lower socioeconomic groups. Two different policy scenarios may be envisaged. In the first "national" scenario, overall rates of smoking prevalence are decreased by 25 percent, and a similar proportional decrease is achieved for different socioeconomic groups. In the second "equity-oriented" scenario, special efforts are made to reach lower socioeconomic groups, with the effect that smoking prevalence rates among these groups decrease by more than 25 percent. Precise quantitative estimates cannot be derived directly from the available data. Based on all available evidence, we judged that a 33 percent reduction may be achievable for lower socioeconomic groups, i.e. a decrease of 1/3 in these groups compared to 1/4 in higher groups.

Such scenarios embody ambitious targets. These targets go further than the quantitative targets that some member states have set for the reduction of smoking prevalence among lower groups. For example, the British set the target to reduce smoking prevalence among manual groups from 32% in 1998 to 26% in 2010, i.e. a 19% reduction in 14 years. However, targets of 25% or even 33% may be achievable, at least over a longer time period, with the support of new and vigorous tobacco control policies at national and European levels. These policies may have large effects especially in countries where comprehensive tobacco control policies have not yet been developed.

4. Potential effects of tobacco control policies on health inequalities and their macro-economic implications: a modelling exercise

The purpose of this modelling exercise is to evaluate two policy scenarios with regards to smoking-related mortality and morbidity in lower and upper socioeconomic groups. In the first "national" scenario, overall rates of smoking prevalence are decreased by 25 percent, and a similar proportional decrease is achieved for different socioeconomic groups. In the second "equity-oriented" scenario, special efforts are made to reach lower socioeconomic groups, with the effect that smoking prevalence rates among these groups decrease by 33 percent, compared to 25 percent among higher groups.

Approach

We first estimated the average smoking prevalence of adult population in EU in the early 2000's, for men and women combined. Our estimates based on a compilation of data from national health interview surveys in 20 member states. For the total adult population (including elderly people), the smoking prevalence rates were assumed to be 25% in the upper educational groups, and 35% in the lower educational groups. This corresponds to an about 50% higher prevalence in lower compared to upper groups that is observed in international surveys (see also Figure 1).

"Lower" and "higher" groups are assumed to refer to the lower and upper 50% of the educational hierarchy within each member state. Because these two groups are assumed to be of identical size, educational differences in absolute numbers of deaths can be set equal to educational differences in death rates.

The total number of smoking related deaths was derived from the total number of deaths in EU 2004, as given in table 3 of the main report. The total number of 4,633 deaths, 1,963 thousands occurred among higher groups and 2,670 thousands among lower groups. The corresponding mortality rate ratio of 1.36 is derived from the estimations presented in Appendix A, end of section 6.

These numbers of deaths were multiplied by the "etiologic fraction" (EF) of smoking, using the formula p(RR-1) / (p(RR-1)+1), where p is the smoking prevalence, and RR is the relative mortality risk of smokers vs. non-smokers. Following a previous European study (18), the RR was assumed to be 2.0 (18). For example, in the baseline scenario, the smoking prevalence rates were 25% and 35% and the corresponding EF's were 20% and 26% for high and low educational levels.

The impact of smoking on morbidity was measured using estimates of the total number of people with 'poor/fair' self assessed general health in EU-25 in 2004 (see table 3 of the main text). The total number of cases was equal to 74.4 million of cases for higher groups, and 107.8 million for lower groups. The proportion of these cases that is attributable to smoking was derived using the same EF's as those applied to mortality.

Results

The results are presented in table 1. This table focuses on the effects of two different policies scenarios on the magnitude of educational differences in mortality and morbidity. This magnitude is expressed in both relative terms (rate ratios) and absolute terms (rate differences).

Table 1. Aggregate estimates of the impact of smoking reductions on inequalities in mortality and mortality in the EU-25 in 2004

	Baseline situation (EU-25 in 2004)	Policy scenario 1: 25% reduction of smoking prevalence in all groups	Policy scenario 2: 25% in high groups vs. 33% in low groups
Smoking prevalence (%)			
- higher groups	0.25	0.19	0.19
- lower groups	0.35	0.26	0.23
- **average (total population)**	**0.30**	**0.23**	**0.21**
- ratio low/high	1.40	1.40	1.23
- difference low-high	0.10	0.08	0.04
Total deaths in EU-25 (* 1000)			
- higher groups	1,963	1,880	1,880
- lower groups	2,670	2,533	2,479
- **sum (total population)**	**4,633**	**4,413**	**4,359**
- ratio low/high	1.36	1.35	1.32
- difference low-high	707	652	598
Smoking-related deaths in EU-25 (* 1000)			
- higher groups	393	310	310
- lower groups	692	555	501
- **sum (total population)**	**1,085**	**865**	**811**
- ratio low/high	1.76	1.79	1.62
- difference low-high	300	245	191
Total morbidity in EU-25 (* million)			
- higher groups	74.4	71.2	71.2
- lower groups	107.8	102.3	100.1
- **sum (total population)**	**182.2**	**173.5**	**171.4**
- ratio low/high	1.45	1.44	1.41
- difference low-high	33.5	31.1	28.9
-			
Smoking-related morbidity in EU-25 (* million)			
- higher groups	14.8	11.7	11.7
- lower groups	27.9	22.4	20.2
- **sum (total population)**	**42.8**	**34.2**	**32.0**
- ratio low/high	1.88	1.91	1.72
- difference low-high	13.1	10.7	8.5

Relative inequalities in smoking prevalence would not diminish under the first scenario, because smoking prevalence rates decrease by 25% in both educational levels. However, absolute differences in smoking prevalence decrease from 0.10 to 0.08 units. In the second scenario, relative inequalities decrease, thanks to the larger proportional decrease of smoking prevalence among lower groups. Absolute differences become small (0.04 units).

Inequalities in smoking-related mortality diminish in absolute, but persist in relative terms: the rate ratio declines from 1.76 to 1.62. Substantial inequalities remain probably because of the higher general level of mortality among lower socioeconomic groups, and therefore a greater likelihood of interaction of smoking with other factors (such as occupational exposure and psychosocial risk factors) within lower socioeconomic groups.

The total number of deaths among lower educational groups diminishes to an important extent: from about 2,670 to about 2,479 deaths. The number of deaths among upper educational groups diminishes to a lesser extent. As a result, absolute differences in mortality declined substantially (from about 700 to 600), while relative inequalities in total mortality declined to a modest extent (from 1.36 to 1.32).

Similar patterns are observed for inequalities in morbidity. For example, the total number of cases of morbidity among lower socioeconomic groups decreases substantially (from about 108 to 100 million cases). The absolute difference with higher groups decreases as well (from 33.5 to 28.9). Relative inequalities in morbidity hardly changes under the two policy scenarios. The rate ratio comparing low to high groups remains virtually the same under scenario 1 (change from 1.45 to 1.44), while a small increase occurs under scenario 2 (towards 1.41).

The persistency of an important relative gap in both mortality and morbidity is plausible in view of the likely effect of other risk factors, many of which may be even more unequally distributed between high and low socioeconomic groups. As a result, a reduction of smoking could contribute to a reduction of inequalities in both relative terms (in addition to absolute terms), only if much larger reductions in smoking prevalence are achieved among lower groups.

While relative inequalities are persistent, absolute levels and absolute differences do change in the desired direction. In both scenarios, important decreases are observed in the total burden of mortality and morbidity among the EU-25 member states in 2004, and this decrease is largest in the equity oriented scenario 2. This large decline implies a potentially large economic impact. This point is further elaborated in table 5 of the main text.

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