INEQUALITIES IN HEALTH, TO BE CONTINUED?

A life-course perspective on socio-economic inequalities in health

Dike van de Mheen

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ONGELIJKHEID IN GEZONDHEID, WORDT VERVOLGD?

Een levensloopperspectief op sociaal-economische gezondheidsverschillen

proefschrift

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CONTENTS

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1 Mheen H van de, Stronks K, Mackenbach JP. A life course perspective on socio-ecnomic inequalities in health. In: Bartley M, Blane D, Davey Smith(eds). Sociology of Health Inequalities, Soc Health Illness, Monograph, accepted for publication (adapted version)

2.1 Stronks K, Mheen H van de, Mackenbach JP. Achtergronden van sociaal-economische gezondheidsverschillen. Een overzicht van de literatuur en een onderzoeksmodel. (The background to socio-economic inequalities in health: a review of the literature and a conceptual model) T Soc Gezondheidsz 1993; 71:2-10 (adapted version)[in Dutch]

2.2 Mackenbach JP, Mheen H van de, Stronks K. A prospective cohort study investigating the explanation of socio-economic inequalities in health in the Netherlands. Soc Sci Med 1994;38:299-308

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3.2 Mheen H van de, Stronks K, Bos J van den, Mackenbach JP. The contribution of childhood environment to the explanation of socio-economic inequalities in health in adult life: a retrospective study. Soc Sci Med 1997;44:13-24

3.3 Mheen H van de, Stronks K, Looman CWN, Mackenbach JP. Does childhood socio-economic status influence adult health through behavioural factors? Int J Epidemiol, in press

3.4 Bosma JHA, Mheen H van de, Mackenbach JP. Childhood social class and adult health: the contribution of psychological attributes. [submitted for publication]

4.1 Mheen H van de, Stronks K, Looman CWN, Mackenbach JP. Recall bias in self-reported childhood health: differences by age and educational level. Soc Health Illness,1998;20:241-254

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5.2 Mheen H van de, Borsboom GJJM, Mackenbach JP. Is there indirect selection? The influence of health related determinants on social mobility. [submitted for publication]

CHAPTER 1

INTRODUCTION

1. INTRODUCTION

People in lower socio-economic positions are generally worse off with respect to their health than people in higher positions. These so-called socio-economic inequalities in health exist from birth to death, in youth, adulthood and in old age. Socio-economic inequalities in health in *adult life* have been found in many European countries over a long period of time[1,2]. The question on the processes that underlie the generation of these inequalities is still largely unanswered. The influential Black Report, which was published in Great Britain in 1982[3], offers some explanations for these inequalities. In this report the causal explanation and the selection mechanism are the most important mechanisms. The causal explanation implies that socio-economic health inequalities are caused by the unequal distribution across socio-economic groups of lifestyle factors, material factors or psycho-social factors. The health selection mechanism involves that health affects social mobility: healthy people may move up whereas unhealthy people may move down in the social hierarchy. The latter hypothesis is also referred to as the 'drift hypothesis'[3]. The Black Report stresses the importance of the causation mechanism as an explanation for socio-economic inequalities in health. Although behavioural factors are said to play a role in this mechanism, the role of material factors is suggested to be greater. In the Black Report little attention has been paid to childhood conditions.

However, after more than a decade of research, in which the causal mechanism played a central role, the social processes that underlie exposure to behavioural risk factors, material factors and psychosocial factors, as well as the mechanisms through which exposure leads to disease, are still not properly understood[4]. As socio-economic health differences in adult life are probably partly explained by processes earlier in life, some authors recently stressed the importance of studying health inequalities and their determinants over people's life course[4,5]. This implies that childhood conditions should be taken into account in the explanation of socio-economic inequalities in health in adult life. A life-course perspective also stresses the possible role of the selection mechanism in adult life: throughout the life course ill health may influence the attained position in the social hierarchy[6].

In a life-course perspective, the accumulation of adverse socio-economic circumstances and selection are important mechanisms, which together may cause a downward spiral, in which adverse socio-economic conditions and adverse health affect each other. Accumulation of disadvantage implies that the longer a person is exposed to poor circumstances, the greater the health risks become. Throughout the life course, mechanisms of social causation and health selection may act in succession to cause a downward spiral. Health problems in youth may be followed by a lower socio-economic position upon starting employment. A lower socio-economic status will lead to more health problems in adult life (through e.g. adverse health behaviour, psychosocial stress or poor material circumstances), and these health problems may in turn cause downward social

mobility. This downward spiral may lead to a continuation of both socio-economic and health disadvantages throughout the life course.

In addition to selection on health, which is called 'direct selection', also so-called 'indirect selection' may play a role. In terms of this 'indirect selection', downward and upward social mobility can be caused not only by health itself, but also by health-related risk factors at adult age or by personality traits which are (partly) formed in youth. The idea of indirect selection refers to selection by these 'common underlying causes': determinants that may influence both social mobility and later health. Whether indirect selection is considered to be selection or causation is just a matter of perspective[7]. In this thesis we will discuss indirect selection from the 'selection' perspective.
To study the mechanisms that play a role in this downward spiral on the basis of empirical data seems worthwhile, but a further conceptualization is required of the way in which these mechanisms might act in the life course.

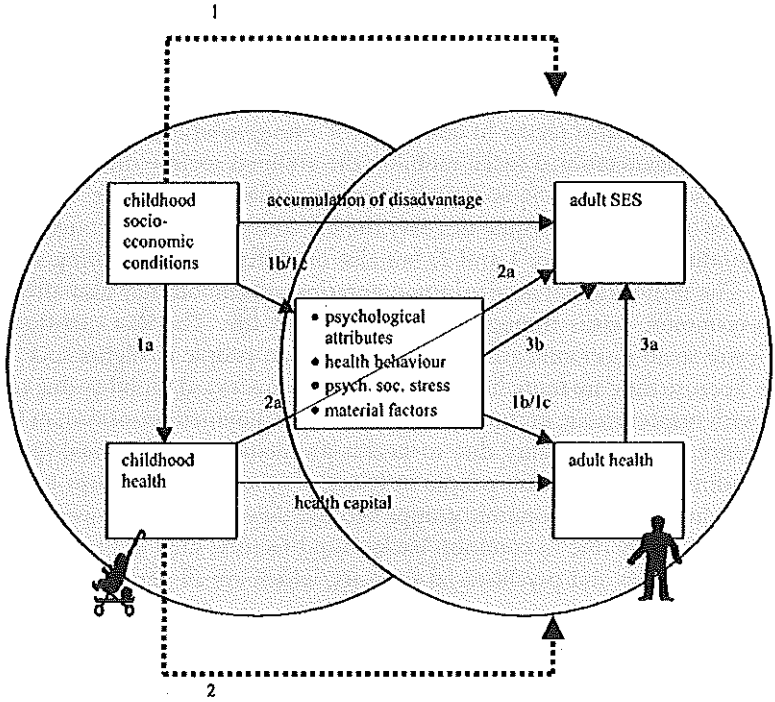
In this thesis a conceptual model is presented (Figure 1) which will be examined on the basis of empirical data. This model is a specification of an extensive theoretical framework (described in chapter 2.1), which also covers other explanations of socio-economic health differences in adult life, such as causal mechanisms through material factors, adult behaviour and psychosocial stressors. The conceptual model presented here emphasizes the influence of childhood conditions and selection processes. For ease of reference, other (causal) factors have not been included, but this does not deny the importance of these factors.

Three processes will be emphasized. The numbers refer to the relations which will be discussed in this thesis.

The first process (relation 1 in the model) concerns the contribution of *childhood socio-economic conditions* to socio-economic health inequalities in adult life. The central question is: are adult people in lower socio-economic groups less healthy than people in higher socio-economic groups because they grew up in relatively poor socio-economic conditions? It is important in this question to find out whether there is a direct effect of childhood conditions on adult health, or whether this effect runs via the achieved socio-economic position in adulthood.
Firstly, it might be a direct *causal* mechanism[8]: childhood socio-economic circumstances may have a significant influence on childhood health, which, in turn, is related to adult health. As children from lower class families are more likely to become lower class adults, and as childhood illness is related to health status in adult life[9], childhood socio-economic circumstances may contribute to the explanation of socio-economic inequalities in health in adult life.
In addition, adverse childhood conditions may act through a *selection* mechanism. It may influence the chances of good education, job opportunities and life chances in general, resulting in 'unhealthy life careers'[10]. The influence on adult health of child-

hood disadvantage can be described in terms of 'social programming': the effect of early social environment on adult health is mediated through social conditions during upbringing, educational achievement, starting employment and adult living conditions and lifestyle[10]. Pathways in this 'social programming' may run through health-related behaviour and psychological attributes. Thus, the subsequent question is: is it through intermediate factors such as behavioural and/or psychological attributes (e.g. personality traits) that the effect of childhood conditions is determined?

Figure 1. Conceptual model



1	contribution of childhood socio-economic conditions to socio-economic health inequalities in adult life
1a	independent effect of childhood socio-economic conditions on childhood health
1b	independent effect of childhood socio-economic conditions on adult health
1c	independent effect of childhood socio-economic conditions on adult health through health behaviour and psychological attributes
2	contribution of childhood health to socio-economic health inequalities in adult life
2a	contribution of childhood health to socio-economic health inequalities in adult life through selection on health in childhood
3a	selection on health in adult life ('direct' selection)
3b	selection on health-related factors in adult life ('indirect' selection)

A second process (relation 2 in the model) concerns the contribution of *childhood health* to socio-economic health inequalities in adult life. Are people in lower socio-economic groups less healthy than people in higher socio-economic groups because they experienced more health problems in childhood? If so, as with the first process, it might be a *causal* mechanism: adverse childhood socio-economic circumstances may cause childhood health problems. In addition there may also be an effect of childhood health by means of health *selection.* Is it (also) through a selection process that the effect of childhood health on socio-economic health inequalities in adult life is brought about? This selection process in childhood concerns so-called *intergenerational* social mobility, i.e. the attained socio-economic position compared to *childhood* socio-economic background. It implies that health problems in childhood may influence educational opportunities and consequently job career and income level later on in life.

The third process (relation 3a and 3b in the model) in the model concerns *selection on health* and *health-related factors* in adult life, or *intragenerational* social mobility. In the process of intragenerational social mobility the attained socio-economic position is compared to people's own socio-economic position earlier in *adult* life. Studying the determinants of adult health inequalities over the life course implies not only a focus on childhood conditions (processes 1 and 2) but also on different stages during adulthood (process 3). The health capital accrued upon entering adulthood may also affect a person's socio-economic status throughout the rest of his life. The first question is: are people in lower socio-economic groups less healthy than people in higher socio-economic groups because they are more likely to experience downward mobility due to health problems (with respect to e.g. occupation, income or employment position), or less likely to experience upward mobility due to health problems? An additional question is related to 'indirect' selection. Are people in lower socio-economic groups less healthy than people in higher socio-economic groups because they experience downward mobility or upward mobility due to common background factors, such as health behaviour, psychological attributes and psychosocial stressors, which are all partly rooted in childhood?

In this thesis the conceptual model described above will be examined on the basis of empirical data. Each of the identified processes will be discussed separately in different chapters.

Most chapters (except chapter 3.1) are based on data from the Longitudinal Study of Socio-Economic Health Differences (LS-SEHD) in the Netherlands. In the LS-SEHD, data on childhood socio-economic conditions, childhood and adult health, adult socio-economic status, psychological attributes and adult health-related behaviour are available to investigate the mechanisms whereby childhood socio-economic conditions and childhood health and selection on health and health-related factors, play a role in the explanation of socio-economic health inequalities in adult life.

The theoretical framework, design and objective of the LS-SEHD are described in chapter 2. Chapters 3 to 5 deal with the results of empirical analyses with respect to the processes represented in the conceptual model in Figure 1. Chapter 3.1 presents a historical overview of studies in the last 150 years. Chapters 3.2, 4.1 and 4.2 are mainly based on retrospective data, chapters 3.3 and 3.4 on cross-sectional data, while chapters 5.1 and 5.2 use longitudinal data.
Chapter 3.1 deals with the relation between childhood socio-economic circumstances and childhood health (relation 1a in the model). The chapter is based on data on socio-economic inequalities in perinatal and infant mortality in Amsterdam in the last 150 years.
In chapter 3.2 it is studied whether childhood socio-economic conditions contribute to the explanation of socio-economic health inequalities in adult life (relation 1 in the model). In other words: to what extent are socio-economic inequalities in adult health caused by childhood socio-economic conditions? In addition it is discussed which childhood socio-economic conditions were the most important.
The next step in unravelling the first process is to study whether childhood socio-economic status has an independent effect (i.e. adjusted for adult socio-economic status) on adult health (relation 1b in the model), and whether this effect operates through intermediate factors (1c). First we concentrated on health behaviour: does childhood socio-economic status affect adult health through behavioural factors? (chapter 3.3). In addition to the role of health behaviour, we also studied the role of psychological attributes (personality traits and coping styles). Does the influence of childhood socio-economic status on adult health operate through psychological attributes? This question will be answered in chapter 3.4.

Chapter 4 deals with the second process in the conceptual model: the role of childhood health in explaining socio-economic health inequalities in adult life (relation 2). Chapter 4.1 deals with the usefulness of retrospective data for studying this role. In chapter 4.2 the question about the influence of childhood health in explaining socio-economic health inequalities is answered for young adults (25-34 years). This chapter also examines the role of selection on health in childhood (intergenerational social mobility) (relation 2a).

Chapter 5 deals with the third process in the conceptual model: the role of the selection mechanism at adult age (intragenerational mobility). Chapter 5.1 deals with (direct) selection on health (relation 3a): to what extent are health problems at adult age related to downward or upward social mobility?
In chapter 5.2 the mechanism of indirect selection is explored (relation 3b). This chapter presents results with respect to the influence of background factors (i.e. psychological attributes, behavioural factors and psycho-social stressors) on social mobility.

The final chapter will include a synthesis of all elements, which will lead to an overall conclusion about the impact of unfavourable childhood socio-economic conditions and childhood health, and (indirect) selection.

The title of this thesis might suggest that we will predict the existence and/or extent of socio-economic inequalities in health in the future. We will not give a direct answer to that question, but as the reader will notice, in an indirect way we will provide some insight, since the central question is in what way an accumulation of socio-economic disadvantage and mechanisms of selection continue throughout the course of life. We will address this subject in the final chapter of this thesis.

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CHAPTER 2

THE LONGITUDINAL STUDY ON SOCIO-ECONOMIC HEALTH DIFFERENCES

2.1

A THEORETICAL FRAMEWORK

ABSTRACT

This chapter provides an overview of the explanations that have been put forward with regard to the origins of socio-economic inequalities in health. According to current scientific opinion both processes of 'selection' (health influences socio-economic position through health-related social mobility) and of 'causation' (socio-economic position influences health through the differential distribution of specific risk factors) play a role in socio-economic inequalities in health. The 'selection' processes are commonly divided between the effects of health in childhood on 'intergenerational' social mobility (change of socio-economic status between parents and children), and the effects of health at adult ages on 'intragenerational' social mobility (change of socio-economic status after entry into the labour market). Specific risk factors which may be involved in the 'causation' mechanism can be grouped into health-related behavioural factors (e.g. smoking, nutrition), structural/material factors (e.g. material deprivation, occupational exposures) and psychosocial stress-related factors (e.g. life events, lack of social support). The distribution of these risk factors across socio-economic groups in its turn probably is partly determined by childhood environment (e.g. socio-economic position of parents) and attitudes/personality (e.g. neuroticism and locus of control). The latter are not simply 'intermediary' between socio-economic status and health because they may also influence socio-economic status. They are therefore not only part of the 'causation' mechanism but also of a 'selection' mechanism. The latter differs from the 'selection' mechanism described above (in which health is the selection criterion) and is sometimes referred to as 'indirect selection' (in which a determinant of health is the selection criterion). Finally, (a small) part of socio-economic inequalities in health is probably due to the differential distribution of genetic factors across socio-economic groups.

2.1.1 INTRODUCTION

Based on existing (international) literature, this chapter provides an overview of the explanations that have been put forward with regard to the origins of socio-economic inequalities in health.
On the basis of this overview as well as empirical data relating to the socio-economic distribution of specific determinants in The Netherlands, an explanatory model was formulated prior to the Longitudinal Study on Socio-Economic Health Differences (LS-SEHD). The model aimed to integrate the relationships between socio-economic status (SES), determinants of health, and health itself. Existing literature presents other models relating to the background of socio-economic inequalities in health[1-5]. These were considered during the development of the conceptual model. The decision to develop a new model was prompted by the wish to be able to derive specific hypotheses on the basis of this model which could then be tested. This required a specification of the relationship between explanatory factors and mechanisms that went further than the scope of the above-mentioned models.
Because it attempts to integrate the existing explanations, the model has the potential to contribute to the discussion on the background of socio-economic inequalities in health. However, in view of the general validity, it should be borne in mind that the model reflects a number of choices that were made in the LS-SEHD. These choices concern both the health indicators and the explanatory factors which were considered.
Firstly, the model was restricted to the explanation of differences in *somatic* health. Although however, the model is partly applicable to the explanation of differences in mental health problems, this was not its primary aim. The model focuses on the incidence of chronic conditions, disabilities, self-perceived health problems and mortality. Other aspects of health, such as medical consumption and prognosis, require other models of explanation, and were therefore not considered here. In addition, the model is concerned with the explanation of inequalities in health *in adulthood.* Factors and mechanisms that occurred in *previous stages in life* (such as social background) are involved in the explanation of these differences.
Choices have also been made with regard to *explanatory* factors. Indeed, the study pays attention to all explanatory mechanisms discussed in the existing literature, but within these mechanisms it focuses on specific aspects. For example only those factors of which it is known that they are differentially distributed among socio-economic groups have been included. Moreover, factors that could not be determined by questionnaires in a reliable way have been excluded (e.g. the majority of genetic factors and biological risk factors), together with factors that would require a disproportionately great effort to measure (e.g. intelligence).

The current explanations of socio-inequalities in health are discussed, i.e. artefact, 'selection' mechanism, genetic predisposition, and 'causation'. The different explanations are then integrated into one model.

2.1.2 ARTEFACT

The artefact explanation assumes that inequalities in health between socio-economic groups that emerge from previous research are biased by the research methods and the measurements used[5]. In reality, it is hypothesized, the differences either do not exist or do so to a lesser degree. For example, the results could be biased if the number of deceased in a particular socio-economic group is calculated, thereby using different methods in the numerator and denominator to indicate the socio-economic status of the deceased. For example, in the British mortality statistics, the occupational level of a deceased person is simply determined by asking the relatives. Data on the number of persons in a specific social class however are taken from the census. Occupational data are therefore derived from two different sources. Consequently, the estimates of inequalities in mortality might be biased.
Although it is possible to point out several sources of bias in empirical studies, it is unlikely that socio-economic inequalities in health are largely or solely an artefact[6,7]. Socio-economic inequalities in health emerge from a large number of studies which have used many different research methods. In this thesis it is therefore assumed that the differences that are to be explained are primarily true differences.

2.1.3 SELECTION

The selection explanation assumes that socio-economic inequalities in health can be explained by the effect of health on the socio-economic status[6,8-11]. Socio-economic health inequalities occur, it is hypothesized, as a result of the fact that selection in relation to health occurs during social mobility. As a consequence, persons who are in poor health less frequently move up or more frequently move down the social ladder than healthy persons.
The 'selection' processes are commonly divided according to the period in people's lives in which selection occurs. Firstly, social mobility may occur during the period of adolescence and early adulthood. Illness during childhood or adolescence may influence a person's future socio-economic status at the start of adult life. In this case, the social mobility of an individual is determined by comparing his/her attained socio-economic status with the SES of his/her parents. This is called *inter*generational social mobility[1,9].
Secondly, health may influence social mobility in adulthood. In this case, the individual is not socially mobile compared to his/her parents, but in comparison to him/herself earlier on in adult life. This process is indicated by the term *intra*generational social mobility[12].
Apart from the period in which selection occurs, the form in which selection emerges can also be further specified. In the literature, a distinction is made between direct and indirect selection[11,13]. Direct selection implies that social mobility is a direct result of either very good or very poor health. Indirect selection occurs when social mobility is selective according to *determinants* of health and disease. An example of this might be

selection according to attitudes that influence one's behaviour. Both selection in adulthood and selection in the period before adulthood can be either direct or indirect. Four forms of selection can therefore be distinguished. These are discussed in more detail below.

An important variable in the case of *direct* selection with *inter*generational social mobility is an individual's chance of education. A long period of illness during childhood or adolescence could influence a person's educational opportunities, for example as a result of absence from school due to illness. An illness can also limit the number and type of jobs which an individual can choose[11]. The results of a British birth cohort study, the National Survey on Health and Development[14], provides evidence to suggest how this might occur. From this study, it emerged that boys who had been very ill in childhood have a greater chance of downward social mobility than healthy boys. Here, mobility was measured by comparing the occupational status of father and son.

In the process of *indirect* selection with intergenerational social mobility, both attitudes and behaviour that influence health play a central role[11-12]. The idea behind this mechanism is that the same behaviour and attitudes that lead to an upward or downward mobility can also influence the long-term state of health. The factor 'orientation towards the future' is an example of this. The extent to which a person orientates himself towards the future might be associated with the inclination to invest in an education. In addition, people with a lack of orientation towards the future are probably less likely to incorporate the long-term effects of certain health-related behaviour in their decision to engage in that behaviour. In this case, the attitude constitutes a common explanation for downward social mobility and illness later on in life, or for upward social mobility and good health. Although several authors assume that indirect selection might be involved in the generation of socio-economic inequalities in health there are no empirical data to support this view. Indirect selection can also occur during *intra*generational social mobility in a similar way as in the case of intergenerational mobility.

Moreover, direct selection can occur during adulthood. This form of selection implies the influence of chronic conditions on *down*ward social mobility. Illness could lead to downward mobility if someone is unable to stay in his/her previous job or function as a result of that illness. This process is sometimes called 'drift'[15], and may arise, for example, when people are excluded from the labour market as a result of a long-term work disability. Alternatively, very good health can also influence *up*ward social mobility. People who enjoy very good general health probably have a better chance to move up the social ladder during adulthood than people who are less healthy[13].

2.1.4 GENETIC PREDISPOSITION

The explanation of inequalities in health in terms of genetic factors is described as follows: because the socio-economic status of the parents is related to that of their child and because parents' health is correlated with socio-economic status, a part of socio-economic health differences in adulthood could possibly be explained by the distribution

of genetic factors in a population[1,16]. This influence is a genetic disposition that runs from parent to child, i.e. a hereditary transferable predisposition for developing a particular disorder. This explanation is closely related to the selection explanation. When people who are ill gradually move down the social ladder, this will eventually result in a differential distribution of genetic material among the population with respect to illnesses that carry a genetic component. This is at the lower socio-economic groups' disadvantage[2].
Although it cannot be excluded that genetic predisposition partially explains the existing socio-economic inequalities in health, this mechanism is expected to be less important than the causation and selection mechanism. In support of this view it should be mentioned that there is no clear indication of a differential distribution of genetic characteristics among socio-economic groups[17,18,19].

2.1.5 CAUSATION

The 'causation' mechanism assumes that a person's socio-economic status affects his/her health[20-22]. This is not a direct effect however. Socio-economic status influences health through more specific determinants of health and illness. Because these determinants are in between socio-economic status and health, they are called intermediary factors. According to this explanation, socio-economic inequalities in health exist because lower socio-economic groups live in less favourable circumstances and more frequently engage in health-damaging behaviour and less frequently in health- promoting behaviour than higher socio-economic groups. Traditionally, intermediary factors are divided into material or structural factors and behavioural factors[23].

Behavioural factors

Habits such as smoking and drinking, dietary habits, physical exercise/leisure activities and use of preventive and curative health care are all examples of behavioural factors. We expect that these factors will explain part of the socio-economic inequalities in The Netherlands because on the one hand they influence health, and on the other they are differentially distributed across socio-economic groups.

Material factors

Material aspects of living conditions that are important for the explanation of socio-economic inequalities in health are, among others, the circumstances in which a person lives and works, and his or her medical insurance. It is likely that inequalities in health partly originate because people from lower socio-economic groups, more often than people in a higher socio-economic position, live and work in circumstances that have a detrimental effect on health.
The influence of medical insurance is linked to the use of medical care. In this respect, the financial accessibility of services for example might be important (for example compensation/no compensation for a GP visit), as well as the rules that are imposed on the

insured party (for example periodic dental check-ups).
The explanations of socio-economic inequalities in health in terms of behavioural and material factors are not separate issues[24-26]. Behavioural factors are partly embedded in a number of material or structural living conditions. Poor dietary habits for example, or a lack of leisure facilities are to some extent determined by a person's financial position.

Psychosocial stress-related factors

Psychosocial stress-related factors are a third group of determinants in the explanation of socio-economic inequalities in health. They include stressors (long-term difficulties, life-events) and factors modifying the impact of stressors on health (social support, coping style, locus of control etc.). Examples of stressors are long-term unemployment, death of a partner and divorce.
It is expected that part of the existing differences in health are due to the fact that lower socio-economic groups are more exposed to stressful conditions or circumstances, or are less well equipped to cope with these stressors. As a result, the effects on their health are larger in lower groups than in higher ones[27-28]. The influence of psychosocial stress on health probably operates through a decline in physical defence which results in an increased risk of illness[29-30]. That is why psychosocial stress is seen by some authors as a background to an increased susceptibility to diseases in lower socio-economic groups[31-32]. In support of this mechanism it can be argued that a negative socio-economic gradient has been demonstrated not only for some, but for many disease categories.

Social background

Over the past few years, various authors have pointed out that it is not only someone's current socio-economic status that influences health. Material circumstances in which a person grew up might also affect adult health[3,22,33-34]. Nutrition and housing for example are important, not only as individual determinants but as elements of a complex system of material circumstances in which people grow up. Because the socio-economic status of a person is related to that of his/her parents, persons in lower socio-economic groups will generally have grown up in worse socio-economic circumstances than persons in higher socio-economic groups. These inequalities in material living conditions possibly explain a part of the differences in health later on in life by way of illness in childhood or a higher susceptibility to disease[7,35].
Because a direct way of measuring these material circumstances is often difficult if not impossible, they are usually measured in an indirect way. A person's height is sometimes used as an indicator[36-37].

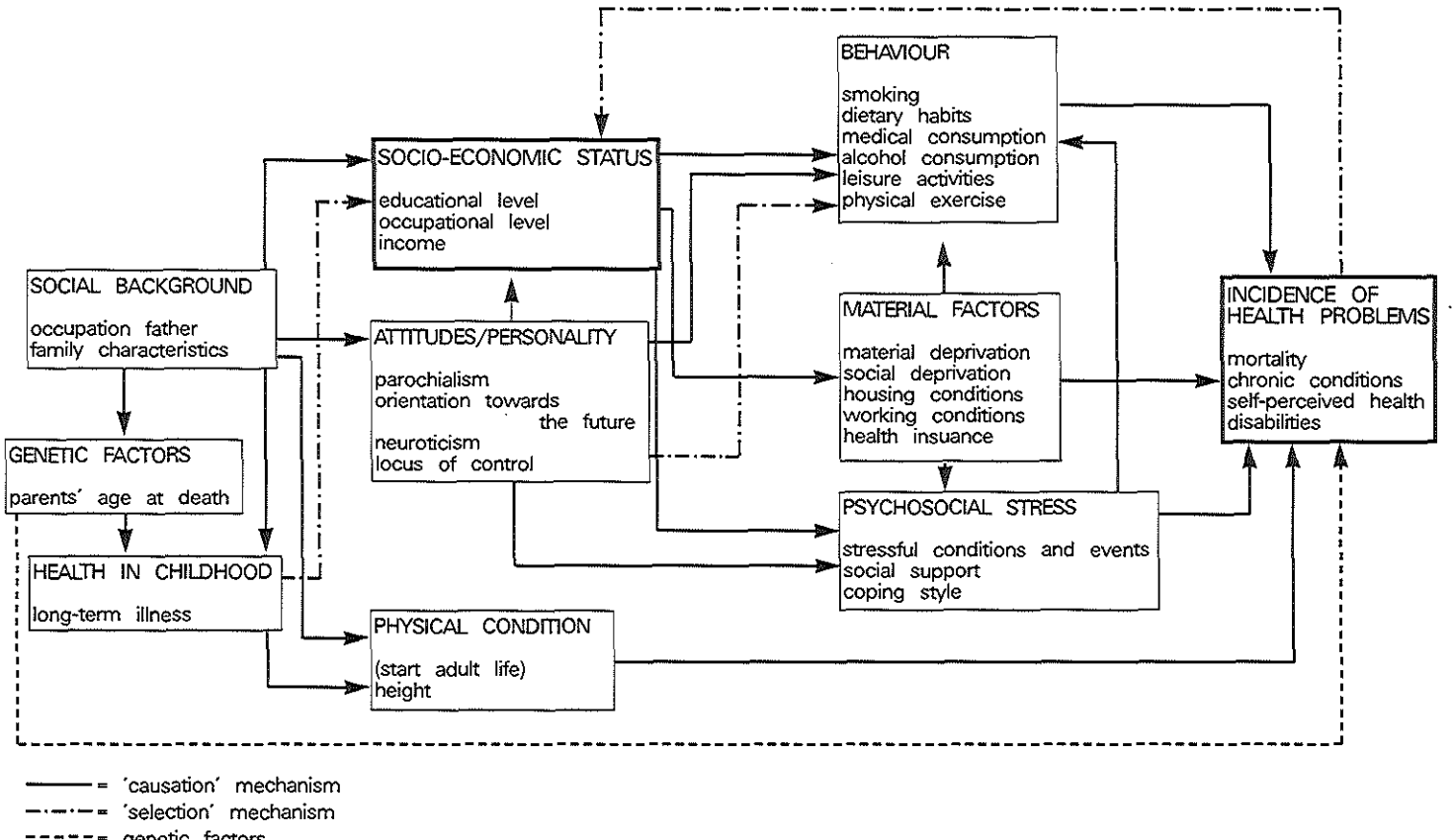
2.1.6 CONCEPTUAL MODEL

The explanatory mechanisms that were discussed above were integrated into one model. A new aspect of this model and therefore of the LS-SEHD, is the attempt to quantitatively assess the importance of the relevant mechanisms and factors in relation to each other. Insight into the interrelationship is necessary to estimate the relative importance of each of the factors and mechanisms involved. Only then is it possible to see how the influence of a particular factor affects other explanatory factors. It is of course impossible to statistically test each and every relationship in the model.
The function of the model lies mainly in the opportunities that it offers to derive hypotheses regarding the explanation of inequalities in health which incorporate the relationship between the various factors and explanations. The hypotheses will then be tested separately by means of the data that have been gathered in the LS-SEHD.
The hypothesized role of mechanisms and factors in the explanation of inequalities in health has schematically been visualized in Figure 1. Each of the blocks in the figure represent the factors that are measured in the LS-SEHD. The relationship between the factors concerned are represented by arrows. The mechanism in which this relationship is placed is also included in the model. The relationships are clarified in this section by way of examples.
Because the diagram serves as the conceptual model for the LS-SEHD, factors and relationships that are not considered in this study have of course not been included in the model. This applies for example to the use of health care. We included use of preventive services but omitted use of therapeutic and rehabilitative services from the model because the LS-SEHD deals with variation in incidence, not prognosis, of health problems.
Although it may sound paradoxical because of the diagram's complexity, the model is still a much simplified representation of reality. The word model has already indicated this. The relationship between factors has also been simplified considerably. It is only generally indicated which groups of factors will influence each other. Moreover, the relationships that exist between different factors in one and the same group have not been specified. Nor does the diagram express the dynamics that characterize most behaviour and circumstances. In reality, many of the characteristics change during the various stages of human life but the model remains a static representation.

Causation

The 'causation' mechanism in this model is represented by the three groups of risk factors which are 'intermediary' between socio-economic status and health problems, i.e. behaviour, material conditions and psychosocial characteristics. The model assumes that the various groups influence each other. As a result, the influence of an intermediary factor on health can be either direct or indirect. This may be illustrated by the influence of material conditions on psychosocial factors. The model shows for example, that long-term difficulties may arise from a number of material conditions, such as housing circumstances (e.g. over-crowding) and working conditions (e.g. noise).

Figure 1. A graphical representation of mechanisms and factors hypothesized to be involved in the explanation of socio-economic inequalities in the incidence of health problems at adult ages



Within the scope of the causation mechanism, the social background is also important. Material circumstances during childhood are supposed to affect health later on in life. Because there is a relationship between a person's social position and the social environment (s)he grew up in, this could explain part of the existing socio-economic inequalities in health. Above, it was indicated that the influence of childhood environment can be indicated using 'height'. In addition, these factors are measured in a more direct manner by means of some approximate indicators of the social status of the family a person grew up in (occupation of the father, some family characteristics).
In the causation mechanism, someone's social background is supposed to be important in other respects as well. It is assumed that it has an influence on the socio-cultural and psychological characteristics of an adult, which, in turn, may influence a number of intermediary factors.
Cultural factors in particular are very closely related to the concept of socio-economic status. Occupation and education as the operationalisation of this concept carry with them a socio-cultural element[38]. By explicitly including a number of these elements in the model it was indicated that specific attitudes might affect health (behaviour). These could therefore explain part of the existing socio-economic inequalities in health. Naturally, attitudes and personality are not just a result of a person's social background. However, the model does not further discuss the background of these determinants. The inclusion of these factors in the model is primarily an attempt to show that the socio-economic distribution of intermediary factors is determined not only by the current socio-economic status but also by the socio-cultural background.

Selection

Attitudes and personality might also play a role in the process of indirect selection. The hypothesis is that these constitute a common explanation for a more frequent occurrence of unhealthy behaviour in lower socio-economic groups and for attained socio-economic status. Next to this form of indirect selection, direct selection according to health is also considered in the model. It is represented by the effect of health problems at adult ages on adult socio-economic status ('intragenerational social mobility'), and by the effect of health in childhood on both adult socio-economic status ('intergenerational social mobility') and health problems at adult ages.

Genetic factors

In the model, one aspect of the contribution of genetic factors to the explanation of socio-economic inequalities is considered. It concerns the role of genetic predisposition in the distribution of diseases among socio-economic groups which is indicated here, in a very general way, by the age at which a person's parents died. The link between parents' age of death and that of the individual him/herself, irrespective of the parents' socio-economic status, might give some indications to the extent to which genetic factors play a role in the development of inequalities in health between socio-economic groups.

2.1.7 CONCLUSION

This chapter provides an overview of factors and mechanisms that might be involved in the generation of socio-economic inequalities in health. It emerged that the international literature offers sufficient leads to identify these factors and mechanisms.
In order to adequately represent the background of socio-economic inequalities in health, it is necessary to study the various explanatory mechanisms and factors by looking into their mutual relations. For example, it is important to study the contribution of behavioural factors to the explanation of inequalities in health relative to that of living conditions. Moreover, it emerged that it is relevant to study the background to behaviour, as it may arise to some extent from a differential distribution of material or psychosocial factors or socio-cultural differences. It may not be a person's behaviour, but the underlying living conditions or cultural factors which constitute the real explanation of inequalities in health.
Another relevant question is to what extent inequalities in health can be traced to circumstances during childhood. In addition, circumstances during childhood could explain part of the socio-economic inequalities in health in adulthood by way of behaviour later on in life and by way of selection according to behaviour. The hypotheses that are specified here, as well as other hypotheses derived from the conceptual model, will be tested in the LS-SEHD.

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2.2

AIM AND DESIGN

ABSTRACT

In this chapter, the objectives, design, data-collection procedures and enrollment rates of the Longitudinal Study on Socio-Economic Health Differences (LS-SEHD) are described. This study started in 1991, and is the first large-scale longitudinal study of the explanation of socio-economic inequalities in health in the Netherlands.

The LS-SEHD aims at making a quantitative assessment of the contribution of different mechanisms and factors to the explanation of socio-economic inequalities in health. It is based on a research model incorporating both 'selection' and 'causation' mechanisms, and a wide range of specific factors possibly involved in these mechanisms: health-related life-style factors, structural/environmental factors, psychosocial stress-related factors, childhood environment, cultural factors, psychological factors, and health in childhood.

The design of the LS-SEHD is that of a prospective cohort study. An aselect sample, stratified by age, degree of urbanization and socio-economic status, of approximately 27,000 persons was drawn from the population registers in a region in the Southeastern part of the Netherlands. The persons in this sample received a postal questionnaire. An aselect subsample of approximately 3,500 persons from the respondents to the postal questionnaire was, in addition, approached for an oral interview. The follow-up of these samples will use routinely collected data (mortality by cause of death, hospital admissions by diagnosis, cancer incidence), as well as repeated postal questionnaires and oral interviews.

The response rate to the base-line postal questionnaire was 70.1% (n=18,973), and that to the base-line oral interview was 79.4% (n=2,802).

If the LS-SEHD is compared to a number of frequently cited longitudinal studies of socio-economic inequalities in health from the United Kingdom, it appears that the differences with the OPCS Longitudinal Study and the birth cohort studies (such as the National Survey of Health and Development) are huge. The LS-SEHD is more akin to the Whitehall(I)-study and the West of Scotland 20-07 study. E.g. it has the sample size of the former but the open population and emphasis on social factors of the latter. A comparison of the results of various longitudinal studies of socio-economic inequalities in health is recommended.

2.2.1 INTRODUCTION

Evidence on differences in the frequency of health problems between socio-economic groups in the Dutch population has accumulated rapidly in recent years. Health problems for which the frequency rises with decreasing socio-economic position range from subjective health complaints to mortality, and from less-than-good perceived general health to specific chronic conditions. The explanation of these differences is still largely unknown in the Netherlands (as it is in other countries), although it has already been shown that the prevalence of some risk factors (e.g. smoking, obesity, lack of social support) is higher in the lower socio-economic groups[1].

In 1989 a national research programme on socio-economic inequalities in health was launched by the Dutch Ministry of Welfare, Public Health and Cultural Affairs. The primary goal of this programme is to find clues for the explanation of these differences[2,3]. It was soon recognized that a comprehensive analysis of the mechanisms and factors linking socio-economic status and health can only be made in the framework of a large-scale prospective cohort study. The preparations for this study started in 1989, a pilot-study was held in 1990, and data collection started in 1991. In this chapter, the objectives, design, data collection procedures and enrollment rates of this study, the Longitudinal Study on Socio-Economic Health Differences (LS-SEHD), are described. In the last section of this chapter we will briefly compare the LS-SEHD with a number of other longitudinal studies investigating the explanation of socio-economic inequalities in health.

In its practical implementation, the LS-SEHD has been embedded in a larger data collection effort, the GLOBE-study. The GLOBE acronym refers to 'Gezondheid en LevensOmstandigheden Bevolking Eindhoven en omstreken' ('Health and Living conditions of the population of Eindhoven and surroundings'). While the LS-SEHD deals with socio-economic inequalities in the incidence of health problems, the other parts of the GLOBE-study, which are not described here, are concerned with:
- socio-economic inequalities in health care utilization;
- socio-economic inequalities in cancer survival;
- differences in health by marital status and living arrangement.

These other studies involve additional data-collection efforts, both at base-line and during follow-up.

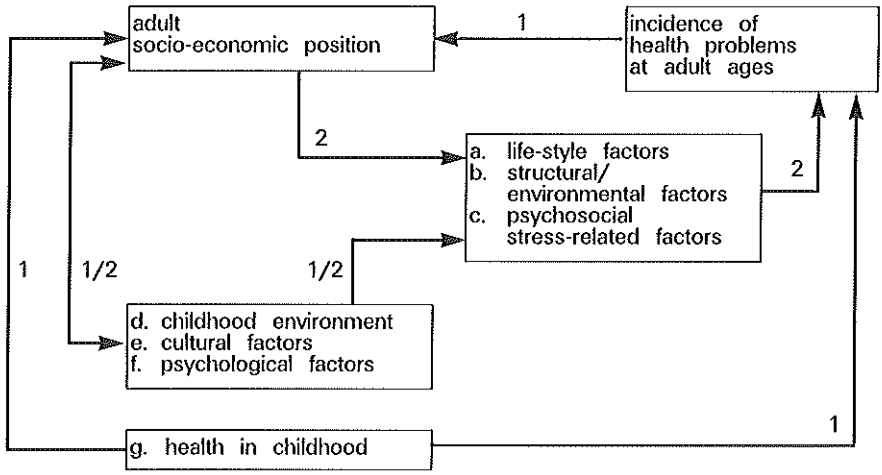
2.2.2 OBJECTIVES

The conceptual framework of the LS-SEHD is based on a review of the international literature which tried to identify the prevailing insights and hypotheses on the explanation of socio-economic inequalities in the incidence of health problems at adult ages[4]. The results of this review can be summarized as follows.

According to current scientific opinion both processes of 'selection' (health influences socio-economic position through health-related social mobility) and of 'causation' (socio-economic position influences health through the differential distribution of specific risk factors) play a role in socio-economic inequalities in health, although there is some evidence that 'causation' is the more important mechanism[5-7]. The 'selection' processes are commonly divided between the effects of health in childhood on 'intergenerational' social mobility (change of socio-economic position between parents and children), and the effects of health at adult ages on 'intragenerational' social mobility (change of socio-economic position after entry into the labour market)[8-10]. Specific risk factors which may be involved in the 'causation' mechanism can be grouped into health-related life-style factors (e.g. smoking, nutrition), structural/environmental factors (e.g. material deprivation, occupational exposures) and psychosocial stress-related factors (e.g. life events, lack of social support)[1,5,11-13]. The distribution of these risk factors across socio-economic groups in its turn probably is partly determined by childhood environment (e.g. socio-economic position of parents)[14,15], cultural factors (e.g. parochialism)[16], and psychological factors (e.g. neuroticism)[17]. The latter three groups of variables are not simply 'intermediary' between socio-economic position and health, because they may also influence socio-economic position. They are therefore not only part of the 'causation' mechanism, but also of a 'selection' mechanism. The latter differs from the 'selection' mechanism described above (in which health is the selection criterion), and is sometimes referred to as 'indirect selection' (in which a determinant of health is the selection criterion)[18].

The hypothesized role of these mechanisms and factors in the explanation of socio-economic inequalities in health has schematically been visualized in figure 1. The 'selection' processes (denoted '1') are represented by an effect of health problems at adult ages on adult socio-economic position ('intragenerational social mobility'), and by an effect of health in childhood on both adult socio-economic position ('intergenerational social mobility') and health problems at adult ages. The 'causation' mechanism (denoted '2') is represented by the three groups of risk factors which are 'intermediary' between socio-economic position and health problems. Finally, childhood environment, cultural factors and psychological factors are included in the model, which acknowledges their contribution to inequalities in health through both 'selection' and 'causation' processes ('1/2').

Figure 1. A graphical representation of mechanisms and factors hypothesized to be involved in the explanation of socio-economic inequalities in the incidence of health problems at adult age



1. 'selection' mechanism
2. 'causation' mechanism

It is perhaps important to note that, although the model in Figure 1 is intended to give a comprehensive representation of mechanisms and factors involved in the explanation of socio-economic inequalities in health, several factors which are sometimes mentioned in the literature have been left out. The first of these is genetic factors[19,20]. Although it is interesting to speculate on their contribution to health inequalities, it has until now been very difficult or impossible to include genetic factors in empirical studies. The second is use of health care[21,22]. We included use of preventive services in 'life-styles', but omitted use of therapeutic and rehabilitative services from the model, because the latter deals with variation in incidence, not prognosis, of health problems. (Socio-economic inequalities in prognosis of health problems are studied in other parts of the GLOBE-study - see 2.2.1)

The LS-SEHD aims at making a quantitative assessment of the contribution of these two mechanisms and seven groups of factors to the explanation of socio-economic inequalities in health in the Netherlands. It studies the effect of health on socio-economic position, by relating changes in socio-economic position to health status at an earlier moment in time. This is partly done in retrospect (effect of health in childhood on intergenerational social mobility), and partly in a prospective design (effect of health problems at adult ages on intragenerational social mobility). In the prospective part, health status at a base-line measurement will be related to changes in socio-economic position during the follow-up period. Using the same prospective design, the incidence

of health problems will be related to the socio-economic positions the individuals had at the base-line measurement. A comparison of both differentials (socio-economic change by original health status, and health status change by original socio-economic position) will help us to assess the relative importance of the 'selection' and 'causation' mechanisms. The 'causation' mechanism will further be elaborated by relating the second differential to socio-economic differences in the prevalence of the three groups of risk factors at base-line, and by relating these differences in risk factors to childhood environment, cultural factors and psychological factors.

Four types (or aspects) of health problems will be studied: impaired perceived health, long-term disability, specific chronic conditions, and mortality. It was thought that this would give a good balance between 'generic' and 'disease-specific', as well as between 'subjective' and 'objective' dimensions of health. We decided to include in the study persons in a rather wide age-range: 15-74 years. Health problems disproportionally affect people in the middle and older age-groups, but health-related social mobility can only be studied by including younger people as well.

2.2.3 DESIGN

The objectives of the study clearly necessitate a longitudinal design, because the time order of events should be established unambiguously. This is important for the distinction between the 'selection' and 'causation' mechanisms (did ill health precede a low socio-economic position, or vice versa?). As information on a wide range of factors will have to be available, many of which cannot be measured retrospectively, a prospective cohort design imposes itself.

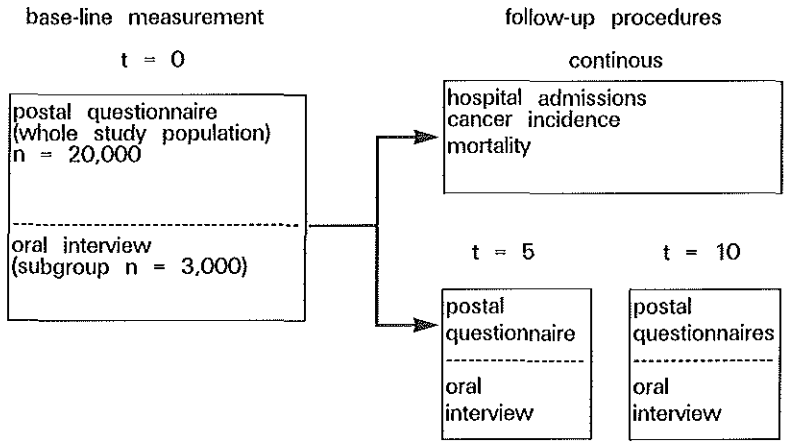
Power calculations showed that the number of person-years of follow-up which is necessary to detect socio-economic inequalities in the incidence of the rarer outcome measures (specific conditions, cause-specific mortality) is quite large. In order to increase the statistical power of the study we decided to increase the number of 45-74 year olds at the expense of the 15-44 year olds. The calculations are summarized in note 1. Based on these calculations, and assuming a duration of follow-up of 10 years, we chose a cohort size at the start of follow-up of approximately 20,000 persons.

Given this large sample size budgetary constraints necessitated a choice for cost-effective ways of data collection. The core of the LS-SEHD therefore consists of a baseline measurement in the form of a postal questionnaire, and follow-up procedures using both registration data (hospital admissions, cancer incidence, mortality) and a second and third postal questionnaire after 5 and 10 years, respectively (to measure changes in self-reported health and socio-economic position). This first part of the study will be used to explain socio-economic inequalities in the incidence of the rarer outcome measures, and to assess social mobility. The information on factors involved in the 'causation' mechanism which is available in this part of the study, is relatively limited because postal questionnaires impose certain limits on the number and nature of questions that can be asked.

A subsample of those who responded to the postal questionnaire were therefore approached for a more extensive oral interview. This interview permitted a more complete measurement of factors involved in the 'causation' mechanism. The follow-up of this subsample includes a second and third oral questionnaire after 5 and 10 years respectively. This second part of the study can be used to explain socio-economic inequalities in the more frequent outcome measures. The basic design of the study is visualized in Figure 2.

As the follow-up procedures heavily rely on the availability of administrative data from public and health care authorities we decided to perform the study in a geographically restricted area. Eindhoven, the fifth largest city of the Netherlands, and a number of surrounding municipalities, ranging from small and rural to medium-sized and urban in character, were chosen for practical reasons.

Figure 2. The design of the LS-SEHD



t = 0,5,10: in years
numbers at the baseline measurement are intended numbers of responders to the questionnaires

The population registers of these municipalities were used as a sampling frame. After a pilot-study in the same area had shown a response rate to our postal questionnaire of 75%, an aselect sample of approximately 27,000 persons was drawn, stratified by age (35% 15-44; 65% 45-74), municipality (60% Eindhoven, the other 40% balanced according to degree of urbanization), and within municipality by post code (in order to overrepresent the lowest and highest socio-economic groups, and thus to increase the socio-economic contrast within our study population). Persons with a non-Dutch nationality were excluded from the sample in order to avoid language problems.

For the oral interview an aselect sample was drawn from the respondents to the postal questionnaire. This sample was again stratified by post code, in order to further increase the socio-economic contrast.

In order to be able to evaluate the effects of non-response on the study results, we decided to incorporate the following two elements in the study design. Firstly, the total sample (including non-responders) will be followed-up for hospital admissions, cancer incidence and mortality. This will help to determine whether non-responders differ from responders in the frequency of a number of health problems. Secondly, a small subsample of the non-responders to the postal questionnaire was approached for a brief oral interview, the contents of which were practically identical to the postal questionnaire. Responders and non-responders can therefore also be compared with regard to socio-economic position, self-reported health, and a number of factors involved in the explanation of socio-economic inequalities in health.

2.2.4 DATA COLLECTION PROCEDURES

The data collected during the base-line measurement are summarized in Table 1. In addition to the postal questionnaire and the oral interview, the population registers were used as a source of information, mainly on socio-demographic background variables. Extensive measurements of socio-economic position were made, following the recommendations of a Dutch Committee on the measurement of socio-economic status in epidemiological and socio-medical research[23]. Three dimensions of socio-economic status (educational level occupational level, income) were measured, both for the respondent and his/her partner. Following the example of a number of British studies, we also measured car access and housing tenure. For the health measurements we mainly used instruments as developed and validated for the Netherlands Health Interview Survey[24]. 'Perceived health' was operationalized in three instruments: a single question regarding perceived general health ('how do you rate your health, generally speaking?' answers ranging from 'very good' to 'poor'); a list of subjective health complaints[24,25]; and the Dutch version of the Nottingham Health Profile[26,27]. Long-term disabilities were measured with a list of Activities of Daily Living and with the OECD indicator of long-term disabilities[28]. The prevalence of specific chronic conditions was measured by administering a checklist of 23 frequent disorders. Although the postal questionnaire did not permit a complete survey of all factors possibly involved in the explanation of socio-economic inequalities in health, the factors included (partially) cover health-related life-styles, structural/environmental factors, psychosocial stress-related factors, childhood environment, and health in childhood. The oral interview supplements this with, among other things, some relevant cultural and psychological factors. In addition, an extensive food questionnaire was included, measuring fat intake.

The population registers of the municipalities involved in the study (and other municipalities if cohort members move from the study area) will be used to track the study population with respect to place (and address) of residence, marital status, and vital status. In case of death, the medical cause of death will be retreived by linkage to the national cause-of-death register. The incidence of specific chronic conditions will be measured using data on hospital admissions, by diagnosis at discharge and counting first admissions for each condition only. Hospital admission data will be obtained by linkage to the national hospital admission registry. A regional cancer registry will enable us to measure the incidence of cancer in the study population.

After 5 and 10 years, respectively, the postal and oral questionnaires will be repeated (with some modifications). Socio-economic position will be measured again, as will be health status. These health measurements supplement the follow-up data on the more 'objective' outcome parameters (mortality, hospital admissions, cancer).

2.2.5 ENROLLMENT RATES

The data collection for the base-line measurement started in March 1991, following a publicity campaign in the local newspapers and other media. The postal questionnaire was mailed in a personally addressed envelope, accompanied by an introductory letter signed by the project leader and the director of the municipal public health service. A stamped envelope was added to facilitate an easy response. Three reminders were sent: after 1 week (a simple postcard), after 3 weeks (a letter with another copy of the postal questionnaire), and after 6 weeks (a very urgent letter). The design of this procedure was guided by Dillman's recommendations[29].

Table 1. The base-line measurement in the Longitudinal Study on Socio-Economic Health Differences (LS-SEHD)

	Population register	Postal questionnaire	Oral interview
Background variables	Date of birth Sex Marital status Place of birth Country of birth of the mother Place of residence	Religious affiliation Marital status/ living arrangements Children	Social desirability scale
Socio-economic position	Post code	Educational level Occupation (also of partner) Source of income Car access Housing	Educational level of partner Family income
Health indicators	---	Perceived general health Subjective health complaints Chronic conditions	Perceived general health Nottingham Health Profile Long-term disabilities
Factors involved in explanation[*]	---	Smoking habits (a) Alcohol consumption (a) Food habits (a) Physical activity (a) Leisure-time activities (a) Body-mass index (a) Working conditions (b) Housing conditions(b) Transport (b) Health insurance (b) Life events (c) Occupation of father (d) Height (g) Long-term disease in childhood (g)	Medical consumption (preventive) (a) Food habits (extensive)(a) Material deprivation (b) Social support (c) Continuous psychological burdens (c) Coping style (c) Socio-economic circum stances in childhood (d) Parochialism (e) Orientation towards the future (e) Attitudes towards smoking(e) Locus of control (f) Neuroticism (f)

[*] letters between brackets refer to the grouping of variables used in Figure 1

The response rates were quite satisfactory (Table 2). The over-all response rate was 70.1%, slightly lower than the expected 75% but still rather high for a postal questionnaire. Differences in response rates between different subgroups of the sample were modest in size: women, elderly people, the better-off, and country-dwellers responded a little more frequently than did their respective counterparts.

Table 2. Response rates: postal questionnaire

	Numbers approached [a]	Numbers responding (abs) [b]	Numbers responding (%)
Gender			
- men	13,583	9,207	67.8
- women	13,487	9,766	72.4
Age			
- 15-34 years	7,083	4,762	67.2
- 35-54 years	10,088	6,977	69.2
- 55-74 years	9,899	7,234	73.1
Post code group [c]			
- 1 (well-to-do)	6,805	4,960	72.9
- 2	3,829	2,727	71.2
- 3	4,537	3,232	71.2
- 4	4,163	2,853	68.5
- 5 (deprived)	7,615	5,134	67.4
Degree of urbanization			
- 1 (rural)	213	160	75.1
- 2	2,681	1,969	73.4
- 3	4,462	3,268	73.2
- 4	3,639	2,521	69.3
- 5 (big city)	16,075	11,055	68.8
Total	27,070	18,973	70.1

[a] net sample, i.e total sample (n=27,278) minus:
questionnaires which were returned because the address was wrong (n=124); persons who had died (n=30); persons who were absent for a long time (n=18); nursing home residents (n=7); mentally handicapped (n=29).
[b] i.e. those who returned a completed questionnaire
[c] classification based on commercial post code segmentation data;
unknown for 121 persons in the net sample and for 67 responders respectively.

The data collection for the oral interview started in April 1991, and lasted until the end of June. A personal letter was sent to announce the interviewer, who visited the address a maximum of three times. The over-all response rate was 79.4% (Table 3), with

even smaller differences between subgroups of the sample than in the case of the postal questionnaire.

239 non-responders to the postal questionnaire were approached for a brief oral interview. Of these, 64 (26.8%) completed this interview.

Table 3. Response rates: oral interview

	Numbers approached [a]	Numbers responding (abs) [b]	Numbers responding (%)
Gender			
- men	1,718	1,372	79.9
- women	1,811	1,430	79.0
Age			
- 15-34 years	912	732	80.3
- 35-54 years	1,295	1,033	79.8
- 55-74 years	1,322	1,037	78.4
Post code group [c]			
- 1 (well-to-do)	981	796	81.1
- 2	507	412	81.3
- 3	591	469	79.4
- 4	452	348	77.0
- 5 (deprived)	981	764	77.9
Degree of urbanization			
- 1 (rural)	27	22	81.5
- 2	335	277	82.7
- 3	597	480	80.4
- 4	476	394	82.8
- 5 (big city)	2,094	1,629	77.8
Total	3,529	2,802	79.4

[a] net sample, i.e total sample (n=3,637) minus: persons whose addresses were wrong (n=18); persons who had moved (n=50); persons who were absent for a long time (n=40). Persons who had not sent back their postal questionnaire, but were selected accidently for the interview, are excluded from the sample.

[b] i.e. those who returned a complete questionnaire

[c] classification based on commercial post code segmentation data; unknown for 17 persons in the net sample and for 14 responders respectively.

2.2.6 DISCUSSION

The LS-SEHD is the first large-scale longitudinal study of socio-economic inequalities in health in the Netherlands. It represents a conscious attempt to translate recent insights and hypotheses on the possible causes of socio-economic inequalities in health into an appropriate and cost-effective research design. The conceptual framework of the study (Figure 1) reflects the complexities of the phenomenon: causality is probably bidirectional, multiple factors are involved in the 'causation' mechanism, and the distribution of these factors across socio-economic groups is partly determined by circumstances and experiences in early life. The use of postal questionnaires and administrative data from public and health care administrations, in addition to the more conventional oral interviews, enabled us to combine a large sample size with an adequate data collection effort.

The response rate of the postal questionnaire used for the base-line measurement actually is higher than that obtained in large-scale oral interview procedures in the Netherlands: surveys of the Netherlands Central Bureau of Statistics, including the Health Interview Survey, currently have response rates of ca. 55%[30]. As there is no reason to suppose that the validity of responses to postal questionnaires is lower than that of responses to oral questionnaires[31], we believe that the data collection procedure adopted for the LS-SEHD will prove to be a good choice.

A comparison of the design of the LS-SEHD with that of other studies investigating the explanation of socio-economic inequalities in health suggests some interesting similarities and differences[32]. Table 4 summarizes the design of the LS-SEHD on the one hand, and that of a number of frequently cited British studies on the other hand.

The 'OPCS Longitudinal Study' is rightly famous for its tremendous contributions to the debate on socio-economic inequalities in health, especially mortality, both in the United Kingdom and internationally. Of the 4 British studies mentioned in Table 4, it is by far the largest in terms of sample size, and it is also much larger than the LS-SEHD. Its advantage in statistical power is, however, counterbalanced by the relatively limited number of variables on which information was collected in the base-line measurement (i.e. the 1971 census). Its stronghold therefore is description, not explanation.

The other 3 British studies mentioned in Table 4 clearly offer many more opportunities for explanatory analyses. The 'National Survey of Health and Development' exemplifies the 3 birth cohort studies which are currently underway in the United Kingdom, and which permit extremely interesting analyses of life histories. This is important for the explanation of socio-economic inequalities in health, because the distribution of risk factors across socio-economic groups is mediated by factors which find their origin in early life (childhood environment, cultural factors, psychological factors)(Figure 1). Birth cohort studies enable researchers to disentangle the time-order of events in these areas, and thereby provide insight into the causality of associations.

Table 4. A comparison between the Longitudinal Study of Socio-Economic Health Differences (LS-SEHD) and selected other longitudinal studies of socio-economic inequalities in health

	NSHD [a]	Whitehall-I Study [b]	OPCS-LS [c]
Starting year (t=0)	1946	1967-1969	1971
Size study population (t=0)	5,362 (national)	17,530 (London)	± 513,000 (national)
Socio-economic data	occupation education income occup. father & mother educ. father & mother occupation partner education partner	occupation	occupation education occup. partner car access housing tenure
Health indicators	mortality self-reported health morbidity [e] chronic conditions [f] mental health injuries	mortality	mortality morbidity [g]
Explanatory variables	genetic health factors housing conditions personality attitudes educational development height & weight family background	behavioural factors (smoking and leisure time activities) height & weight risk factors CHD[e] medical history	family gackground regional characteristics life-events
Sample composition	all children born in one week in 1946 in follow-up overrepresentation of lower occupational groups	male civil servants age 40-64	1% of total population all ages
Data collection procedures (t=0)	oral interview parent medical examination	written questionnaire medical examination	census (written) questionnaire)
Data collection procedures follow-up	oral interview (parents and respondent) medical examination school information written questionnaire cause of death registry	cause of death registry	hospital admissions registry cancer incidence registry cause of death registry census

[a] National Survey of Health and Development [33-37]
[b] see ref. 38-42
[c] Office of Population Censuses and Surveys Longitudinal Study [33, 43-46]

20-07 Study [d]	LS-SEHD
1987 4,800 (Glasgow)	1991 18,973 (1) 2,835 (2) (Eindhoven)
occupation education income occup. father & mother educ. father & mothe occup. partner car access housing tenure	occupation (1) education (1) income (2 occup. father (1) educ. mother (2) occup. partner (1) car access (1) housing tenure (1)
perceived general health chronic conditions [f] mental health disability subjective health complaints injuries	mortality (1) morbidity [g] (1) chronic conditions [f] (1) perceived general health (1) subjective health complaints(1) long-term disabilities (2)
height & weight behavioural factors (smoking, use of alcohol, diet, leisure time) family background housing conditions neighbourhood characteristics biological risk factors psychological factors working conditions medical history values/attitudes/beliefs	see Table 1
3 age-cohort (15, 35, 55 years old) overrepresentation lowest and highest SES-group	15-74 years old, overrepresentation of 45-74 years old and lowest and highest SES-group
Written questionnaire oral interview oral interview parents (15 yr.) physical examination by nurse	postal questionnaire (1) oral interview (2)
written questionnaire oral interview oral interview parents (15 yr.) physical examination by nurse	hospital admissions registry cancer incidence regi cause of death registry postal questionnaire oral interview

[d] West of Scotland Twenty-07 study [47-54]
[e] measured by medical examination
[f] selfreported
[g] measured by use of registries

In addition, the effect of health in childhood on 'intergenerational social mobility' can be studied in a prospective way. The LS-SEHD was not constructed to permit such analyses: we start with a cross-section of age-groups in the range 15-74 years. The objectives of the LS-SEHD are more closely comparable to that of the 'Whitehall (I)-study' and the 'West of Scotland 20-07-study' (Table 4). Data collection at the base-line measurement has been quite extensive in both studies, with an emphasis on biomedical measurements in the Whitehall-study and on social factors in the 20-07-study. The Whitehall-study's sample size is much larger than that of the 20-07-study, but it is restricted to men in the age-range 40-64 years. The 20-07-study intends to document health effects of social factors in three distinct age-cohorts: those 15, 35 and 55 years at base-line respectively. The comparison in Table 4 shows that the LS-SEHD has the sample size of the Whitehall-study, but the emphasis on social factors of the 20-07-study. A large sample size is necessary to detect socio-economic inequalities in the incidence of e.g. specific conditions or mortality from the largest causes. We did not focus on specific age-groups: perhaps the explanations of socio-economic inequalities in health differ between generations, but if they do, the sample sizes of the generations in the study would have to be quite large to detect such differences. On the other hand, a comprehensive analysis of the mechanisms and factors involved in the explanation of socio-economic inequalities in health requires an emphasis on social factors, as is also evident from the data collected in the 'Whitehall II-study'[55]. Which does not imply that we would not have liked to include biomedical measurements, both to validate some of the self-reports in the LS-SEHD (e.g. on body mass index, on the prevalence of chronic conditions) and to provide information which is impossible to obtain with questionnaires (e.g. on serum cholesterol and blood pressure). The absence of such measurements is probably the main weakness of our study.

Although there are many differences between the LS-SEHD and the other studies mentioned in Table 4, as well as longitudinal studies carried out in other countries[32], a comparison of the results of studies performed in different countries may still be worthwhile. International comparisons of socio-economic inequalities in health have shown that the size of these inequalities differs between countries[56-59]. Actually, as these societies differ in many respects, the contribution of different mechanisms and factors to inequalities in health is probably also different. A comparison of the results of different longitudinal studies offers interesting opportunities for an exploration of this issue.

NOTES

1.Power calculations were made for the rarer outcome measures (incidence of specific chronic conditions, cause-specific mortality), using Breslow and Day's reference values[60]. With a = 0,05 (one-sided) and 1 - β = 0,80, a minimum of 300 new cases of ill health during follow-up is necessary to detect a Relative Risk of 1.5 of the lowest versus the highest socio-economic group, assuming 5 socio-economic groups of equal size and the use of a test for linear trend. As the number of person-years of follow-up necessary to find 300 new cases heavily depends on the age-composition of the cohort at the start of follow-up, we decided to increase the number of 45-74 year olds at the expense of the 15-44 years olds (the study cohort was to have 65% of people in the age-range 45-74 years, as compared to 35% in this age-range in the Dutch population as a whole). Using national hospital admission rates by diagnosis we calculated that in order to find 300 new cases of ischemic heart disease 32,000 person-years of follow-up will be necessary (cerebrovascular disease: 83,000; lung cancer: 143,000; respiratory disease: 42,000).
Using national mortality rates by cause of death we calculated that in order to find 300 cases of death due to ischemic heart disease 99,000 person-years of follow-up will be necessary (cerebrovascular disease: 284,000; lung cancer: 228,000; respiratory disease: 416,000). We therefore chose a cohort size at the start of follow-up of approximately 20,000 persons: with 80-95% completeness of follow-up this should generate enough cases in 10 years time to study incidence or mortality for some specific conditions at least.

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2.3

FOLLOW-UP: DESIGN AND ENROLLMENT RATES

2.3 FOLLOW-UP: DESIGN AND ENROLLMENT RATES

At the start of the survey a random sample of approximately 27,000 people was drawn from the population registries of the participating municipalities. People in the sample received a postal questionnaire in 1991. As described in chapter 2.2, the net response rate was 70.1%, resulting in a study population of 18,973 respondents. Additional data were collected among two subsamples of respondents to the postal survey by means of an oral interview. The first subsample was formed by an a-select group (approximately 3,500 persons, stratified by postcode) of respondents to the postal survey. The net response rate for this oral interview was 79.4% (2,802 respondents); the procedure with respect to this subsample was described in detail in chapter 2.2. This subsample will be called the LS-SEHD subsample further below. The second subsample was originally used in a study on socio-economic differences in the use of health services and the course of health problems (LS-SEDUHS subsample). More detailed information about this sample can be found elsewhere[1]. For the LS-SEDUHS subsample (also taken from respondents to the postal survey), ill people that suffered from four chronic conditions were overrepresented (approximately 4,000 persons). These chronic conditions were: chronic bronchitis, asthma and emphysema, severe heart condition or myocardial infarction, diabetes mellitus and persistent back problems. Comorbidity among these four chronic conditions was allowed. In addition a random sample from the remainder of the population was added to the LS-SEDHUS subsample. The overall response rate in this subsample was 72.5% (2,878 respondents).

In 1993 and in 1995 a postal follow-up questionnaire was sent to respondents of the 1991 oral interview in the LS-SEHD subsample. The LS-SEDUHS subsample received a yearly postal follow-up questionnaire. The central aim of these follow-up surveys was to examine changes in health and socio-economic position. Net response rates for the LS-SEHD subsample in both years were approximately 80%. Net response rates for the LS-SEDUHS subsample were also satisfactory: approximately 85% in 1992 and approximately 80% in the following years. In this thesis only the follow-up measurement of 1995 is used. The two subsamples were taken together, and 5,154[1] respondents were approached. The net response rate was 79.7 %, resulting in a study population of 4,106 respondents in 1995.

In order to establish whether our follow-up was selective to demographic factors, or to health or socio-economic status, response rates in 1995 are presented by demographic factors (Table 1), and by health and socio-economic status in childhood and adulthood (Table 2), as measured in 1991. For this purpose response rates in 1995 are

1. net sample, i.e total sample in 1991 (n=5,667) minus: persons who died (230), whose addresses were wrong (n=46); persons who had moved outside the country (n=39); persons who were absent for a long time (n=18), persons that refused to participate after 1991 (N=180)

presented as percentage of the number of respondents in 1991. This means that the number of respondents in 1991 (N=5,667) was used as starting point, instead of the numbers approached in 1995 (N=5,154).

Table 1 shows that some differences in response rate in the follow-up occurred between demographic groups. Younger and elderly people responded somewhat less to the survey than middle-aged people, and response in the follow-up was lower in the more deprived areas. There were some differences in response rate by degree of urbanization. The latter, however, showed no trend in one particular direction.

Table 1. Response rate 1995 by demographic factors as measured in 1991

demographic factors 1991		abs. numbers 1991 (N=5,667)	abs. numbers 1995 (N=4,106)	response 1995 as % of 1991
gender	men	2,844	2,019	71.0
	women	2,823	2,087	73.9
age	15-34 years	1,100	763	69.4
	35-54 years	2,088	1,569	75.1
	55-74 years	2,479	1,774	71.6
post code group	1 (well-to-do)	680	504	74.1
	2	1,029	767	74.5
	3	1,844	1,357	73.6
	4	1,271	912	71.8
	5 (deprived)	843	566	67.1
degree of urbanization	1 (rural)	52	37	71.2
	2	563	396	70.3
	3	967	738	76.3
	4	765	527	68.9
	5 (big city)	3,320	2,407	72.5

Table 2 shows that, in general, non-response in the follow-up seems to be somewhat higher among respondents with good health in 1991 (according to all three health indicators). As mortality is related to socio-economic status in our cohort[2], it is to be expected that the percentage of people that reported good health in 1991 is higher in the 1995 study population. However, since only 4% of respondents had died by 1995, this effect cannot be substantial. Response in the follow-up was also lower in the lowest socio-economic groups as measured by current educational level. With respect to childhood socio-economic group (father's occupation) and employed persons versus economically inactive persons, there were hardly any differences in response in 1995.

Chapter 6 contains a further discussion of the implications of non-response for the study results.

Table 2. Response 1995 by health and socio-economic status as measured in 1991

health and socio-economic status	1991	abs. numbers 1991[1] (N=5,667)	abs. numbers 1995[1] (N=4,106)	response 1995 as % of 1991
perceived general health	good	3,475	2,630	75.7
	less-than-good	2,062	1,383	67.1
health complaints	<= 3	3,301	2,502	75.8
	> 3	2,300	1,564	68.0
chronic conditions	0	2,116	1,556	73.5
	>= 1	3,521	2,529	71.8
educational level	university	273	209	76.6
	higher vocational	722	573	79.4
	intermediate vocational/ higher secondaryschool	1,207	910	75.4
	lower vocational/ lower secondary school	2,104	1,534	72.9
	primary school	1,233	796	64.6
labour market position	employed	2,083	1,561	74.9
	economicallyinactive[2]	3,102	2,222	71.6
	student/military service/ rentiers	379	257	67.8
father's occupational level	higher grade professionals	938	696	74.2
	lower grade professionals/ routine non-manual	448	338	75.4
	self-employed	991	745	75.2
	high and low skilled manual	1,532	1,140	74.4
	unskilled manual	1,150	807	70.2

1 excluding those with missing values
2 economically inactive = unemployed, working disability, early retirement, housewife

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CHAPTER 3

THE ROLE OF CHILDHOOD SOCIO-ECONOMIC STATUS

3.1

THE RELATION BETWEEN CHILDHOOD SOCIO-ECONOMIC STATUS AND CHILDHOOD HEALTH: SOCIO-ECONOMIC INEQUALITIES IN PERINATAL AND INFANT MORTALITY FROM 1854 TO 1990 IN AMSTERDAM, THE NETHERLANDS

ABSTRACT

Trends in socio-economic differences in infant and perinatal mortality in Amsterdam were studied for the period 1854-1990, using published and unpublished material, at the aggregate and at the individual level. Absolute and relative socio-economic mortality differences (SEMD) per data-set were calculated using inequality indices developed by Pamuk. The results show a decrease of the absolute differences in both infant and perinatal mortality. For infant mortality, this is mainly due to the overall decline of the infant mortality rate. Relative differences in infant mortality did not decrease during the study period. This is the result of separate developments in 3 time periods. From approximately 1850 to approximately 1910 an increase in relative differences can be seen, a trend which is reversed from approximately 1910 to the end of World War II. After World War II relative differences seem to stabilize at the same level. For perinatal mortality, for which only data from the post-World War II period are available, the decrease in the absolute differences is due both to the overall decline of the perinatal mortality rate and to a decline of relative differences between socio-economic groups. It is concluded that, although SEMD in infant and perinatal mortality have declined in an absolute sense, they still exist, and that the relative position of deprived groups concerning infant mortality was not ameliorated during the study period.

3.1.1 INTRODUCTION

Socio-economic inequalities in health have received a lot of attention in the last decade, starting with the publication of the Black Report[1]. In particular in Great Britain and Scandinavia a great deal of research has been done on this subject[2,3]. The results show that in lower socio-economic groups health problems are more frequent than in higher socio-economic groups. One of the targets of the World Health Organization is to reduce these health inequalities by 25% by the year 2000[4].

Trends in time are an important issue in research on socio-economic inequalities in health. Is the health gap between lower and higher socio-economic groups closing or widening? Most evidence which may give the answer to this question comes from mortality data. Some authors have demonstrated that inequality in adult mortality has increased since the early 1950s[5-11]. Unfortunately, in The Netherlands data on trends in adult mortality by socio-economic status are scarce. Results from a geographical study suggest that in The Netherlands too the relationship between socio-economic level and adult mortality has become more negative since 1950[12].

This chapter focuses on socio-economic differences in infant and perinatal mortality. Perinatal mortality is defined as stillbirths plus deaths in the first week (per 1,000 births, i.e. stillbirths at 28 or more weeks of gestation and live births). Infant mortality is defined as deaths under 1 year of age per 1,000 live births[13]. Mortality differences between children from different socio-economic groups are generally regarded as unacceptable inequalities[14]. Because children have no choice in their living and environmental conditions, these differences are even more unjust than in an adult population.

Many studies show that socio-economic differences in infant and perinatal mortality exist[15,16]. Studies on infant and perinatal mortality in various Western European countries and the United States have demonstrated that the inverse relationship between social class and perinatal, neonatal and postnatal mortality did not narrow from approximately 1910 to the mid-1960s[15]. Pamuk[17] has demonstrated that relative inequality in infant mortality in Great Britain has not decreased in the second half of the twentieth century. In Scandinavia, socio-economic differences in infant mortality seem to have increased during the last 2 decades[18,19].

We have investigated trends in socio-economic mortality differences (SEMD) in infant and perinatal mortality in The Netherlands. Children in The Netherlands are very healthy judging by these indicators: infant mortality is one of the lowest in the world (6.3 per 1,000 live births in 1992)[20]. However, SEMD in infant and perinatal mortality do exist. In The Netherlands, in particular in Amsterdam, interesting data about infant and perinatal mortality are available over a period of approximately 150 years. In this chapter we will study the trends in socio-economic differences in infant and perinatal mortality in Amsterdam from 1854 to 1990.

3.1.2 DATA AND METHODS

Data

We used published as well as unpublished data in our analysis, at both the individual and aggregate levels. Published data on the relation between socio-economic status (SES), on the one hand, and infant mortality and perinatal mortality, on the other, are available from the second half of the nineteenth century until approximately 1980. Complementary analyses were performed on unpublished data from the last 15 years of 3 different databases[21-23]. Information on the studies used in this analysis is given in Tables 1-3[21-34].

The SES of an individual refers to his or her position in the social hierarchy; in studies on infant and perinatal mortality SES is always defined by the SES of the parents. This was based on the occupational level of the father in most of the studies used at the individual level. In studies at the aggregate level, income or wealth (based on income tax per earner) was used as the SES indicator. This mainly concerned the income of the father, because in The Netherlands up until 1958 income tax was based on the income of the male head of the household. For both the individual and aggregate levels we included only studies which permitted a comparison with respect to the SES indicator and the number of SES groups. Therefore, we excluded studies in which other SES indicators like crowding or housing conditions were used[35,36]. Because most studies at the aggregate as well as at the individual level concerned the city of Amsterdam, we excluded studies which concerned other cities only[37-39]. It is unknown what aspects related to socio-economic inequalities (for example, level of urbanization, environmental characteristics, houses, occupational composition and total level of infant and perinatal mortality) differed between cities in the period under review. Finally, only studies in which the size of the SES groups in proportion to the total population was given could be included in this analysis, because this information was necessary to calculate the measures of inequality we used (see below).

Methods

Presenting inequalities in infant and perinatal mortality by SES group over time requires that an inequality measure takes into account mortality rates in all the SES groups and the distribution of the population over the SES groups. Moreover, it should reflect only the socio-economic dimension of inequality in health[40]. By using the size of the SES groups in the calculation, one measures not only the effect of decreasing SES on health but also the total impact of socio-economic inequalities in health upon the health status of the population as a whole. Thus, the impact of changes over time in the size of the SES groups is taken into account. In addition, relative and absolute differences are important. A relative measurement presents the frequency of mortality in the lowest SES group as a percentage of the mortality rate of the highest SES group. An absolute measurement presents the difference in mortality rate between the highest and the lowest SES group. A high relative difference of a rare health problem (like perinatal

or infant mortality) between SES groups may be less important for the public's health than a far less elevated relative rate of a frequent health problem[41].
The size of inequalities was measured by a set of inequality indices, which were modifications of indices applied by Pamuk[17] and modified by Kunst et al[42]. These indices meet the requirements mentioned above[40]. In Pamuk's[17] indices all socio-economic groups or neighbourhoods are included in the calculation separately. In addition, they do not measure all mortality differences between SES groups, but only the differences that are systematically related to an ordering of classes from high to low status.
The inequality indices developed by Pamuk[17] are based on regression analysis. The application of regression analysis requires that the socio-economic status of neighbourhoods or groups is quantified. Essential to the indices is that SES is quantified by conceptualizing it as the relative position in the socio-economic hierarchy. More specifically, SES is equated to the proportion of subjects in the population with a higher position in this hierarchy. For example, if the highest SES group or neighbourhood comprises 10% of the population, this proportion is 5% on the average. If the next highest group or neighbourhood also comprises 10% of the population, the average proportion is 15%. Thus, 15% of the population have a higher SES than an average member of this second SES group: the 10% of the population in the highest SES group and one half of the second highest.

We related the SES measure to mortality by means of ordinary least-squares regression. The regression equation was

$$\log (M_j) = \alpha + \beta * SES_j$$

where M is the mortality rate and SES is socio-economic status, quantified as explained above. The subscript j denotes the SES group or neighbourhood and α and β are the regression coefficients. The model was used for both individual and aggregated data.

The formula e^{β}-1 yields the (modified) relative index of inequality (RII). It represents the proportional increase in mortality per 1 unit increase in the SES measure.Since this 1 unit increase is equivalent to the difference between the top (0) and the bottom (1) of the socio-economic hierarchy, the RII can be interpreted as the ratio of the mortality rates of those at the bottom of the social hierarchy compared to those at the top of the hierarchy. Multiplying the RII by the (infant or perinatal) mortality rate predicted for the top of the hierarchy yields the (modified) slope index of inequality (SII). The SII can be interpreted as the absolute increase in number of deaths per 1,000 (live) births by moving from the top to the bottom of the social hierarchy. The regression equation assumes that mortality rates have a log-linear relationship with the SES score. This assumption was verified by means of inspection of the residuals. No large departures from log-linearity were observed. Differences between SES groups were statistically significant ($p < 0.05$) in almost all time periods, both at the aggregate and at the individual level. Formulas for the calculation of the SII and RII are given in tables 1-3.

Table 1. Infant mortality per 1,000 live births 1854-1990 by SES, aggregate level, Amsterdam

Year	Author/database	SES indicator
1854-1859	Israëls[24]	Wealth by number of poor people receiving medical aid
1891-1894	Centrale Commissie voor de Statistiek[25]	Wealth by income tax 1892/1893
1909-1911	Sajet and van Gelderen Bureau Statistiek der Gemeente Amsterdam[27,28]	Wealth by income tax (% tax assessments of income >2,200 of total number of tax assessments 1915/1916)
1919-1921	Meulenhoff29 Bureau Statistiek der Gemeente Amsterdam[27,28]	Wealth by income tax (% tax assessments of income >2,200 of total number of tax assessments 1915/1916)
1929-1931	Meulenhoff[29] Bureau Statistiek der Gemeente Amsterdam[27,28]	Wealth by income tax (% tax assessments of income >3,000 of total number of tax assessments and of total number of working population 1931/1932)
1946-1949	Bureau Statistiek der Gemeente Amsterdam[30]	Wealth by income tax (% tax assessments of income >3,000 of total number of tax assessments and of total number of working population 1931/1932)
1972-1978	Lau-IJzerman et al[31]/no published data, source database: Doornbos and Nordbeck[21]	Wealth index (1971) based on occupation income, education, telephone possession
1979-1983	No published data, source database: van der Maas et al[22]	Wealth index (1983) based on 16 indicators related to SES, for example, number of social benefits, crowding, number of 1-parent families[32]
1986-1990	No published data, source database: Amsterdam Municipal Population Register[23]	Mean income 1984, based on income tax

SII, slope index of inequality (estimated mortality lowest SES - estimated mortality highest SES).
RII, relative index of inequality (SII/estimated mortality highest SESx100).

a. RII and SII per number of births in SES group.
b. RII and SII per number of persons in SES group.
c. RII and SII per number of live births in SES group.
d. RII and SII per number of 0 years old in SES group.

Number of neighbourhoods	RI	ISII	Mortality level of total population	Estimated mortality level of highest SES
4	23.1[a]	49.5	239	215
50	39.7[a]	79.0	239	199
6	22.7[b]	32.8	161[e]	145
50	25.1[b]	36.0	162[e]	143
11	94,2[c]	53.4	81.2[f]	56.7
12	75.4[c]	29.0	52.1	38.4
15	74.1[c]	19.0	35.1	25.7
29	46.6[b]	10.5	27.8	22.5
17	66.2[d]	4.9	9.9	7.4
17	84.4[d]	6.4	10.7	7.6
18[g]	76.5[d]	5.9	10.7	7.7
22	85.9[d]	5.1	8.6	6.0
21[h]	76.4[d]	4.7	8.6	6.1

e. Infant mortality per 1,000 births.
f. Infant mortality per 1,000 0-1 years old.
g. Ranking neighbourhoods by mean income 1984.
h. Ranking neighbourhoods by wealth index 1983.

Table 2. Infant mortality per 1,000 live births 1937-1980 by SES, individual level, Amsterdam

Year	Author/database	SES indicator	Number of SES groups	RII	SII	Mortality level of total population	Estimated mortality level of highest SES
1937-1940	Bureau Statistiek der Gemeente Amsterdam[33]	Occupation	4	86.6[a]	18.4	29.5	21.2
1941-1943	Bureau Statistiek der Gemeente Amsterdam[33]	Occupation	4	44.3[a]	12.0	32.8	27.1
1946-1950	Bureau Statistiek der Gemeente Amsterdam[33]	Occupation	4	110.0[a]	20.2	27.2	18.4
1960-1963	Bureau Statistiek der Gemeente Amsterdam[34]	Occupation	4	61.2[a]	7.0	14.8	11.5
1975-1980	Unpublished data, source database: Doornbos and Nordbeck[21]	Occupation	4	87.0[a]	5.8	9.3	6.7

SII, slope index of inequality (estimated mortality lowest SES - estimated mortality highest SES). RII, relative index of inequality (SII/estimated mortality highest SESx100).

a. RII and SII per number of live births in SES group.

Table 3. Perinatal mortality per 1,000 births 1946-1980 by SES, individual level, Amsterdam

Year	Author/database	SES indicator	Number of SES groups	RII	SII	Mortality level of total population	Estimated mortality level of highest SES
1946-1950	Bureau Statistiek der Gemeente Amsterdam[33]	Occupation	4	64.9[a]	15.4	31.0	23.8
1960-1963	Bureau Statistiek der Gemeente Amsterdam[34]	Occupation	4	38.0[a]	7.9	24.5	20.8
1975-1980	Unpublished data, source database: Doornbos and Nordbeck[21]	Occupation	4	25.2[b]	3.1	13.8	12.3

SII, slope index of inequality (estimated mortality lowest SES - estimated mortality highest SES). RII, relative index of inequality (SII/estimated mortality highest SESx100).

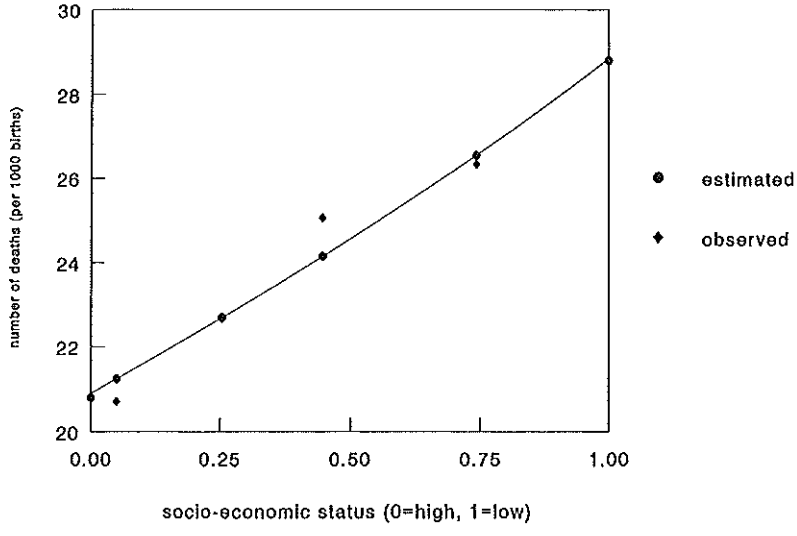
a. RII and SII per number of births in SES group.
b. RII and SII per number of live births in SES group.

An example of the computation of these indices is given in figure 1. In this figure the difference in perinatal mortality between the SES groups is presented for the years 1960-1963[34] (table 3). The mean perinatal mortality is 24.5 per 1,000 births. The estimated mortality level at the top (value 0) of the social ladder is 20.8. The RII of 38.0 implies a percentual increase of 38% of 20.8, yielding an absolute value of 7.9 more perinatal deaths per 1,000 births at the bottom (value 1) of the social ladder.

The different data sets at the individual level were not entirely comparable as far as the position of the self-employed on the occupational ladder is concerned. Therefore, the measures of inequality were calculated for different positions of the self-employed in the rank order. This yielded equal trends over time in inequality for infant as well as perinatal mortality and for both measures of inequality. In the analysis reported here the self-employed are placed between labourers and administrative employees. In 1 study only, the unemployed were distinguished separately[21]. They were excluded from the analysis.

Doornbos and Nordbeck[21] reported an over-registration of infant mortality between 1975 and 1980, caused by the registration of some stillbirths as first-week deaths. This over-registration seems to be small (8.9 instead of 8.8 per 1,000 live births)[43]. In the database of the Amsterdam Municipal Population Register (1986-1990) some deaths in the first 3 days after birth were not recorded. These data were added by means of checking all forms on perinatal deaths from 1986 to 1990[44]. This left a minor underestimation of infant mortality in the database concerned (8.6 instead of 8.9 per 1,000 live births).

Figure 1. Perinatal mortality by socio-economic status, 1960-1963



3.1.3 RESULTS

The results of the analyses at both the individual and the aggregate level are presented below. With respect to perinatal mortality, only data at the individual level were available. The trend in estimated infant and perinatal mortality rate for both the top and the bottom of the social hierarchy is given in Figures 2 and 3. Figures 4 and 5 show the SII and RII respectively for infant mortality and Figures 6 and 7 for perinatal mortality.

Figure 2. Trend in estimated infant mortality by socio-economic status, 1854-1990

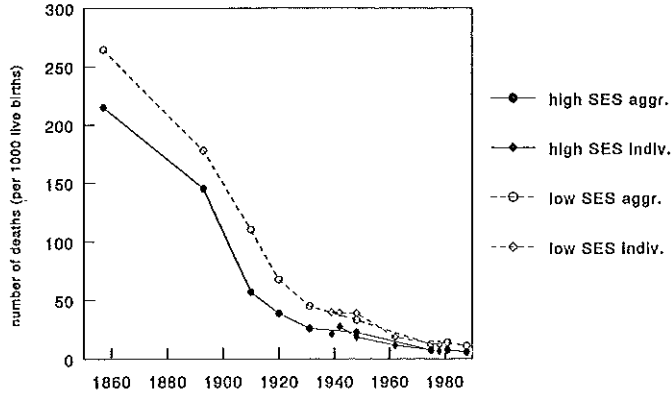


Figure 3. Trend in estimated perinatal mortality by socio-economic status, 1946-1980

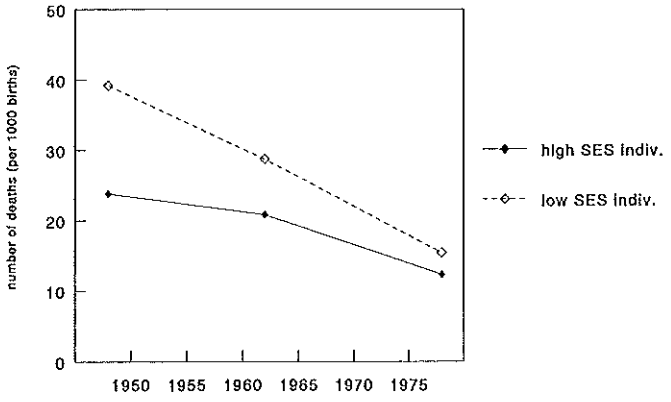


Figure 4. Infant mortality by socio-economic status, slope index of inequality, 1854-1990

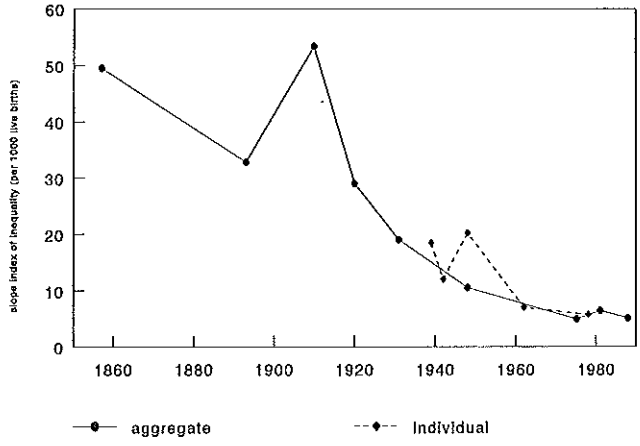
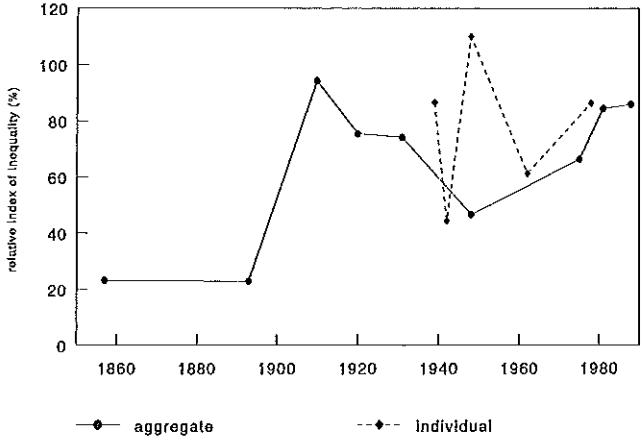


Figure 5. Infant mortality by socio-economic status, relative index of inequality, 1854-1990



Infant mortality at the aggregate level

The overall infant mortality rate declined enormously during the period studied, from 239 to 9 infant deaths per 1,000 live births. Absolute inequality in infant mortality (the SII), measured at the aggregate level, decreased also. From 1854 to 1859, the infant mortality rate at the bottom of the social ladder was almost 50 per 1,000 live births higher than at the top. In the period 1986-1990 this figure is only 5 more deaths per 1,000 live births. The SII has been decreasing continuously since 1854. Only the

years 1909-1911 are an exception to this trend: in this period the SII is as high as in 1854-1859, although the total mortality level decreased to one-third of the level in 1854-1859 (from 239 to 81 per 1,000).

The relative inequality in infant mortality (the RII) at the aggregate level increases during these 150 years. In the nineteenth century relative inequalities were markedly smaller than in the twentieth century. In the twentieth century an extreme value of 94.2 for the RII is found in the period 1909-1911. In the period after World War I its value decreases, but after World War II it increases again. The RII in the most recent period (1986-1990) is 85.9. This means that in 1986-1990, infant mortality at the bottom of the social ladder is approximately 86% higher than at the top. A very low value of the RII is found just after World War II (46.6): approximately 47% more infant deaths at the bottom of the social ladder than at the top.
In summary, the results from the aggregate level analysis suggest that absolute differences in infant mortality have decreased during the study period, whereas relative differences have increased.

Infant mortality at the individual level

The absolute differences in infant mortality by occupational class could only be studied from 1937 onwards and they decreased markedly, thereby confirming the results of the aggregate level analysis. The surplus of infant deaths per 1,000 live births at the bottom of the social ladder decreased from 18 in 1937-1940 to 6 in 1975-1980. Shortly after World War II the SII temporarily increased to a level of 20.2.
There seems to be no overall decrease or increase in relative socio-economic differences at the individual level between 1937 and 1980. The relative index is approximately 87 in the period 1937-1940 as well as in the period 1975-1980. This means 87% more infant deaths in the lowest SES relative to the highest SES. The smaller value of the RII during World War II is striking. Despite a higher mean level of infant mortality during these years, relative inequality seems to be smaller: the RII is 44.3. Shortly after World War II the RII reached the very high level of 110.

A comparison between studies at the individual and aggregate levels shows largely the same trends in time for absolute and relative inequality, though data at the aggregate level encompass a longer time period. SEMD have been decreasing in absolute terms since World War II, but relative differences have not. The small absolute inequality during World War II at the individual level could not be compared with aggregate data because the latter were not available. Relative differences at the individual and aggregate levels only deviate substantially from each other in 1946-1950, with RIIs of 110 and 47 respectively.

Figure 6. Perinatal mortality by socio-economic status, slope index of inequality, 1946-1980

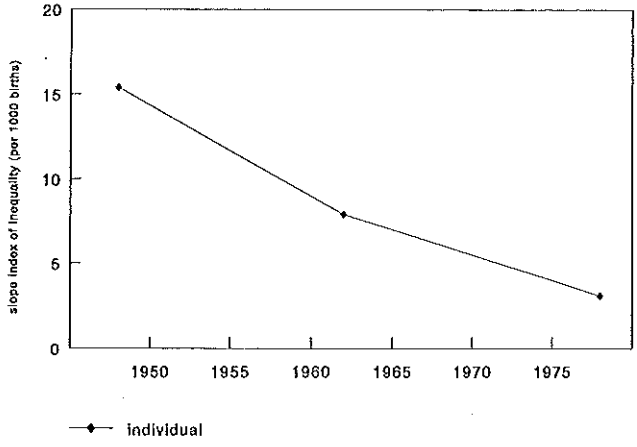
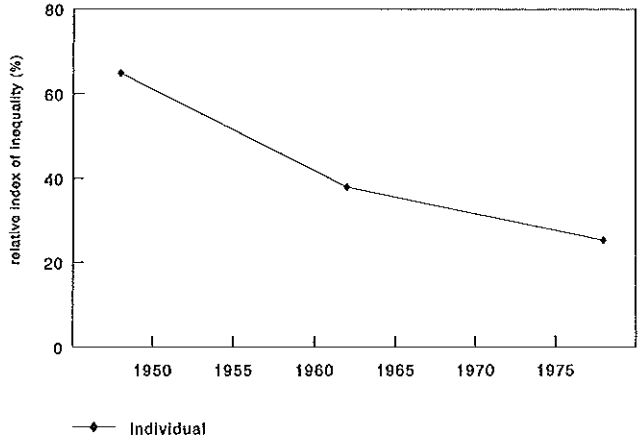


Figure 7. Perinatal mortality by socio-economic status, relative index of inequality, 1946-1980



Perinatal mortality at the individual level

The trend with respect to inequality in perinatal mortality could only be studied from 1946 onwards and differs from that in infant mortality. The overall mortality rate declined from 31 deaths per 1,000 births in 1946-1950 to 14 in 1975-1980. Both absolute and relative inequalities decreased markedly. The SII demonstrates a decrease in the period 1946-1980 from 15 to 3 more perinatal deaths per 1,000 births at the bottom of the social ladder than at the top, while the RII decreases from 65 to 25%.

3.1.4 DISCUSSION

In this chapter, data are presented on socio-economic differences in infant and perinatal mortality in Amsterdam from 1854 to 1990. It can be concluded that SEMD in infant and perinatal mortality still exist, although the overall level of infant and perinatal mortality decreased markedly in this period. Data at the aggregate level show that in absolute terms socio-economic inequalities in infant mortality have decreased since the second half of the nineteenth century. Data at the individual level (only available for the period after 1937) confirm this trend. The decrease in absolute SEMD is mainly caused by the overall decrease in infant mortality since relative differences show a completely different pattern: they increase or at least do not decrease during the time period described. With respect to perinatal mortality, absolute and relative differences have decreased since 1946.

The figures may be biased in several ways. Firstly, some data sets concern fewer SES groups or neighbourhoods than others. In the case of fewer groups the differences within groups may become larger and those between groups smaller. We tested this hypothesis by comparing a different number of SES groups for the same data sets on 1854-1859 (4 and 50 neighbourhoods)[24] and 1891-1894 (6 and 50 neighbourhoods)[25] (Table 1). The SII and RII increase with the number of neighbourhoods. However, the differences are relatively small and even with 50 neighbourhoods the RIIs are smaller than in the twentieth century. We conclude that the number of groups did not introduce much bias in the inequality indices used.
A second source of bias with respect to infant and perinatal mortality at the individual level might be the exclusion of the unemployed (as a separate SES group) from the analysis of the 1975-1980 data. It is not known whether the unemployed are included in the other studies. If they are, inequalities in the period 1975-1980 may be underestimated, because the unemployed are over-represented in lower SES groups and have a higher perinatal and infant mortality[21].
Thirdly, bias with respect to infant mortality at the aggregate level may have been introduced by applying different SES measures. The neighbourhoods were ranked by a wealth score, determined partly on the basis of income or income tax. The exact components of the wealth score were not given in all studies. However, since income tax was used as part of the SES measure in most of the studies, bias introduced by differences in the SES measure is not very likely. We tested the influence of the SES measure by using 2 SES measures for the same data set: the neighbourhoods for the period 1979-1983 were also ranked by the mean income for 1984 and for the period 1986-1990 by the wealth index for 1983[22,23], (Table 1). Differences in the SII and RII were relatively small, so they do not affect conclusions about trends in time.
Finally, some bias may have been introduced by differences in the registration of mortality in different periods. In 1917 the definition of infant mortality was changed[45]. Up until 1917 children who died before notification (within the first 3 days) were registered as stillbirths and afterwards as infant mortalities. However, the figures we

used were based on the old definition until 1923. The old definition underestimated infant mortality by approximately 13 per 1,000 in the period 1843-1923 compared to the new one[46]. As a consequence the SII in the period before 1923 is sligthly underestimated, but this will hardly affect the trend in time. The RII is not likely to have been affected by this change. Perinatal mortality is affected more directly by variations in the notification practice than infant mortality[47] and in particular underregistration is more likely[48]. Some studies show underregistration among ethnic minorities, which is likely to yield an underestimation of socio-economic differences. For instance Doornbos and Nordbeck[21] reported a 9% under-registration among Dutch ethnic minorities and in Georgia, USA, underregistration was more common among Blacks, unmarried mothers and those of lower SES[49,50]. If so, the SII and RII might be underestimated. However, no direct information is available on socio-economic differences in (under)-registration of perinatal mortality in The Netherlands.

The development of differences in infant mortality between SES groups in Amsterdam can be divided into 3 time periods: 1850-1910, 1910-1950 and post-1950. The *first period* shows an increase in relative differences and a decrease in absolute differences. A possible explanation for the increase in relative differences is that socio-economic differences between neighbourhoods were less distinct in the second half of the nineteenth century, than in the twentieth century. In the late nineteenth and early twentieth century a segregation took place between higher and lower SES groups with respect to the neighbourhood in which they live[39,51]. Thus, the increase in relative SEMD might be due to socio-economic homogenization of neighbourhoods and not to increasing SEMD at the individual level. If this is true, this would be an example of the 'ecological fallacy'[52]. An alternative explanation may be that at the end of the nineteenth century serious efforts were made in improving health, which lowered the infant mortality (e.g. improving the quality of drinking water and food, sanitation reforms, hygienic programmes and preventive care). In 1903 the first office of the municipal health service for preventive infant care opened in Amsterdam[53]. The increase in SEMD at the beginning of this century and the decrease later on may be explained by the fact that at the time the innovation started these efforts reached the higher SES groups earlier than the lower SES groups.
Our data show a high level of SEMD in the period around 1910 at the aggregate level. At the individual level no data were available concerning Amsterdam. However, individual data from other cities confirm this result[39,54]. This indicates that the high level of relative differences we found at the beginning at the twentieth century cannot (fully) be explained by the ecological fallacy.

The *second period* (from approximately 1910 to approximately 1950) can be characterized by a decrease in relative and absolute SEMD from the high level at the beginning of the century, up until the end of World War II. The small size of SEMD during World War II can perhaps be explained by the fact that the general socio-economic context was so uniformly poor[55] that unfavourable living conditions, like food shortages,

which caused an absolute increase in infant mortality, might have affected the total population (more or less) equally. As a result, relative differences between SES groups decreased.
In the period 1946-1950 a large discrepancy was found between data at the aggregate level and at the individual level. Temporary socio-economic heterogenization of neighbourhoods is the most likely explanation for this decrease: due to the severe housing shortage just after World War II, many people lived in areas with a socio-economic level not corresponding to their individual socio-economic status. In addition, the difference between aggregate and individual level data may also be caused by the use of an SES indicator based on income tax in 1931/1932 for ranking the neighbourhoods in 1946-1950. Possibly the wealth ranking of neighbourhoods changed during the war period; for instance, the Jewish quarter disappeared. However, the indices we used are not very sensitive to a change in 1 single neighbourhood.
This comparison between individual and aggregate data thus suggests that the ecological fallacy explains the low level of relative differences between neighbourhoods in the period 1946-1950. The real differences between individuals may have been larger, as shown by data at the individual level.

The *third period*, after World War II, is characterized by a stabilization of relative inequalities in infant mortality. The data at the individual level show large fluctuations around the same, approximately stable level. The data at the aggregate level point in the same direction: if the small size of the relative inequality as measured at the aggregate level in the period 1946-1950 is indeed caused by the ecological fallacy, the real differences were larger and the overall trend of relative differences at the aggregate level also suggests a stabilization.
With respect to perinatal mortality the absolute and the relative differences decreased after World War II. It is known that perinatal mortality is affected more by medical care than infant mortality. The implementation of a public health insurance system after World War II may have diminished differences in access to medical care. Infant mortality is more related to differences in life style and economic environment than perinatal mortality. After World War II the adoption of healthier life styles (for instance the decline in smoking) started earlier among higher SES groups[56,57]. This may account for an increase in infant mortality differences; differences in perinatal mortality however, will hardly have been affected by this process, which possibly explains why socio-economic differences in perinatal mortality decrease more than in infant mortality.

With respect to relative inequality in infant mortality, the results from this study on The Netherlands are consistent with results from studies on Great Britain and Scandinavia[17-19]: SEMD seem to have increased, or at least do not seem to have decreased during the last 150 years. The reduction in absolute SEMD in the same period means, however, that the overall burden of early mortality among low socio-economic groups has been diminished. However, infant mortality in particular is a

reliable indicator of general welfare and deprivation[18] and the persistence of relative mortality differences indicates that efforts that have been made to improve the health of the lowest socio-economic groups have not been fully effective. For instance, an intervention to improve the uptake of infant immunization in a region in Great Britain contributed to an increase in overall uptake, but inequalities between deprived and affluent areas widened[58]. Our results emphasize the need for a policy which does not only rely on a general improvement, but aims at improving health among the most deprived groups. Research on the explanation for socio-economic inequalities in health, for instance on the contribution of life style and environmental exposure concerning socio-economic differences in infant mortality, is a necessary basis for such a policy. The development of effective interventions on determinants of socio-economic differences in infant mortality is necessary. If no extra efforts are made, relative SEMD in infant mortality will not have been reduced by 25% by the year 2000. Worse still, they may well even prove to have increased by then.

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3.2

THE CONTRIBUTION OF CHILDHOOD ENVIRONMENT TO THE EXPLANATION OF SOCIO-ECONOMIC INEQUALITIES IN HEALTH IN ADULT LIFE: A RETROSPECTIVE STUDY

ABSTRACT

In this study the contribution of childhood environment to the explanation of socio-economic inequalities in health in adulthood is examined. Childhood environment was measured using indicators of social, socio-economic and material aspects. Retrospective data obtained from an oral interview, part of the Longitudinal Study on Socio-Economic Health Differences (a longitudinal study in the South East of the Netherlands), were used. Indicators for socio-economic status at adult age were educational and occupational level, whilst health indicators included perceived general health and self-reports of chronic conditions. The percentage reduction in Odds Ratios of education and occupation after adjustment for childhood environment was used to estimate the contribution of childhood environment.

The results suggest that a substantial part of differences in health between educational and occupational groups can be attributed to differences in childhood environment. Educational level of the mother, occupation of the father and financial situation of the family are the most important childhood characteristics in the explanation of socio-economic health differences in adult life. Different mechanisms of explanation concerning the contribution of childhood environment to socio-economic differences in adult life are discussed.

3.2.1 INTRODUCTION

Inequalities in health between people from different socio-economic classes have been observed in many West European countries.[1-3] Childhood environment, such as deprivation in early life, probably explains part of these socio-economic health differences (SEHD) in adult life.[4] However, it is still unknown to what extent childhood environment plays a role in the explanation of SEHD. Its contribution will be studied in this chapter.

Childhood environment can only contribute to the explanation of SEHD in adult life if it is related to both adult health and adult socio-economic status (SES).
Adverse environmental conditions during childhood that affect adult health include material factors such as bad housing conditions, social circumstances such as living in a one-parent family, and behavioural factors such as unhealthy dietary habits. For example, growing up in a big family, low birth order, living in a one-parent family[5-10], material deprivation during childhood[9,11], and low levels of parental occupation and education[8,12,13] have been demonstrated to influence health later on in life.
Unfavourable childhood conditions are also related to adult socio-economic position. As the SES of a person is partially determined by the SES of his or her parents, people who belong to lower SES-groups will usually have grown up in worse circumstances than persons from higher SES-groups.

Although there have been several studies that examined the relationship between poor childhood conditions and health in adult life, studies in which childhood environment ánd adult health ánd adult SES are incorporated still remain rare. In Great Britain and Scandinavia some research has been done in which these three aspects were studied simultaneously, but the results do not lead to the same conclusions. On the one hand, for example, Power[5] and Lundberg[11] found that childhood circumstances made a substantial contribution to class differentials in health in adult life. On the other hand, Lynch et al[14] reported that the increased risk for lower income groups of all-cause and cardiovascular mortality was not related to childhood conditions. However, Vågerö and Leon[15] carried out the same analysis in a cohort of Swedish middle-aged men and they concluded the opposite. Results of some other studies in which childhood environment, adult health and adult SES were analysed simultaneously[16,17,18] suggest that part of the socio-economic inequalities in adult life can be explained by childhood environment. However, since the research questions in these studies focus on the direct effect of childhood environment on adult health and not, as we did in our study, on the contribution of childhood environment to SEHD in adult life, definite conclusions about the impact on SEHD cannot be drawn.

In the Longitudinal Study of Socio-Economic Health Differences (LS-SEHD) in the Netherlands, retrospective data on childhood environment are available to investigate the contribution of childhood environment to socio-economic inequalities in adult

health. The LS-SEHD offers the opportunity to study the effects of childhood environment in a population of 25-74 year olds, in contrast with other studies[5,14] which focus on restricted age groups. Moreover, in the LS-SEHD the contribution of several aspects of childhood environment (material, socio-economic and social) can be examined simultaneously. It is possible to determine *which* aspects of childhood environment are the most important in the explanation of SEHD. Data are available for different health indicators and different SES-measures. The results of the LS-SEHD can give important additional information about the contribution of childhood environment to the explanation of SEHD.

In this chapter the contribution of childhood environment to the relationship between SES and health in adult life is studied. Childhood environment is defined as material, socio-economic and social circumstances at the age of 12. The research questions are as follows:

- What is the contribution of childhood environmental characteristics to the explanation of SEHD in adult life?
- Which childhood environmental characteristics are the most important in this explanation?

3.2.2 DATA AND METHODS

The design and objective of the LS-SEHD are described in detail elsewhere.[19] The study is based on a cohort of 15-74 year old, non-institutionalized Dutch nationals, living in the city of Eindhoven and surroundings (a region in the South East of the Netherlands). At the time of the start of the survey a random sample of approximately 27,000 people was drawn from the population registries of the participating municipalities, stratified by age and post code (45-74 year old people and people from the highest and lowest SES-groups, as indicated by post code, were overrepresented in order to increase the statistical power of the study and the socio-economic contrast within the study population). Because we analyse differences between SES-strata adjusted for age, weighting of the sample is not required. People in this sample were sent a postal questionnaire in 1991. In this analysis cross-sectional data obtained from a subsequent oral interview were used. The aselect sample (approximately 3,500 persons) for this interview (again stratified by post code) was taken from the group of respondents to the postal survey. The response rate for the postal survey was 70.1%, resulting in a study population of 18,973 respondents. The response rate for the oral interview was 79.4% (2,802 respondents). No significant differences in response rate for both the postal survey and the oral interview have been found by sex, age, marital status, degree of urbanization and socio-economic status (measured by post code). This implies that this study population highly resembles the original sample as far as the distribution of socio-demographic variables is concerned. The study population used in this analysis was restricted to persons 25 and older, since the influence of childhood characteristics on the socio-economic status finally attained, as well as on adult health, has not yet been established in persons of younger age. This resulted in a study population of 2,462 persons. Persons whose occupational status could not be determined because they and their partner never were in paid employment (182 respondents) were excluded from the study population. In additional analysis we checked whether this changed the results with respect to education, and it did not. People for whom information on any childhood environmental factor, education, occupation, perceived general health or chronic conditions was missing in the remaining study population of 2,280 respondents, were excluded from the analysis (18.9%). The analysis is based on complete data of 1,850 respondents.

In the LS-SEHD several indicators of (self-reported) health and socio-economic status were measured. In this analysis the highest level of education attained and the occupational level of the head of the household were used as indicators of socio-economic status. Students were classified by their current course. Educational level was divided into 5 categories (university, higher vocational, intermediate general and intermediate vocational, lower general and lower vocational, primary school). The occupational level was determined on the basis of the current occupation (or the last if not in paid employment) of the head of the household. Occupations were classified according to the Erikson, Goldthorpe and Portocarero (EGP)-scheme[20] into 5 cate-

gories: higher grade professionals, lower grade professionals/routine non-manual, self-employed, high and low skilled manual and unskilled manual. Self-reported health was indicated by perceived general health and by presence of chronic diseases at the time of the survey. Perceived general health was measured by the question "how do you rate your health in general". A dichotomous variable was constructed ("very good, good" versus "fair, sometimes good and sometimes bad, bad"). Chronic conditions were determinded according to a list of 23 chronic diseases. The answers were classified in two categories: none versus one or more chronic conditions.
Environmental childhood characteristics were measured retrospectively by means of questions on the respondent's situation at the age of 12. The following socio-economic variables were constructed: position of the father in the labour market (paid job versus other), position of the mother in the labour market (housewife versus other), occupational level of the father (7 categories) and educational level of the mother (5 categories). Social variables were: family structure (two-parents, one-parent, other), family size (one child, 2-4 children, 5 or more children) and number of older siblings (no older siblings, 1-3 older siblings, 4 or more older siblings). Financial situation (no shortage of money, sometimes shortage of money, (very) often shortage of money) was measured as material variable. This was asked for the whole period of upbringing, not only for the age of 12. Respondents living with their parents at the time of the survey did not answer the question about financial situation.

The first step in the analysis was to study the association between childhood environment and socio-economic status (as indicated by education and occupation), as well as that between childhood environment and health. Only when childhood characteristics are related to both socio-economic status and health, they can play a role in the explanation of SEHD in adult life. Percentages were standardized for sex and age using the direct method. As the numbers in the highest educational levels (higher vocational level and university) were small, these groups were combined.

Logistic regression was used to estimate the contribution of childhood environment to the explanation of SEHD in adult life. The demographic variables age (5-years categories), sex, marital status, degree of urbanization and religious affiliation were added as confounders to the model. Health differences between educational and occupational groups are expressed in Odds Ratios (OR) with 95% confidence intervals. The highest level was used as a reference. One or more environmental childhood characteristics were added to a model with educational or occupational level and confounders only. The contribution of childhood environment was measured by the percentage reduction in the Odds Ratios of educational and occupational level compared to the first model. The formula used is: (OR model A - OR model B)/ (OR model A -1). Childhood characteristics were separately added to the model, and as a cluster. The models contained no zero cell counts. Some cells contained only a few cases, but this did not cause numeric instability. This was checked using the methodology of Belsley et al.[21]
Because childhood factors may be interrelated it is recommended to fit models with

interactions between childhood characteristics.[9] Interactions that significantly changed the model ($p<0.15$)[22], were added to the full model. This was the case for a few interactions only. The reduction in deviance caused by the inclusion of education or occupation (RD) was used as an overall statistical test of *the effect of education respectively occupation* on health. The difference in RD between a model with and a model without childhood characteristics (DRD) was used as a statistical test of *the contribution of childhood environment* to the relationship between education respectively occupation and health.

3.2.3 RESULTS

The association between childhood environment and socio-economic status resp. health is shown in Table 1 and 2. As shown in Table 1, the percentage of persons reporting unfavourable childhood conditions is highest among persons who currently are in the lower educational and occupational groups. This relationship is found for almost all childhood characteristics. For unfavourable situations such as a one-parent family, having a father without a paid job or a mother not being a housewife the results are less clear in the case of occupational level: "unskilled manual workers" do not register the highest percentage of persons reporting these (unfavourable) circumstances. Respondents with unfavourable circumstances during childhood, e.g. respondents whose father was an unskilled manual worker or whose mother had a lower educational level, report a less-than-"good" perceived general health more frequently than respondents who had grown up in good circumstances (Table 2).

Table 1. Persons with unfavourable environmental childhood characteristics by current educational and occupational level, men and women, 25-74 years, standardized by age[a] and sex

		Father's occupation unskilled		Mother's education primary school		(Very) often short of money[b]		Family size > 4 children		> 3 older siblings		One-parent family		Father no paid job		Mother not a housewife	
		%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N
educational level[c]	1	9.0	37	31.5	123	2.5	10	47.6	164	18.4	61	6.7	25	9.1	34	10.5	42
	2	15.2	64	55.7	215	6.9	25	47.1	181	20.7	78	5.2	22	8.7	37	12.6	58
	3	27.2	194	69.8	495	8.8	63	59.4	430	26.9	192	5.7	40	10.2	69	11.4	81
	4	39.0	127	81.5	299	20.5	63	67.5	245	32.0	115	7.9	20	10.7	39	13.6	39
occupational level[d]	1	11.0	22	44.1	87	2.7	6	47.4	96	16.1	33	5.5	11	8.9	18	10.5	19
	2	16.4	145	53.4	470	6.0	52	49.4	433	20.7	182	5.5	48	8.3	72	12.4	110
	3	13.6	8	59.8	40	4.5	3	72.2	48	29.0	20	6.0	3	14.1	9	19.1	12
	4	34.8	143	75.5	313	13.1	56	62.2	257	28.4	117	6.6	27	12.6	52	10.8	43
	5	37.0	104	76.9	222	15.5	44	64.2	186	32.6	94	6.1	18	10.1	28	12.3	36

a. 10-years categories
b. respondents living with parents at the time of the survey not presented (N=19)
c. 1 = higher vocational/university; 2 = intermediate vocational/intermediate general; 3 = lower vocational/lower general; 4 = primary school
d. 1 = higher grade professionals; 2 = lower grade professionals/routine non-manual; 3 = self-employed; 4 = high/low skilled manual; 5 = unskilled manual

Table 2. Persons with less-than-"good" perceived general health or one or more chronic conditions by environmental childhood characteristic, men and women, 25-74 years, standardized by age[a] and sex

		less-than-"good" perceived health		≥ 1 chronic conditions	
		%	N	%	N
Occupation father[b]	1	18.6	22	46.8	54
health	2	22.0	49	50.0	116
	3	22.2	39	48.8	86
	4	26.4	95	43.9	158
	5	29.8	37	43.4	54
	6	28.8	121	49.7	209
	7	32.2	136	50.7	217
Education mother[c]	1	16.9	6	42.9	19
	2	23.0	21	55.6	49
	3	18.7	41	40.9	88
	4	25.5	80	50.1	152
	5	28.5	351	49.5	586
Financial situation[d]	Never short of money	25.8	391	47.8	726
	Sometimes short of money	28.6	38	55.2	78
	(Very) often short of money	37.0	66	49.6	84
Family size	1 child	21.2	9	46.9	22
	2-4	26.3	188	49.7	365
	>4	28.5	302	48.4	507
Number of older siblings	No older siblings	23.4	116	44.5	222
	1-3	27.0	241	50.6	452
	>3	31.2	142	47.8	220
Family structure	Two-parents	26.7	448	48.4	815
	One parent	26.1	28	45.3	48
	Other	34.8	23	48.1	31
Position father labour market	Paid job	26.8	444	48.2	804
	Other	30.7	55	51.1	90
Position mother labour market	Housewife	26.5	435	48.2	790
	Other	30.3	64	48.5	104

a. 10-years categories
b. 1 = higher grade professionals; 2 = lower grade professionals; 3 = routine non-manual; 4 = self-employed; 5 = high skilled manual; 6 = low skilled manual; 7 = unskilled manual
c. 1 = higher vocational/university; 2 = intermediate vocational/intermediate general; 3 = lower general; 4 = lower vocational; 5 = primary school
d. respondents living with parents at the time of the survey not presented (N=19)

This trend can be observed for all childhood characteristics, except for family structure, where living in a one-parent family was expected to be associated with less-than-"good" perceived general health, but in reality was not. Also the percentage of persons reporting one or more chronic conditions is higher among respondents who had grown-up in the worst childhood circumstances, although the association between childhood characteristics and chronic conditions is less clear than that between childhood characteristics and perceived general health. The results show that mother's educational level, father's occupation, financial situation, and the number of older siblings have the strongest association with current educational and occupational level as well as with health in adult life.
As shown in Table 1, the percentage of persons reporting unfavourable childhood conditions is highest among persons who currently are in the lower educational and occupational groups. This relationship is found for almost all childhood characteristics. For unfavourable situations such as a one-parent family, having a father without a paid job or a mother not being a housewife the results are less clear in the case of occupational level: "unskilled manual workers" do not register the highest percentage of persons reporting these (unfavourable) circumstances. Respondents with unfavourable circumstances during childhood, e.g. respondents whose father was an unskilled manual worker or whose mother had a lower educational level, report a less-than-"good" perceived general health more frequently than respondents who had grown up in good circumstances (Table 2). This trend can be observed for all childhood characteristics, except for family structure, where living in a one-parent family was expected to be associated with less-than-"good" perceived general health, but in reality was not. Also the percentage of persons reporting one or more chronic conditions is higher among respondents who had grown up in the worst childhood circumstances, although the association between childhood characteristics and chronic conditions is less clear than that between childhood characteristics and perceived general health. The results show that mother's educational level, father's occupation, financial situation, and the number of older siblings have the strongest association with current educational and occupational level as well as with health in adult life.

In order to estimate the contribution of childhood environment to the explanation of educational and occupational differences in health a multiple logistic regression analysis was performed. The childhood characteristics were all added to a model with educational or occupational level and confounders only (Figure 1-4). The association between educational and occupational levels and perceived general health is statistically significant. For both health indicators socio-economic differences in health problems decrease when childhood characteristics are added to the model. The decrease in Odds Ratio is bigger in the lower socio-economic groups. After adjustment for childhood characteristics the effect of educational and occupational level on perceived general health is still significant. This means that class differences in health can only partly be explained by childhood environment. Chronic conditions are not statistically significantly related to educational and occupational level. But the pattern of decline caused

by the inclusion of childhood environmental factors is comparable to that in the case of perceived general health.

For example, the Odds Ratio of the lowest occupational group for a less-than-"good" perceived general health is 2.64. When childhood characteristics are added to the model the Odds Ratio decreases to 2.21. This means that an estimated 26% [(2.64-2.21)/(2.64-1.00)]x100% of the increased risk of a less than "good" perceived general health for the lowest occupational group, as expressed by the Odds Ratio, can be attributed to childhood environment. With respect to the relationship between educational level and perceived general health a reduction in Odds Ratio of 10.6% was found in the next highest and 18.1% in the lowest educational group.

Figure 1. Perceived general health by education. Adjustment for childhood environment

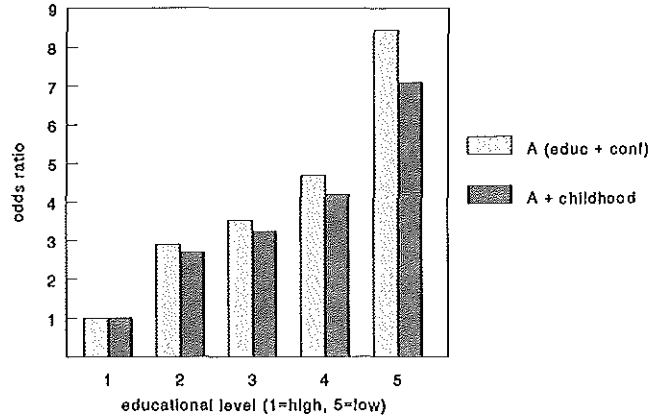


Figure 2. Perceived general health by occupation. Adjustment for childhood environment

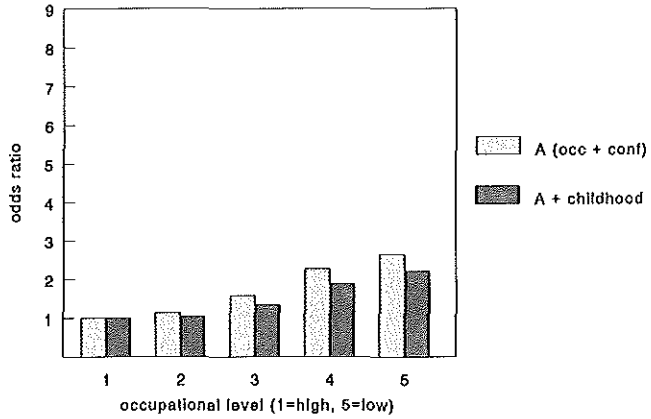


Figure 3. Chronic conditions by education. Adjustment for childhood environment

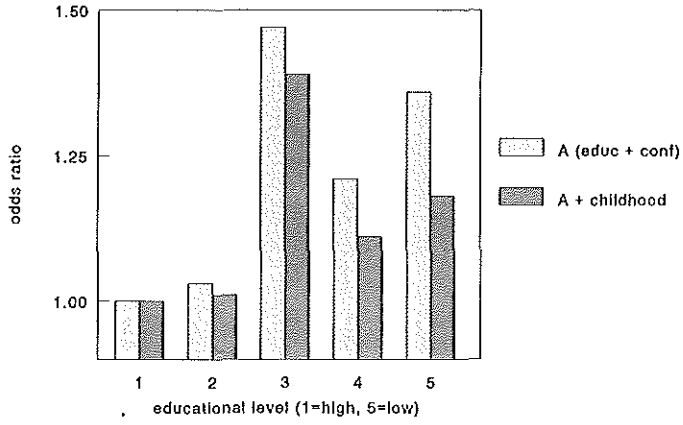
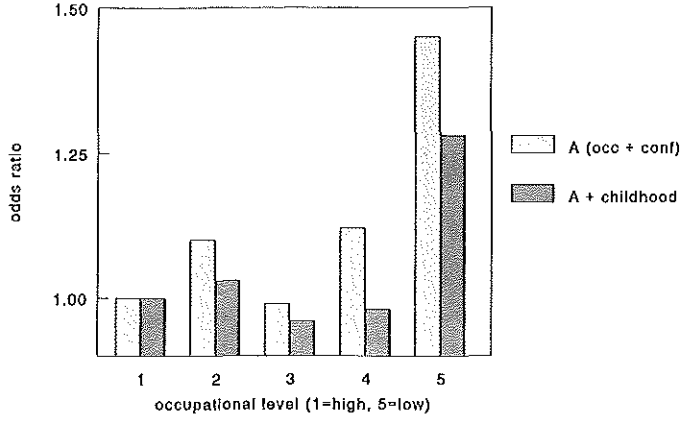


Figure 4. Chronic conditions by occupation. Adjustment for childhood environment



To examine *which* of the childhood characteristics are the most important in the explanation of SEHD in adult life we estimated the contribution of each single childhood characteristic. We fitted models for perceived general health as well as for chronic conditions using educational and occupational level as an indicator of SES. Because the results were highly similar, the relationship between educational level and perceived general health is presented as an example (Table 3). Childhood characteristics were added separately to a model (model A) with educational level and confounders only.

When for example occupation of the father is added to model A, the percentage reduction in Odds Ratios varies between 3.2% (higher vocational) and 6.9% (primary school). Factors making a contribution are educational level of the mother, occupation of the father and financial situation. Other factors hardly contributed. Three factors caused an increase of the Odds Ratio in the lower socio-economic groups instead of a decrease: family size, position of the father in the labour market and family structure, but these effects were not statistically siginificant. These factors cannot contribute to the explanation of the increased risk of health problems for the lower educational levels.

Since environmental childhood characteristics are likely to be interrelated[9], the contribution of a single childhood factor can be divided in two parts: a specific childhood characteristic can have an impact on health or socio-economic position either by its own or through other childhood characteristics. So the contribution of the three most important factors was estimated adjusting for other childhood factors. Childhood characteristics were added stepwise to the model in sequence of their univariate importance (i.e. reduction in Odds Ratio as presented in Table 3), in order to examine the cumulative impact of a chain of circumstances. The results are presented in Table 4. The larg-est part of the reduction in Odds Ratios can be attributed to educational level of the mother. Occupation of the father accounts for about one quarter more, followed by financial situation. In the lowest educational group financial situation accounted for more (approximately 22%) than in other educational groups. The total decrease in Odds Ratios when adding childhood environment to the model can be attributed to about 70 to 90% to these three variables.

Table 3. Odds Ratios[a] for less-than-"good" perceived general health by current educational level, before and after adjustment for specific environmental childhood characteristics, men and women, 25-74 years

		model A[b]	model A + *education mother*	
		OR [95% CI]	OR [95% CI]	Diff. with A (%)[d]
educational level[c]	1 (110)	1	1	-
(N)	2 (278)	2.89 [1.31-6.37]	2.82 [1.27-6.23]	3.7
	3 (409)	3.52 [1.63-7.57]	3.35 [1.54-7.25]	6.7
	4 (715)	4.68 [2.20-9.95]	4.40 [2.05-9.47]	7.6
	5 (338)	8.44 [3.91-18.21]	7.91 [3.60-17.35]	7.1
RD education[e]		60.461***	50.686***	
DRD education[e]				9.775*

		model A + *position mother labour market*	
		OR [95% CI]	Diff. with A (%)
educational level	1	1	-
	2	2.88 [1.31-6.36]	0.5
	3	3.50 [1.63-7.54]	0.8
	4	4.67 [2.20-9.92]	0.3
	5	8.41 [3.90-18.16]	0.4
RD education		60.275***	
DRD education			0.186 ns

a. Odds Ratios corrected for age (5-years categories), sex, marital status, degree of urbanization and religious affiliation
b. model A = educational level + confounders
c. 1 = university; 2 = higher vocational; 3 = intermediate vocational/intermediate general; 4 = lower vocational/lower general; 5 = primary school
d. only decrease in Odds Ratios > 1 is calculated:
(OR model A − OR model B)/(OR model A − 1)
e. * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$; ns = $p \geq 0.05$

less-than-"good" perceived general health

model A + *occupation father*		model A + *financial situation*		model A + *number of older siblings*	
OR [95% CI]	Diff. with A (%)	OR [95% CI]	Diff. with A (%)	OR [95% CI]	Diff. with A (%)
1	-	1	-	1	-
2.83 [1.28-6.25]	3.2	2.85 [1.29-6.28]	2.1	2.87 [1.30-6.33]	1.1
3.41 [1.58-7.37]	4.4	3.45 [1.60-7.43]	2.8	3.50 [1.62-7.53]	0.8
4.46 [2.08-9.56]	6.0	4.57 [2.15-9.71]	3.0	4.61 [2.17-9.81]	1.9
7.93 [3.61-17.39]	6.9	7.98 [3.68-17.27]	6.2	8.22 [3.80-17.76]	3.0
49.533***		54.744***		57.626***	
	10.298*		5.717 ns		2.835 ns
model A + *family size*		model A + *position father labour market*		model A + *family structure*	
OR [95% CI]	Diff. with A (%)	OR [95% CI]	Diff. with A (%)	OR [95% CI]	Diff. with A (%)
1	-	1	-	1	-
2.89 [1.31-6.37]	0.0	2.91 [1.32-6.42]	-	2.92 [1.32-6.45]	-
3.51 [1.63-7.56]	0.4	3.54 [1.64-7.63]	-	3.63 [1.68-7.83]	-
4.71 [2.22-10.01]	-	4.70 [2.21-10.00]	-	4.88 [2.29-10.39]	-
8.49 [3.93-18.36]	-	8.48 [3.93-18.29]	-	8.82 [4.08-19.08]	-
60.127***		60.404***		62.628***	
	0.334 ns		0.057 ns		2.167 ns

Table 4. Odds Ratios[a] for less-than-"good" perceived general health by current educational level, before and after adjusting for specific environmental childhood characteristics (stepwise), men and women, 25-74 years

		model A[b]	model B	
		OR [95% CI]	OR [95% CI]	Diff. with A (%)[c]
educational level[d] (N)	1 (110)	1	1	-
	2 (278)	2.89 [1.31- 6.37]	2.82 [1.27- 6.23]	3.7
	3 (409)	3.52 [1.63- 7.57]	3.35 [1.54- 7.25]	6.7
	4 (715)	4.68 [2.20- 9.95]	4.40 [2.05- 9.47]	7.6
	5 (338)	8.44 [3.91-18.21]	7.91 [3.60-17.35]	7.1
RD education[e]		60.641***	50.686***	
DRD education[e]				9.775*

a. Odds Ratios corrected for age (5-years categories), sex, marital status, degree of urbanization and religious affiliation
b. model A = educational level + confounders
model B = A + education mother
model C = B + occupation father
model D = C + financial situation
model E = D + other environmental childhood characteristics
(incl. interactions between environmental childhood characteristics)
c. only decrease in Odds Ratios >1 is calculated:
(OR model A − OR model B)/(OR model A − 1)
d. 1 = university; 2 = higher vocational; 3 = intermediate vocational/intermediate general; 4 = lower vocational/lower general; 5 = primary school
e. * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$; ns = $p \geq 0.05$

less-than-"good" perceived general health						
model C		model D		model E		
OR[95% CI]	Diff. with B (%)	OR [95% CI]	Diff. with C (%)	OR [95% CI]	Diff. with D (%)	Diff. with A (%)
1	-	1	-	1	-	-
2.78 [1.26- 6.16]	2.2	2.75 [1.24- 6.08]	1.7	2.69 [1.20- 6.03]	3.4	10.6
3.30 [1.52- 7.16]	2.1	3.26 [1.50- 7.09]	1.7	3.23 [1.47- 7.13]	1.3	11.5
4.30 [1.99- 9.30]	2.9	4.26 [1.97- 9.20]	1.2	4.18 [1.91- 9.17]	2.5	13.6
7.67 [3.47-16.98]	3.5	7.41 [3.34-16.44]	3.9	7.09 [3.14-16.00]	5.0	18.1
45.945***		43.382***		38.643***		
	4.741 ns		2.563 ns		4.749 ns	21.828

3.2.4 DISCUSSION

In this study the health effect of childhood environment is examined from a different viewpoint than most other authors do. Our focus is to investigate the contribution of childhood environment to the relation between adult SES and adult health. The long-term objective of the LS-SEHD is to explore which factors should be subject of interventions aimed at diminishing socio-economic inequalities in health. In this approach adult SES is not a mediating factor in the relationship between childhood environment and adult health: the aim is to establish to what extent SEHD in adult life have their roots in childhood environment.

The results of this study suggest that a substantial part of differences in adult health between educational and occupational groups can be attributed to childhood environment. Educational level of the mother, occupation of the father and financial situation account for the largest part of this contribution. The reduction in Odds Ratios for lower educational groups for a less-than-"good" perceived general health varies between approximately 11% (higher vocational) and 18% (primary school), for the lowest occupational group (unskilled manual) the reduction in Odds Ratio is approximately 26%. The reductions in Odds Ratio for chronic conditions show a similar pattern. Our results are broadly in agreement with those of Power[5] and Lundberg[11]. Power found comparable reductions in Odds Ratios when social class in childhood was added to a model with occupation and perceived general health (e.g. the Odds Ratio for the lowest group among men decreased from 2.55 to 2.35). Lundberg reported a DRD of 6% when childhood deprivation was added to a model with occupation and physical illness. In the analysis reported here a DRD of 9% was found when childhood characteristics were added to a model with education and perceived general health.

The results must be interpreted with some caution. *First,* non-response may have influenced the results. To start with, survey non-response has to be considered. As mentioned before, non-response on the postal survey and the oral interview was not related to age, sex, marital status, degree of urbanization and socio-economic status (measured by post code). In order to get insight in other characteristics of the non-respondents a short oral interview was held among a sample of the non-respondents to the postal survey. Thirty percent of them participated. This group was representative for the total group of non-respondents with respect to the demographic variables described above. With respect to health problems (perceived general health and chronic conditions) no differences were found between non-respondents to the postal survey who participated in the short oral interview, and respondents to the postal survey. The percentage of people who attended primary school only, was higher among the non-respondents (34% vs. 23% among the total population). With respect to other SES-measures no differences occurred.[23] In summary results from the oral interview among non-respondents confirm the idea that non-respondents do not differ significantly from respondents. No information was gathered according to childhood conditions. Other authors found that

response rates were not significantly lower among those who had been chronically ill in childhood (in fact they were higher).[24]

There can only be non-response bias in our main results if the relationship between childhood environment on the one hand and educational level and adult health on the other, is different between respondents and non-respondents. If unfavourable childhood conditions had been more frequent among unhealthy non-respondents or non-respondents with lower educational level, an underestimation of the contribution of childhood environment to SEHD would occur; overestimation would occur in case of the opposite. We can only speculate if this could actually be the case. We consider this bias to be unlikely though, since, as mentioned before, no differences were found in the frequency of health problems between respondents and non-respondents; with respect to SES only some differences occurred in the frequency of people who attended primary school only.

In addition to survey non-response item non-response has to be considered too. For reasons of comparison we excluded all respondents with a missing value on any of the SES, health and childhood variables in the analyses. Additional analyses showed that the exclusion of respondents from the study population because of a missing value on any childhood environmental factor, education, occupation, perceived general health or chronic conditions did not change the results (results not shown). Item non-response may further bias the results when the non-response on a childhood characteristic is related to health and the non-response on that childhood characteristic is also related to SES, or when the non-response on health is related to a childhood characteristic and the non-response on SES is also related to that childhood characteristic. This appeared to be the case only with respect to missing values on occupation of the father ($p < 0.05$): respondents whose father's occupation was missing more frequently reported a less-than-"good" perceived general health and a lower educational and occupational level. This means that the contribution of occupation of the father may be underestimated.

Second, bias may have been introduced by the retrospective character of questions on childhood environment. Recall bias would occur if childhood reports vary systematically between subgroups, such as ill and healthy persons or socio-economic groups. Systematic differences according to health status in adult life are unlikely to occur, as was demonstrated by Lundberg.[9,11] Systematic recall bias between socio-economic groups may be more likely to underestimate the correlation between socio-economic status in adult life and childhood environment, than to overestimate this correlation.[11] The basic assumption here is that lower socio-economic groups report childhood conditions less accurately than higher groups. For example, education is reported to be related to the recall of autobiographic events in childhood among persons of 55 years and older.[25]

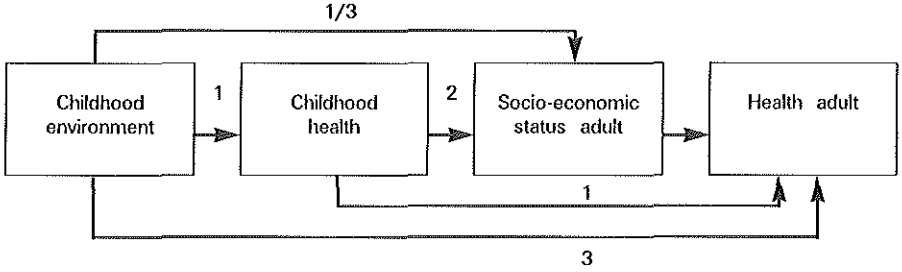
Third, the choice for self-reported health as indicator for adult health status may cause bias. More pronounced differences were observed for the subjective than for the objective health indicator. However, the fact that childhood environment contributes to both perceived general health and chronic conditions levels, indicates that the conclusion about the relevance of childhood environment in the explanation of SEHD not only

applies to subjective health. At this moment the number of deaths in the LS-SEHD cohort is too small to study mortality differences. In other studies an increased risk of developing handicaps later on in life[6,18] and higher hospital admission rates[12,26] have been found among persons with unfavourable childhood conditions. In further analyses these health indicators and mortality should also be taken into consideration.
Fourth, the restricted set of environmental childhood characteristics used in this study may have influenced the results. Socio-economic circumstances were more extensively measured than social factors. Social circumstances such as conflicts within the family, as measured by e.g. Lundberg[9] were not included. Also biological characteristics like birthweight, which are associated with socio-economic circumstances in childhood[27,28], were not taken into account. Due to this restriction, the contribution of childhood characteristics may have been underestimated in the present study.
In this analysis marital status is considered as confounder of the relationship between socio-economic status and health. By doing this the contribution of childhood family structure may be underestimated, since present marital status is correlated with childhood family structure.[29] This indirect effect of childhood family structure is not taken into account.
Finally, bias may have been introduced because persons who had already died before the sample was drawn were of course not included in the study population. As the risk of death in adulthood is higher among those from manual class of origin[30] and among those with serious illness in childhood[24], adverse childhood conditions and consequently the contribution of childhood environment to the explanation of SEHD in adult life may be underestimated. As death in the adult life of the study population is relatively rare this effect will not be substantial.

The contribution of childhood environment to SEHD in adult life may act through different mechanisms: selection and causation, which probably both play a role in the explanation. In the latter mechanism unfavourable circumstances during childhood (e.g. poor nutrition) influence health in adulthood through increased ill health in childhood which continues into adulthood, through an increased generalized susceptibility to illness, or through an effect on unhealthy behaviour later on in life.[31] The selection mechanism assumes social mobility. In the case of *direct* selection, health problems during childhood, caused by an unfavourable childhood environment, influence SES in adult life. For example financial problems, unfavourable social circumstances and poor nutrition may increase the risk of (long periods of) sickness during childhood, which in their turn may negatively influence the educational career[32], lowering the chance of reaching a high occupational class, or entrance to the labourmarket. More recently, the importance of *indirect* selection has also been stressed.[33] This mechanism assumes that (among others) unfavourable circumstances in childhood can act as a common background factor which affects both health in adult life and social mobility.[31,34] Factors like material deprivation during childhood may influence both educational (and thereby occupational) achievement and health in adult life. These mechanisms of explanation are summarized in Figure 5.

Further research into the pathways along which the contribution of childhood environment is realized can increase our insight in the explanation of socio-economic inequalities in health. Childhood conditions are likely to be both a causal factor and a factor influencing social mobility. Direct selection on health in childhood seems to play a minor role in the explanation of class differences in health.[12,33,34] Indirect selection may be more important. In the analysis presented here however, it is not possible to distinguish the described mechanisms.

Figure 5. Mechanisms of contribution of childhood environment to the explanation of socio-economic inequalities in health in adult life



1 = causation
2 = direct selection
3 = indirect selection

Adult risk factors such as adverse behaviour (like smoking, unhealthy dietary habits or physical activity)[17,35] may be related to childhood conditions. In a multivariate analysis Lundberg[11] demonstrated that economic hardship during upbringing and behavioural factors caused an equally large reduction in class differences in health. Since we did not control for risk factors in adult life in the present analysis, it was not possible to disentangle the direct and indirect (that is through other intermediate factors) contribution of childhood environment to the explanation of SEHD in adult life. For that purpose other intermediate factors such as behavioural factors and structural or material factors should be taken into consideration. This will be the next step in unravelling these mechanisms in the explanation of SEHD.

The results of the present analysis show that childhood environment (their direct and indirect influence taken together) does, to a certain degree, contribute to the explanation of SEHD in adult life. The size of the contribution of childhood environment to current socio-economic inequalities in health suggests that the effects of interventions in childhood environment will be substantial. The analysis demonstrates which childhood conditions are the most important: educational level of the mother, occupation of the father and financial situation. This indicates that the socio-economic position of the household in which someone has grown up may be more important in the explanation

of SEHD than social circumstances (such as a broken family).
The influence of childhood environment is still a topical subject. The health of children has increased markedly over the last 50 years. It is generally accepted that a higher standard of living is one of the major determinants of these improvements.[36] Over the last two decades however, a decline in child welfare has been reported due to economic factors (like increasing unemployment), changes in family structure (a growing number of one-parent families) and social disintegration of communities.[37]
Our findings may have implications for policy measures aimed at the reduction of SEHD, since interventions in the childhood environment are important not only in reducing SEHD among children, but also in reducing SEHD in adult life. For example, preventive child health and school health services should pay attention to these (social and material) factors during upbringing. The results clearly show that the contribution of adverse childhood conditions is bigger as socio-economic status is lower. This means that interventions in the childhood environment should focus on the lower socio-economic groups. To attain a future decline in SEHD (one of the targets of the WHO is to reduce health inequalities by 25% in the year 2000[38]), it is important to intervene in the childhood environment now.

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3.3

DOES CHILDHOOD SOCIO-ECONOMIC STATUS INFLUENCE ADULT HEALTH THROUGH BEHAVIOURAL FACTORS?

ABSTRACT

Background - The purpose of this study is to asses to what extent the effect of childhood socio-economic status on adult health could be explained by a higher prevalence of unhealthy behaviour among those with lower childhood socio-economic status.

Methods - Data were obtained from the baseline of a prospective cohort-study in The Netherlands (13,854 respondents, aged between 25-74). Childhood socio-economic group was indicated by occupation of the father, and adult health was indicated by perceived general health, health complaints and mortality. Adult socio-economic status was measured by current occupation. Behavioural factors were smoking, alcohol consumption, Body Mass Index and physical activity. Relations were analyzed using logistic regression models.

Results - A clear association between childhood socio-economic circumstances and adult health was shown, as well as an association between childhood socio-economic circumstances and health-related behaviour, even after adjustment for current socio-economic status. Physical activity shows the strongest relation with childhood socio-economic circumstances. Behavioural factors explain the relation between childhood socio-economic status and adult health for approximately 10%.

Conclusions - Childhood socio-economic circumstances have an independent effect on adult health and health-related behaviour: the risk of health problems and health damaging behaviour is higher in lower childhood socio-economic groups. The independent effect of childhood circumstances on adult health operates for a small part through unhealthy behaviour.

3.3.1 INTRODUCTION

After publication of the Black Report[1] much attention was paid to the influence of current socio-economic status on health. However, childhood socio-economic circumstances may also play a role. Results of some studies on the direct effect (that is, irrespective of adult social class) of childhood socio-economic environment on adult health suggest that growing up in poor socio-economic circumstances leads to poor health or premature death at adult age[2-7]. Other studies however, did not find a clear effect of childhood socio-economic status on adult health or mortality[8-10]. In summary, definite conclusions about the impact of childhood socio-economic environment on later health cannot be drawn, but an independent influence may exist.

The *process* by which the impact of childhood environment on adult health is established is not yet clear understood. Important pathways which can operate between early life and adult health status may run trough biological risk factors, according to Barker and Forsdahl[11-15], and through health-related behaviour.
In this study, we concentrate on *health-related behaviour* during (early) adult life as the pathway that links childhood circumstances to health. Since some of the backgrounds of health-related behaviour go back to childhood and early adulthood[16], it is very likely that the influence of childhood socio-economic circumstances on later health operates through health-related behaviour. Some research on this pathway has been done, but this is surprisingly little[17]. Behavioural factors like smoking, leisure time physical activity and alcohol consumption did not explain the relation between childhood poverty and heart disease[3,18]. In some recent studies a substantial independent effect was not found of father's social class on adult smoking, heavy drinking and leisure time physical activity[5,19] nor of father's education on adult smoking[20]. Leisure time physical activity, however, was related to education of the mother[21]. Reviewing the scarce evidence, the influence of childhood social class on behavioural factors is not yet clearly understood.

In the Longitudinal Study of Socio-Economic Health Differences (LS-SEHD) in the Netherlands, data on childhood environment, adult health and adult health-related behaviour are available to investigate the mechanisms whereby health-related behaviour may relate childhood environment to adult health. The LS-SEHD offers the opportunity to study the effects of childhood environment in a population of men and women, aged 25-74 year. The research questions to be answered in this chapter are:

- Does childhood socio-economic status have an independent effect (i.e. adjusted for adult socio-economic status) on adult health?
- Does childhood socio-economic status have an independent effect on behavioural factors in adult life?
- Does the influence of childhood socio-economic status on adult health operate through behavioural factors?

3.3.2 DATA AND METHODS

The design and objective of the LS-SEHD are described in detail elsewhere[22]. The study is based on a cohort of 15-74 year old, non-institutionalized Dutch nationals, living in the city of Eindhoven and surroundings (a region in the South-East of the Netherlands). At the time of the start of the survey a random sample of approximately 27,000 people was drawn from the population registries of the participating municipalities, which was stratified by age and post code (45-74 year old people and people from the highest and lowest SES-groups, as indicated by post code, were overrepresented). People in the sample received a postal questionnaire in 1991. In this analysis, cross-sectional data obtained from the base-line measurement, as well as mortality follow-up data were used. The response rate was 70.1%, resulting in a study population of 18,973 respondents. The study population used in this analysis was restricted to persons aged 25 and over, since the influence of childhood characteristics on behaviour and health, as well as on the socio-economic status finally attained, may not have worn off yet in younger persons. This resulted in a study population of 16,722 persons.

In the LS-SEHD several indicators of adult and childhood socio-economic status were measured. Childhood socio-economic circumstances were measured retrospectively by means of questions about the occupational level of the father of the respondent at the age of 12. Occupations were classified according to the Erikson, Goldthorpe and Portocarero (EGP)-scheme[23] into 5 categories: higher grade professionals, lower grade professionals/routine non-manual, self-employed, high and low skilled manual and unskilled manual. The occupational level of the respondent was used as indicator of adult socio-economic status. Housewives/-husbands were added as a sixth category. Health was indicated by three indicators: perceived general health, health complaints and mortality. Perceived general health was measured by the question "how do you rate your health in general". A dichotomous variable was constructed ("very good, good" versus "fair, sometimes good and sometimes bad, bad"). Health complaints were measured by a 13-items questionnaire, divided into two categories: 0-3 and 4 or more complaints. Mortality follow-up was completed until 15 July 1996. Health-related behavioural factors are smoking, alcohol consumption, leisure time physical exercise and Body Mass Index. The demographic variables age (5-year categories), sex, marital status, religious affiliation and degree of urbanization were added as confounders. Respondents for whom information on occupation of the father or current occupation was missing were excluded from the analysis (N=2,868), leaving 13,854 respondents.

The first step in the analysis was to study the prevalence of health problems by current and childhood socio-economic status. Prevalences were standardized for age and sex using the direct method.
Health differences between father's occupational groups are expressed in Odds Ratios with 95% confidence intervals, using logistic regression. The model included occupation of the father, respondent's occupation and confounders. The highest level was used

as the reference category. We tested if the interaction between the respondent's own and father's occupation significantly changed the model (p-value < 0.05). If so, the independent effect of occupation of the father would be different in different classes of respondent's own occupation. This was not the case, so we used a model without interaction-terms.

The next step in our analysis was to study the association between childhood socio-economic status and health-related behaviour. Because we are interested in the independent effect of childhood socio-economic circumstances we adjusted for current socio-economic status. The association between behavioural factors and childhood socio-economic status is expressed in Odds Ratios, using logistic regression models. The highest occupational level of the father was used as the reference category. Also in this analysis, there was no interaction between childhood and adult socio-economic status. Again, we tested the significance of father's occupation with a test on trend (p-value < 0.05).

The last step was to estimate to what extent the effect of childhood socio-economic status on adult health could be explained by a higher prevalence of unhealthy behaviour. Behavioural factors were added both separately and simultaneously to a model that included father's occupational level, current occupation and confounders only. The contribution of behavioural factors was measured by the percentage reduction in the Odds Ratios of the occupational level of the father compared to the first model. The reduction in deviance (likelihood ratio test) due to the inclusion of behavioural factors was used as an overall statistical test of their effect.

Only when results were significantly different for men and women analyses were done separately. In most cases however, no differences were found between the sexes.

3.3.3 RESULTS

Results for the three health indicators were comparable. For ease of reference, figures will be presented for perceived general health. In addition, some figures of health complaints and mortality are presented. Table 1 shows the distribution of the population across classes of current occupation and occupation of the father.

Table 1. Number of respondents by father's occupation and current occupation, men and women, 25-74 years

	father's occupation	high prof	low prof/ routine non-man	self-empl	skilled man	unskilled man	total
current occupation	high prof	208	410	281	277	158	1,334
	low prof/ routine non-man	381	1,217	749	1,093	713	4,153
	self-empl	25	74	252	104	109	564
	skilled man	41	221	262	705	594	1,823
	unskilled man	39	185	321	660	669	1,874
	house wife	223	707	909	1,231	1,036	4,106
	total	917	2,814	2,774	4,070	3,279	13,854

Figure 1 shows the standardized prevalence of a less-than-good perceived general health for adult occupation by father's occupational class. Childhood socio-economic status seems to have an independent effect on perceived general health. Overall, the prevalence of a less-than-good perceived general health is higher in lower classes of adult occupation. Within each occupational group, the occupation of the father has an independent effect: the lower the father's occupational class, the higher the risk of a less-than-good health. Only the risk for respondents whose father was self-employed is exceptional. (Housewives/-husbands are not included in the figure).

The Odds Ratios for all three health indicators are presented in Table 2. Father's occupation has an independent effect on adult health, even after adjustment for repondent's own occupation. Respondents with fathers in the lowest occupational class have a significantly higher risk of a less-than-good perceived general health.
Health complaints and mortality also showed an independent effect of father's occupation, the Odds Ratio for e.g. unskilled manual workers was 1.35 and 1.25 respectively, although the latter was not statistically significant different from 1.

Figure 1. Perceived general health. By father's and current occupation.

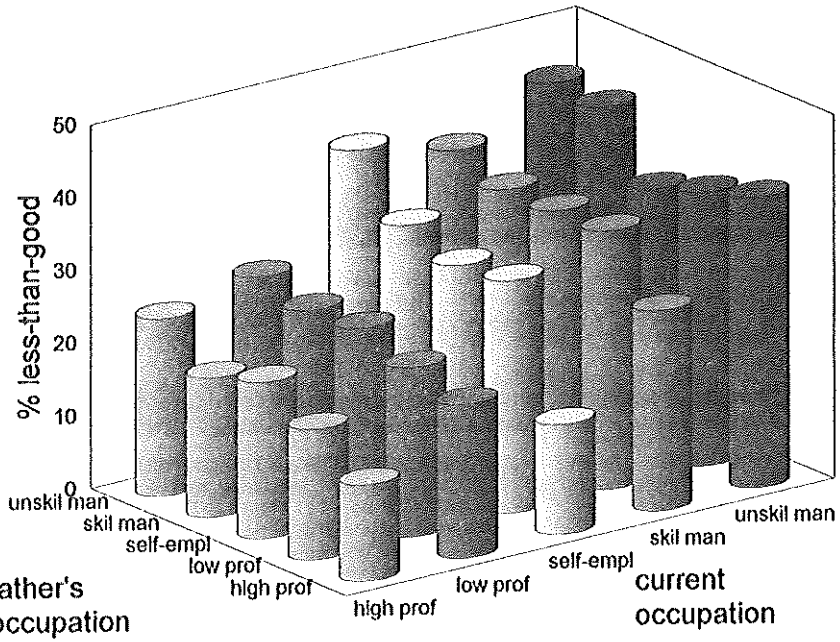

Table 3 represents the relation between behavioural factors and father's occupation. The effect of adjustment for current occupational level is also shown. Only categories which are commonly known as risk factors for health are presented. For most behavioural factors the expected relation is found: the lower the occupation of the father the higher the risk of unhealthy behaviour in adulthood. The independent effect is statistically significant for almost all categories of unhealthy behaviour.
The risk of overweight (QI > 27) is higher and the risk of underweight (QI < 20) is lower in lower childhood socio-economic groups. The risk of total abstainment is higher in lower occupational classes of the father. This is only among women statistically significant after adjustment for current occupation. The risk of (very) excessive drinking seems somewhat higher in lower occupational classes of the father, with the exception of the self-employed, but the relationship is not very clear. There is no clear relation-ship between smoking and occupation of the father. The risk of no physical exercise is much higher in lower childhood socio-economic groups. After adjustment for current occupation the p-value for trend is not significant, although all classes differ significantly from the highest occupational group (CI's do not include 1). The risk of heavy exercise is lower in higher childhood socio-economic groups. After adjustment for current occupation this is only statistically significant for women.

Table 2. Odds Ratios health problems by father's occupation, adjusted for current occupation, men and women, 25-74 years[1]

		father's occupation	high prof	low prof/ routine non-man	self-empl	skilled man	unskilled man	p-value test for overall effect[2]
perceived general health	less-than-good (N=3,892)	father's occupation	1	1.46 [1.20-1.78]	1.62 [1.33-1.97]	2.00 [1.65-2.42]	2.24 [1.85-2.71]	**
		father's occupation adjusted for current occupation	1	1.39 [1.14-1.70]	1.40 [1.15-1.71]	1.66 [1.37-2.01]	1.78 [1.47-2.17]	**
health complaints	4 or more (N=4,555)	father's occupation	1	1.19 [1.01-1.39]	1.18 [1.00-1.37]	1.39 [1.18-1.61]	1.58 [1.34-1.84]	**
		father's occupation adjusted for current occupation	1	1.15 [.98-1.35]	1.07 [.91-1.24]	1.22 [1.03-1.42]	1.35 [1.14-1.56]	**
mortality	persons died (N=544)	father's occupation	1	1.47 [.93-2.30]	1.33 [.84-2.08]	1.33 [.86-2.04]	1.42 [.92-2.18]	ns
		father's occupation adjusted for current occupation	1	1.41 [.90-2.21]	1.19 [.76-1.86]	1.19 [.77-1.82]	1.25 [.79-1.96]	ns

1 adjusted for age (5-yr categories), sex, marital status, religious affiliation and degree of urbanization

2 * < 0.05, ** < 0.01

Table 4 shows that the relation between childhood socio-economic status and adult health decreases when behavioural factors are added to the model. After adjustment for behavioural factors the effect of occupational level of the father is still statistically significant. This means that childhood socio-economic differences in adult health can only be partly explained by behavioural factors. For example, the odds ratio of the lowest occupational group of the father (adjusted for current occupational status and confounders) for a less-than-good perceived general health is 1.78. When physical activity is added to the model the odds ratio decreases to 1.69. This means that an estimated 11.5% of the increased risk of a less-than-good perceived general health for the lowest father's occupational group, as expressed by the odds ratio, can be attributed to physical activity. When all behavioural factors (except smoking, because this factor did not

contribute at all) are added to the model simultaneously, the reduction in Odds Ratio is approximately 14% for the lowest group. Also with respect to health complaints and mortality, physical activity was the most important factor. As for health complaints, the Odds Ratio for unskilled manual workers decreased from 1.35 to 1.29 (17%) and for mortality from 1.25 to 1.06 (76%). As for mortality, however, the confidence intervals include 1 (results not shown).

Table 3. Odds Ratios behavioural factors by father's occupation, adjusted for current occupation, men and women, 25-74 years[1]

		father's occupation	high prof	low prof/ routine non-man	self-empl	skilled man	unskilled man	p-value test for overall effect[2]
BMI	OI < 20 (N=874)	father's occupation	1	.90	.66#	.68#	.63#	**
		father's occupation adjusted for current occupation	1	.90	.67#	.71#	.65#	**
	OI > 27 (N=2,695)	father's occupation	1	1.39#	1.70#	1.88#	2.03#	**
		father's occupation adjusted for current occupation	1	1.36#	1.52#	1.68#	1.76#	**
alcohol consumption	abstainer (N=2,925)	father's occupation	1	1.12	1.47#	1.56#	1.91#	**
		father's occupation adjusted for current occupation	1	1.05	1.27#	1.28#	1.49#	**[3]
	(very) excessive (N=1,142)	father's occupation	1	1.24	.90	1.09	1.26	**
		father's occupation adjusted for current occupation	1	1.25	.86	1.09	1.25	**
smoking	once smoker (N=9,666)	father's occupation	1	1.12	.90	1.19	1.09	**
		father's occupation adjusted for current occupation	1	1.09	.86	1.10	1.09	**
	current smoker (N=4,877)	father's occupation	1	.96	.94	1.06	1.23#	**
		father's occupation adjusted for current occupation	1	.94	.86	.94	1.06	**
leisure time physical activity	no physical activity (N=644)	father's occupation	1	1.62#	2.03#	1.73#	1.82#	*
		father's occupation adjusted for current occupation	1	1.61#	1.72#	1.58#	1.62#	ns
	frequent physical activity (N=4,301)	father's occupation	1	.78#	.66#	.66#	.59#	**
		father's occupation adjusted for current occupation	1	.80#	.74#	.73#	.68#	**[3]

1 adjusted for age (5-yr categories), sex, marital status, religious affiliation and degree of urbanization
2 * < 0.05, ** < 0.01
3 difference between men and women ($p < 0.05$): significant for women, not for men
CI does not include 1

Table 4. Odds Ratios less-than-good perceived general health by father's occupation, adjusted for current occupation and behavioural factors, men and women, 25-74 years[1]

		Father's occupation adjusted for current occupation (model A)	model A, adjusted for BMI		model A adjusted for alcohol consumption		model A, adjusted for smoking		model A adjusted for physical activity		model A, adjusted for behavioural factors[5]	
		Odds Ratio	Odds Ratio	% red.[4]	Odds Ratio	% red.	Odds Ratio	% red.	Odds Ratio	% red.	Odds Ratio	% red.
father's occupation	high prof	1	1		1		1		1		1	
	low prof/ routine non-man	1.39#	1.37#	5.1	1.40#	-	1.39#	-	1.33#	15.4	1.36#	7.7
	self-empl	1.40#	1.41#	-	1.38#	5.0	1.41#	-	1.29#	27.5	1.32#	20.0
	skilled man	1.66#	1.65#	1.5	1.62#	6.1	1.67#	-	1.59#	10.6	1.58#	12.1
	unskilled man	1.78#	1.75#	3.8	1.74#	5.1	1.79#	-	1.69#	11.5	1.67#	14.1
deviance/ reduction deviance[2]		1055.690 (df 29)	86.339[2] (df 2)		232.771[2] (df 4)		62.057[2] (df 4)		324.279[2] (df 3)		523.519[2] (df 9)	
p-value red dev.[3]		–	**		**		**		**		**	

1 adjusted for age (5-yr categories), sex, marital status, religious affiliation and degree of urbanizationdev.[3]
2 reduction in deviance due to inclusion of behavioural factor to model A
3 * < 0.05, ** < 0.01
4 only reduction (red.) in Odds Ratio was calculated:
(OR model A – OR model B)/ (OR model A – 1)
5 BMI, alcohol consumption and physical activity
CI does not include 1

3.3.4 DISCUSSION

The results show an independent effect of childhood socio-economic group on adult health. This means that the risk of health problems is higher among respondents who grew up in unfavourable socio-economic circumstances, irrespective of their current socio-economic status.
Childhood socio-economic circumstances also seem to have an independent effect on health-related behaviour. With respect to almost all behavioural factors, the relation points in the same direction: there is more unhealthy behaviour among respondents from lower childhood socio-economic groups, independent of their current socio-economic status. Behavioural factors contribute for a small part (approximately 10%) to the explanation of differences in adult health between childhood socio-economic groups. Physical activity seems to be the most important behavioural factor in this process. The relation between childhood socio-economic status and health, however, is still largely unexplained, which is not in conflict with the scarce evidence from other studies.

When interpreting the data, there are a few limitations to the study design that need consideration. Firstly, non-response may have influenced the results. Non-response to the postal survey appeared not to be related to demographic variables. In addition, a short oral interview was held among a sample of the non-respondents to the postal survey. 30% of them participated. This group was representative for the total group of non-respondents with respect to demographic variables, and health differences were not found compared to respondents to the postal survey. This confirms the view that non-respondents do not differ significantly from respondents.
Secondly, the influence of childhood socio-economic circumstances could be underestimated due to a reporting bias. This would occur if lower socio-economic groups report unfavourable childhood conditions less accurately than higher groups. Omitting to report (or forgetting) events from childhood appears to be related to education among persons of 55 years and older[24]. Other retrospective measurements in the GLOBE-study with respect to events in childhood (like serious illness and hospital admissions) showed that the level of underestimation was higher in lower educated groups[25]. Compared to childhood events, however, occupation of the father is less likely to be completely forgotten. Therefore, we expect a possible underestimation to be less serious.
Thirdly, the attitude towards health may affect the association between self-reported (subjective) health and health behaviour, since it may influence both adult health behaviour and subjective health. In that case the contribution of health behaviour to the relation between childhood socio-economic status and subjective health might be overestimated. At the contrary, one might assume that the attitude towards health is indeed formed by adverse childhood circumstances. In that case the attitude is causally prior to the behaviours. Then, the contribution is not overestimated because it is part of the causal chain we are interested in.[26]

To increase the effectiveness of interventions with respect to behavioural factors, it is important to understand the mechanisms by which behaviour at adult age is influenced by childhood socio-economic circumstances. Since this relation has not been described extensively before, however, further reserarch is needed to these mechanisms. For example, parents' (un)healthy behaviour may play a role, as well as personality traits and cultural factors. These latter factors, most of which develop in youth, may influence adult life-styles. For example, it has been demonstrated that in the Netherlands less effective coping-styles are more common among adolescents from lower school-levels[27]. In addition, material circumstances may link childhood socio-economic circumstances to health behaviour. Lower socio-economic status in childhood may cause financial deprivation, making it e.g. impossible to join a sports club, which lead to less physical activity. In our and other studies, childhood economic problems (like financial deprivation) show independent associations with adult health[6,28].

In this study we found that the effect of childhood socio-economic circumstances on behaviour is most apparent for physical activity. It has been shown that long-term maintenance of health-related physical activity is possible[29]. It may be that the effect of e.g. cultural factors in early life is stronger with respect to physical activity than to other behavioural factors, since physical activity may often be started at an earlier age than e.g. smoking and alcohol consumption. The minor contribution of smoking might also be explained by the fact that smoking behaviour was adopted later in the life course than other behavioural factors and may be more sensitive to occupational environment and workplace culture[26].
The relation between childhood socio-economic circumstances and physical activity may also partly reflect selection on health: childhood socio-economic circumstances are related to health, and health problems (in childhood and adulthood) may lead to less physical activity. Not much research has been done about the influence of health in childhood on adult behaviour. In adult life however, it is shown that physical activity still shows a relationship with mortality even when initial (adult) health status is taken into account[30,31]. This means that selection on adult health cannot explain the relation between physical activity and health in adult life. It is therefore not to be expected that selection on childhood health will explain the whole phenomenon. We need to explore this relation in more detail, however, to understand the underlying mechanisms.

The outcome that only 10% could be explained by behavioural factors prompts us to search for other explanations. In the literature, some other perspectives are explored in view of the influence of childhood circumstances on adult health. First of all, social disadvantage may exist throughout the course of life. Davey Smith et al[7] showed that the risk of mortality was higher in those who had experienced cumulative socio-economic disadvantage. An accumulation of disadvantage may increase the effect of childhood socio-economic circumstances. Our results show that people who grew up in unfavourable circumstances, and who are still in unfavourable circumstances at adult age, run the highest risk. We found no interaction, however, between childhood and

current socio-economic status: the influence of childhood circumstances is the same in all adult socio-economic groups.
Secondly, as described in the introduction, the independent effect of childhood social class on adult health may also point to biological determinants of health that operate in the early years. This perspective emphasises the early living conditions, which are not influenced by later socio-economic circumstances[10,12-15]. Blane[19] found a significant relation between childhood socio-economic status and biological factors, including Body Mass Index. Although Body Mass Index reflect genetic factors associated with inherited class or material deprivation in early life, it is also considered to be the out come of behavioural factors[32]. Therefore, in this analysis it is recarded as an (indirect) indicator of health behaviour. Because other measurements of biological risk factors are not available in our study, the biological pathway could not be explored further.
Thirdly, childhood circumstances can act, in a process of indirect selection, as a common background factor, influencing both social mobility and later health. In this mechanism, cultural factors[17,33] and personality traits[34] play a role: they may influence adult life-styles and therefore later health, and, they may also influence social mobility. A next step in our study will be to explore this mechanism.

The risk of health problems is significantly higher for those respondents whose fathers came from the lowest socio-economic groups. This means that children growing up in the most unfavourable circumstances may be especially at risk. These are e.g. children from broken families, which live on social security. In the Netherlands, almost two thirds of the broken families with children under 18 live on social security[35]. In other countries, were benifits are less, the situation for these children may be even worse. Interventions that are aimed at reducing inequalities in later health, e.g. with respect to (knowledge of) health-related behaviour, are particularly needed among those groups that live in deprived circumstances.

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3.4

CHILDHOOD SOCIAL CLASS AND ADULT HEALTH: THE CONTRIBUTION OF PSYCHOLOGICAL ATTRIBUTES

ABSTRACT

Objective – To determine the contribution of psychological attributes (personality traits and coping styles) to the association between childhood social class and adult health among men and women.

Design – Cross-sectional (retrospective) study (Dutch GLOBE study on socio-economic inequalities in health). Baseline self-reported data from 1991 provided information on childhood and adult social class, general and cardiovascular health, and psychological attributes.

Setting – General population sample from the South-East of The Netherlands.

Subjects – 2,174 men and women, aged 25 - 74, filled out a questionnaire and participated in an interview.

Main outcome measures – Perceived general health, self-reported health complaints, and self-reported cardiovascular diseases (myocardial infarction and stroke).

Results – Independent of adult social class, low childhood social class was related to "less-than-good" perceived general health (Odds Ratio = 1.67 for subjects whose fathers were unskilled manual workers versus subjects whose fathers were higher grade professionals), more than three health complaints (Odds Ratio = 1.19), and particularly the risk of cardiovascular diseases (Odds Ratio = 4.34). Subjects whose fathers were manual workers generally had more unfavourable personality profiles and more negative coping styles. External locus of control, neuroticism, and the absence of active problem focusing (active, problem-oriented coping) explained at least half of the association between childhood social class and "less-than-good" perceived general health and self-reported health complaints. These factors also explained about one fifth of the association with self-reported cardiovascular diseases.

Conclusions – A higher prevalence of negative personality profiles and adverse coping styles in subjects who grew up in lower social classes explains part of the childhood social class - adult health association. This finding underlines the importance of psychological mechanisms in the examination of the negative effects of adverse early life and childhood conditions.

3.4.1 INTRODUCTION

There is now cumulating evidence that differences in adult health are partly caused by socio-economic factors during early life and upbringing.[1-5] According to the biological programming hypothesis, the origins of adult health lie in utero and early infancy.[2,6,7] For example, there is some evidence that adverse socio-economic conditions, such as poverty, during the mother's pregnancy have a long term impact on adult cardiovascular functioning of her offspring. According to an alternative social programming hypothesis, adult socio-economic differences in health are caused by a cumulation of negative or positive socio-economic circumstances during the whole life course.[1,8-10] Social programming advocates also found elevated risks of mortality for persons who grew up in lower social classes, independent of current social class.[1] This was particularly so for deaths from cardiovascular diseases. Hence, evidence for both hypotheses suggest that socio-economic factors during early life and upbringing may have important implications for adult health.

The causal mechanisms relating childhood socio-economic conditions and adult health have not yet been examined extensively. Biological mechanisms have been suggested[6,7] and there is some evidence for lifestyle-related mechanisms, such as smoking and physical activity.[3,11-18] With few exceptions, the contribution of psychological attributes, such as personality factors and coping styles, has hardly been examined.[14,15,19,20] Psychological attributes are partially rooted in childhood environmental conditions, (learning) experiences, and rearing styles.[21,22] There is now also increasing evidence that psychological attributes influence health either through behavioural mechanisms (e.g. via smoking) or through direct physiological mechanisms or through both.[23] Personality and coping may, therefore, be a mechanism through which adverse childhood socio-economic conditions contribute to adult poor health. Although recent studies of Lundberg[15] and Schwartz[20] found no evidence for a mediating role of personality, more research is needed using additional measures of psychological attributes.

Dutch GLOBE baseline data allowed us to examine whether childhood social class is related to psychological attributes, and whether psychological attributes are mediating factors in the association between childhood social class and adult health. To obtain the direct effects of childhood social class on adult health, adult social class is separately taken into account.[8,9,24,25] Because the evidence for the importance of childhood socio-economic conditions is most strong for cardiovascular diseases,[1] and personality has been found to be of special importance in the etiology of cardiovascular diseases,[23] we will not only focus on perceived general health and self-reported health complaints, but also on self-reported cardiovascular diseases.

3.4.2 SUBJECTS AND METHODS

Study population

Data were collected within the framework of the GLOBE study. GLOBE is the Dutch acronym for Health and Living Conditions of the Population of Eindhoven and its surroundings. A postal survey was conducted in 1991 among 27,070 non-institutionalized inhabitants (aged 15-74 years) of Eindhoven and a number of surrounding municipalities, all in the southeastern part of the Netherlands. Stratified by age and post code, the sample was randomly drawn from the municipal population registries. People between 45 and 70 years old and people from the highest and lowest social classes were overrepresented. The response rate was 70.1%, which resulted in a study population of 18,973 respondents. The response rates were not substantially different by age, sex, marital status, level of urbanization, or social class.[26] A sub-sample of those who responded to the postal questionnaire was approached for a more extensive oral interview. This sub-sample consisted of 3,529 randomly chosen respondents to the postal questionnaire. There were 2,802 subjects who agreed to have an interview (79,4%). The response rates did hardly differ by relevant demographic characteristics. More details on the study design can be found elsewhere.[26] To allow for a more valid measurement of adult social class, the analyses were restricted to men and women older than 24 (N = 2,462). The analyses were based on subjects who reported both their father's and their own adult occupational level (N = 2,174).

Social class

Adult social class was measured by the respondent's current or last occupational level. Childhood social class was measured retrospectively by the father's occupational level, when the respondent was 12 years old. If the father was not in paid employment, father's last occupation in paid employment was asked for. The occupations of both the respondent and the father were classified by the Erikson, Goldthorpe, and Portocarero (EGP) scheme.[27] The classification was recoded into five categories: higher grade professionals, lower grade professionals or routine non-manual workers, self-employed workers, skilled manual workers, and unskilled manual workers. Homemakers were added as a separate, sixth category for respondents's own occupational level.

Health outcomes

"Less-than-good" perceived general health was used as a general measure of health (N = 621). This was based on the subject's answer to the question: 'How do you rate your health in general?' (very good; good; fair; sometimes good and sometimes bad; bad). Perceived general health has been shown to be strongly related to physical health and to survival.[28,29] Health complaints were measured by summing the number of complaints that people reported on a 13-item checklist. Subjects reporting more than three complaints were considered cases (N = 726). A more specific health outcome, i.e. cardiovascular diseases, was based on reporting either severe heart problems (myocardial infarction), or stroke (cerebrovascular disease) (N = 106).

Psychological attributes

The psychological attributes were assessed by questionnaires on personality traits and coping styles. Four personality factors were examined: locus of control, neuroticism, parochialism, and orientation towards the future. Locus of control was measured by Rotter's locus of control scale.[30] The Dutch 11-item scale[31] measures the extent to which persons think they have control over outcomes of behaviours (Cronbach's α = 0.84).One of the items is: 'I sometimes consider myself a victim of circumstances'. Neuroticism was assessed by the Eysenck Personality Questionnaire.[32] The 12-item scale had a high internal consistency (Cronbach's α = 0.81). One of the items is: 'Do you often feel lonely?' Parochialism refers to an attitude which is relatively closed, narrow, local, and non-scientific.[33] The scale has five items (Cronbach's α = 0.63).[34] One of the items is: 'A local newspaper is of much more use than a national newspaper'. Orientation towards the future[34] was measured with four items, having a poor reliability (Cronbach's α = 0.51). One of the items is: 'I like to organise things'. The latter two scales were based on the work of Kohn and colleagues.[35] The 41-item Utrecht Coping List (UCL)[36] was used to distinguish seven typical styles of coping, i.e. active problem focusing, avoidance behaviour, depressive reaction pattern, social support seeking, palliative reaction pattern, disclosure of emotions, and optimism (Cronbach's α ranging from 0.59 to 0.80). The items were summed for all separate scales and then divided into three categories using tertiles.

Statistical analysis

Childhood social class and the psychological attributes were related by logistic regression analysis with adjustment for age and sex. For this analysis, the psychological attributes were divided into two categories by combining the lowest two thirds. This analysis provided adjusted estimated percents. Childhood social class and adult health were also related by logistic regression analysis controlling for age, sex, marital status (married, single, widowed/divorced), religious affiliation (none, catholic, protestant/other), and level of urbanization (four levels). To examine the contribution of psychological attributes to the childhood social class - adult health association, the psychological attributes (tertiles) were separately introduced into a model with childhood social class and confounders. As we were primarily interested in the direct effects of childhood social class on adult health, all analyses were separately adjusted for adult social class. As the findings for men and women were highly similar, we combined men and women and controlled for sex.

3.4.3 RESULTS

Table 1 shows that childhood social class is related to personality. External locus of control (42 percent), parochialism (35), neuroticism (34), and lack of future orientation (41) were more prevalent in the lowest childhood social classes. The prevalence decreases almost linearly as one ascends the hierarchy. This is somewhat less clear for neuroticism. A low childhood social class is also related to particular coping styles, i.e. a lower prevalence of active problem focusing (20 percent), a somewhat more frequent depressive reaction pattern (26) and avoidance (28), and somewhat less often seeking social support (21) and expressing emotions (26). Except for active problem focusing, these associations were not linear. Controlling for the subject's own occupational level weakened the associations, but most associations remained.

Table 1. Age and sex adjusted percents of psychological attributes by father's social class; unadjusted (model 1) and adjusted (model 2) for respondent's own social class

		Psychological attributes: Personality factors				Psychological attributes Coping styles						
	N	External locus of control	Paro-chialism	Neuro-ticism	Lack of future orien-tation	Active problem focusing	Depres-sive reaction	Avoi-dance	Social support seeking	Pallia-tive reaction	Expres-sion of emo-tions	Opti-mism
Model 1												
Father's class												
1 (high)	137	15	12	23	27	40	18	22	36	27	35	26
2	447	22	15	23	34	28	28	19	30	24	28	23
3 (self-empl)	456	28	32	25	33	26	23	23	22	21	21	24
4	649	34	28	27	37	23	21	22	23	22	25	26
5 (low)	485	42	35	34	41	20	26	28	21	23	26	22
$P < 0.05$		*	*	*	*	*	*	*	*		*	
Model 2												
Father's class												
1 (high)	137	17	22	26	21	39	16	29	37	22	33	33
2	447	24	23	34	27	29	25	25	31	20	27	29
3 (self-empl)	456	25	42	26	24	29	22	27	24	17	20	29
4	649	28	35	28	26	27	18	26	26	18	25	31
5 (low)	485	34	40	35	28	25	22	32	24	18	26	26
$P < 0.05$		*	*	*		*	*		*		*	

Table 2 shows that father's occupational level was related to "less-than-good" perceived general health. Subjects whose father had a low occupational level had a 2.10 higher risk of rating their health as "less-than-good" than subjects from a high socio-economic background. Adjusting this Odds Ratio for subject's own social class decreased the Odds Ratio to 1.67 which was still statistically significant. There was a less strong association with reporting more than three health complaints. Here the Odds Ratio was

1.47. When adult social class was controlled for, the Odds Ratio decreased to 1.19, indicating that there was hardly any direct effect of childhood social class on health complaints. Childhood social class was related to reported cardiovascular diseases (Odds Ratio = 4.56). Given the small number of cases reporting the latter health outcome (N = 106), the Odds Ratios were only marginally significant, despite large differences by childhood social class. Controlling for subject's own social class did hardly affect the Odds Ratios of cardiovascular diseases (Odds Ratio = 4.34). There were no significant associations between childhood social class and other chronic conditions, such as cancer and diabetes (data not shown).

Table 2. Odds Ratios[a] (95% confidence intervals) of "less-than-good" perceived general health, reporting more than three health complaints, and self-reported cardiovascular diseases, unadjusted (model 1) and adjusted (model 2) for respondent's own social class

	"Less-than-good" perceived general health (N = 621)	More than three health complaints (N = 726)	Cardiovascular diseases (N = 106)
Model 1			
Father's class			
1 (high)	1.00	1.00	1.00
2	1.39 (0.85-2.28)	1.26 (0.83-1.93)	3.20 (0.72-14.28)
3 (self-employed)	1.50 (0.92-2.45)	1.08 (0.70-1.66)	3.19 (0.73-14.00)
4	1.84 (1.15-2.96)	1.17 (0.78-1.77)	3.22 (0.75-13.95)
5 (low)	2.10 (1.29-3.41)	1.47 (0.97-2.25)	4.56 (1.05-19.74)
Model 2			
Father's class			
1 (high)	1.00	1.00	1.00
2	1.36 (0.83-2.24)	1.24 (0.81-1.89)	3.27 (0.73-14.58)
3 (self-employed)	1.32 (0.80-2.18)	0.97 (0.63-1.50)	3.09 (0.70-13.65)
4	1.50 (0.92-2.43)	0.97 (0.64-1.48)	3.04 (0.69-13.34)
5 (low)	1.67 (1.02-2.75)	1.19 (0.77-1.83)	4.34 (0.98-19.16)

a Odds Ratios were adjusted for age, sex, marital status, level of urbanization, and religious affiliation

Two personality factors and one coping style contributed to the childhood social class - adult health association, i.e. external locus of control, neuroticism, and the absence of active problem focusing. The other personality and coping factors individually explained less than 10 percent of the gradient (data not shown).

The results for the three contributors are shown in Table 3 (unadjusted for own adult social class) and 4 (adjusted for own adult social class). The strongest contribution to the gradient in "less-than-good" perceived general health comes from external locus of control. When external locus of control was taken into account, the Odds Ratio for the unskilled manual workers decreased by 46 percent in the model without respondent's own social class controlled for (Table 3) and by 33 percent in the model with respondent's own social class controlled for (Table 4). This was closely followed by neuroticism (32 and 34 percent, respectively). Similar results were obtained for reporting more than three health complaints. At least 60 percent of the elevated risk of reporting

Table 3. Odds Ratios[a] (95% confidence intervals) of "less-than-good" perceived general health, reporting more than three health complaints, and self-reported cardiovascular diseases by father's social class; separately and simultaneously adjusted for external locus of control, neuroticism, and active problem focusing; unadjusted for respondent's own social class

	Odds Ratio adjusted for confounders only[a]	External locus of control	
		Odds Ratio	% reduction[b]
"Less-than-good" health			
Father's class			
1 (high)	1.00	1.00	
2	1.39 (0.85-2.28)	1.28 (0.77-2.14)	28
3 (self-employed)	1.50 (0.92-2.45)	1.30 (0.78-2.16)	40
4	1.84 (1.15-2.96)	1.50 (0.92-2.45)	41
5 (low)	2.10 (1.29-3.41)	1.60 (0.97-2.65)	46
More than 3 complaints			
Father's class			
1 (high)	1.00	1.00	
2	1.26 (0.83-1.93)	1.13 (0.74-1.74)	50
3 (self-employed)	1.08 (0.70-1.66)	0.92 (0.60-1.43)	100
4	1.17 (0.78-1.77)	0.94 (0.62-1.43)	100
5 (low)	1.47 (0.97-2.25)	1.13 (0.73-1.74)	72
Cardiovascular diseases			
Father's class			
1 (high)	1.00	1.00	
2	3.20 (0.72-14.3)	3.31 (0.74-14.8)	–
3 (self-employed)	3.19 (0.73-14.0)	3.25 (0.74-14.3)	–
4	3.22 (0.75-14.0)	3.07 (0.70-13.4)	7
5 (low)	4.56 (1.05-19.7)	4.54 (1.04-19.9)	1

a. Odds Ratios were adjusted for age, sex, marital status, level of urbanization, and religious affiliation

b. Only the reduction in Odds Ratios was computed: (OR(model A) - OR(model B)) / (OR(model A) - 1)

Adjusted for:						
Neuroticism		Active problem focusing		External locus of control, neuroticism and active problem focusing		
Odds Ratio	% reduction	Odds Ratio	% reduction	Odds Ratio	% reduction	
1.00		1.00		1.00		
1.20 (0.72-2.01)	49	1.35 (0.81-2.24)	10	1.18 (0.69-2.01)	54	
1.37 (0.82-2.28)	26	1.44 (0.87-2.38)	12	1.28 (0.75-2.17)	44	
1.68 (1.02-2.74)	19	1.67 (1.02-2.71)	20	1.49 (0.89-2.49)	42	
1.75 (1.06-2.90)	32	1.90 (1.16-3.13)	18	1.49 (0.88-2.52)	56	
1.00		1.00		1.00		
1.08 (0.68-1.70)	69	1.21 (0.78-1.86)	19	1.03 (0.65-1.65)	89	
0.98 (0.62-1.56)	100	1.06 (0.68-1.63)	25	0.93 (0.58-1.49)	100	
1.04 (0.67-1.62)	77	1.09 (0.71-1.65)	47	0.95 (0.61-1.50)	100	
1.19 (0.76-1.88)	60	1.36 (0.88-2.08)	23	1.07 (0.67-1.70)	85	
1.00		1.00		1.00		
2.73 (0.61-12.3)	21	3.08 (0.69-13.7)	6	2.81 (0.63-12.7)	18	
2.93 (0.67-12.9)	12	2.96 (0.67-13.0)	11	2.86 (0.65-12.6)	15	
2.79 (0.64-12.1)	19	2.79 (0.64-12.2)	19	2.49 (0.57-10.9)	33	
4.02 (0.92-17.5)	15	4.02 (0.92-17.5)	15	3.85 (0.88-16.9)	20	

Table 4. Odds Ratios[a] (95% confidence intervals) of "less-than-good" perceived general health, reporting more than three health complaints, and self-reported cardiovascular diseases by father's social class; separately and simultaneously adjusted for external locus of control, neuroticism and active problem focusing; adjusted for respondent's own social class

	Odds Ratio adjusted for confounders only[a]	External locus of control	
		Odds Ratio	% reduction[b]
"Less-than-good" health			
Father's class			
1 (high)	1.00	1.00	
2	1.36 (0.83-2.24)	1.29 (0.77-2.15)	19
3 (self-employed)	1.32 (0.80-2.18)	1.23 (0.74-2.05)	28
4	1.50 (0.92-2.43)	1.36 (0.82-2.23)	28
5 (low)	1.67 (1.02-2.75)	1.45 (0.87-2.43)	33
More than 3 complaints			
Father's class			
1 (high)	1.00	1.00	
2	1.24 (0.81-1.89)	1.13 (0.73-1.74)	46
3 (self-employed)	0.97 (0.63-1.50)	0.88 (0.57-1.36)	–
4	0.97 (0.64-1.48)	0.85 (0.56-1.30)	–
5 (low)	1.19 (0.77-1.83)	1.01 (0.65-1.57)	95
Cardiovascular diseases			
Father's class			
1 (high)	1.00	1.00	
2	3.27 (0.73-14.6)	3.37 (0.75-15.1)	–
3 (self-employed)	3.09 (0.70-13.6)	3.13 (0.71-13.9)	–
4	3.04 (0.69-13.3)	2.87 (0.65-12.6)	8
5 (low)	4.34 (0.98-19.2)	4.28 (0.96-19.0)	2

a. Odds Ratios were adjusted for age, sex, marital status, level of urbanization, and religious affiliation

b. Only the reduction in Odds Ratios was computed: $(OR_{(model\ A)} - OR_{(model\ B)}) / (OR_{(model\ A)} - 1)$

Adjusted for:						
Neuroticism		Active problem focusing		External locus of control neuroticism, and active problem focusing	
Odds Ratio	% reduction	Odds Ratio	% reduction	Odds Ratio	% reduction
1.00		1.00		1.00	
1.19 (0.71-2.00)	47	1.35 (0.81-2.25)	3	1.18 (0.69-2.02)	50
1.23 (0.74-2.06)	28	1.33 (0.80-2.21)	–	1.23 (0.72-2.10)	28
1.39 (0.84-2.29)	22	1.43 (0.87-2.36)	14	1.37 (0.81-2.30)	26
1.44 (0.86-2.41)	34	1.62 (0.98-2.70)	8	1.37 (0.81-2.35)	45
1.00		1.00		1.00	
1.06 (0.67-1.68)	75	1.20 (0.77-1.85)	17	1.03 (0.65-1.65)	88
0.90 (0.56-1.43)	–	0.98 (0.63-1.52)	–	0.89 (0.55-1.43)	–
0.88 (0.56-1.38)	–	0.93 (0.61-1.43)	–	0.86 (0.54-1.36)	–
0.99 (0.62-1.58)	100	1.14 (0.73-1.77)	26	0.95 (0.59-1.53)	100
1.00		1.00		1.00	
2.78 (0.62-12.5)	22	3.19 (0.71-14.3)	4	3.95 (0.89-17.5)	18
2.84 (0.64-12.6)	12	2.95 (0.67-13.1)	7	2.79 (0.63-12.4)	14
2.62 (0.60-11.6)	21	2.72 (0.62-12.0)	16	2.34 (0.53-10.3)	34
3.81 (0.86-16.9)	16	3.95 (0.89-17.5)	12	3.62 (0.81-16.1)	22

more than three health complaints for subjects whose fathers were unskilled workers was explained by their higher external locus of control and neuroticism. The relative absence of active problem focusing explained a smaller amount. The strongest contribution to the gradient in cardiovascular diseases was provided by neuroticism (15 and 16 percent) and the absence of active problem focusing (15 and 12 percent). External locus of control did not contribute to this association.

When the three psychological attributes were considered simultaneously, half or more of the association of low childhood social class with "less-than-good" perceived general health and reporting more than three health complaints could be explained by a higher prevalence of external locus of control, neuroticism, and a lower prevalence of active coping styles in subjects from lower socio-economic backgrounds. These factors also explained about one fifth of the elevated risk of cardiovascular diseases for unskilled manual workers. The simultaneous contribution of the three personality and coping factors was also substantial, when respondent's own social class was taken into account (Table 4). Despite an only very weak direct effect of childhood social class on reporting more than three health complaints, a substantial part of the remaining effect is explained by the psychological attributes. In the analyses, we found no evidence for interactions between childhood and adult social class, nor between (childhood or adult) social class and personality or coping styles (data not shown).

3.4.4. DISCUSSION

We found evidence that particular personality factors and coping styles substantially contribute to the direct childhood social class - adult health association. Subjects whose fathers were unskilled manual workers generally had more unfavourable personality profiles and negative coping styles. External locus of control, neuroticism, and the absence of active problem focusing (active, problem-oriented coping) explained half or more of the association of childhood social class with "less-than-good" perceived general health and reporting more than three health complaints. These factors also explained about one fifth of the association with self-reported cardiovascular diseases (coronary heart disease and cerebrovascular disease). Despite a very weak direct effect of childhood social class on reporting more than three health complaints, the psychological attributes contributed highly similarly to the small, remaining effect. Recent studies from Sweden[15] and the USA[20] did not find evidence for a mediating role of psychological attributes, possibly because of their examination of other psychological attributes. Our findings suggest that psychological attributes may provide an alternative or supplementary explanation of the childhood social class - adult health association, and they may thus relativize the sole contribution of biological mediating factors as suggested by the biological imprint hypothesis.

For persons with adverse socio-economic living conditions in childhood, we found particularly elevated risks of cardiovascular diseases. This association was not based on adult socio-economic conditions. This disease specificity of the effect of adverse childhood socio-economic conditions corresponds to other studies[3,17,18,37-42] and Davey Smith and colleagues recently found that father's social class was particularly important for mortality from cardiovascular diseases, but not for mortality from non-cardiovascular causes.[1] Even when in our study height - as an indicator of early life influences - was taken into account, personality and coping styles explained about 25 percent of the association between adverse childhood socio-economic conditions and adult cardiovascular diseases (data not shown). This suggests a contributing role of personality, not only fetal development[43] and early growth.[44] This finding should, however, be interpreted cautiously, because, due to small numbers, the Odds Ratios had very wide confidence intervals. The absence of an association between an external locus of control and cardiovascular risk is not in accordance with other studies and should be examined further.

The findings could not be explained by the adult subject's occupational level. When examining the influence of childhood socio-economic conditions from a social programming perspective, it is generally thought to be important to control for adult social class.[8,24,25] As childhood and adult social class are strongly related, associations between childhood social class and adult health may be partly or completely based on adult socio-economic conditions. Adjustment for adult social class gives the remaining, direct effects of childhood social class. We, however, also showed the findings without

adjustment for subject's own adult social class, because the adjusted findings possibly underestimate the contribution of personality and coping styles. From a selection perspective, specific personality traits may affect educational and occupational achievements and preferences.[45,46] Controlling for adult social class would then imply overadjustment. However, the possibility that adult socio-economic conditions affect components of adult personality and coping styles should not be excluded.[47-52] Some personality theorists hypothesise that environmental conditions and experiences in adulthood may induce further personality change and development.[53-55] Given the outlined conceptual dilemma, both adjusted and unadjusted findings were presented. The direct effects of childhood social class were generally somewhat weaker than the effects which were unadjusted for own adult social class. This was particularly so for reporting more than three health complaints. There was hardly any direct effect of childhood social class on this outcome, suggesting that current socio-economic conditions are particularly important for this health measure. The psychological attributes, however, had a similar contribution to the childhood social class - health complaints association in both the unadjusted and adjusted analysis.

Our findings indicate that personality is partially rooted in childhood social class. Rearing styles differ between social classes, resulting in long term effects on people's way of behaving, feeling, and thinking.[21,22] Children from high class backgrounds may more easily experience and learn a sense of mastery and control, instead of feelings of fatalism, powerlessness, or helplessness, because their parents have more material (e.g. money) and immaterial (e.g. knowledge) resources enabling them to exhibit control more frequently and effectively.[51,52,56] Feeling in control over their lives, they probably more often tend to actively confront and solve problems than to avoid them. This may underlie our findings with locus of control and active problem focusing (active, problem-oriented coping). Similarly, neuroticism may also reflect or be the consequence of a perceived lack of control over outcomes and events.[57-59] Neurotic persons may more easily internalise emotions instead of taking problem-oriented approaches. Our findings stress the importance of control-related psychological factors for the development of socio-economic inequalities in health.[51,52,60-65] Further research should examine whether perceived control is related to physical health through its impact on health behaviours, physiological mechanisms or both. In the previous chapter, we have shown that adult health behaviours account for about 10 percent of the direct effect of childhood socio-economic status on adult health. This suggests that there is much room left for the contribution of physiological factors, such as elevated stress-induced catecholamines[66] and inhibition of the immune system[67]. In the field of job stress, low control during high job demands has been shown to influence plasma testosterone fluctuations, immunoglobulin, ambulatory blood pressure, and pain thresholds[68-73].

Methodological considerations

A few methodological issues should be considered. Firstly, the design was cross-sectional, while the ideal design would be to follow a cohort from birth into adulthood.

This would allow a better examination of the causal pathways between childhood social class, psychological attributes, adult social class, and adult health. Our theoretical causal model was based on previous research showing little effects of adult health on adult social class;[9,74] plausible assumptions, such as the assumption that childhood class determines further developments and not vice versa; and not making any assumption on the causal ordering of adult social class and personality by showing results with and without control for adult social class. Another assumption was that personality affects adult health and not vice versa. Although there is evidence of such a causal relation,[23] reverse causation cannot be excluded.[75] Secondly, all measures were self-reported which may have resulted in overestimated associations, because of negative affectivity (tendency to complain).[76] In our study, neuroticism - a proxy for negative affectivity - was more common in subjects with a low childhood social class and was also related to the health outcomes. A possible interpretation may thus be that negative affectivity (reporting bias) explains all our findings. We, however, think that negative affectivity is unlikely to have affected the reports of father's social class. It is more likely that a low childhood social class results in a higher neuroticism score, because neuroticism may reflect worry about lack of control[57-59]. Further research should preferably use alternative, more objective sources of data. Thirdly, the inclusion of other psychological mechanisms would possibly have had an additional contribution to the childhood social class - adult health association. There is evidence that feelings of parental caring,[77] childhood conscientiousness,[78] and attachment via hostility[79] have an effect on adult health. Finally, there were 288 people not reporting childhood or adult social class. These people generally had lower educational levels than those who responded to both questions (data not shown). Moreover, they also had higher risks of reporting "less-than-good" perceived general health and cardiovascular diseases. Hence, it is likely that partial non-response has resulted in underestimated associations between childhood social class and adult health.

Adverse childhood socio-economic conditions are related to poor general health in adulthood and the risk of cardiovascular diseases in particular. This is independent of adult social class. Psychological attributes (personality factors and coping styles) contribute substantially to the childhood social class - adult health association. Psychological attributes are shaped differently in varying childhood socio-economic conditions. Because the psychological attributes are also related to adult health, this suggests an etiologically relevant role for parental rearing styles. Perceived control may be the underlying psychological characteristic. When examining the influence of childhood socio-economic conditions on adult health, the role of specific psychological attributes is worth further exploration, in addition to factors related to fetal development, early growth, and biological and behavioural mechanisms.

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CHAPTER 4

THE ROLE OF CHILDHOOD HEALTH

4.1

RECALL BIAS IN SELF-REPORTED CHILDHOOD HEALTH: DIFFERENCES BY AGE AND EDUCATIONAL LEVEL

ABSTRACT

This study examines the impact of recall bias on self-reported childhood health. In a population of 25-74 years old people, childhood health was assessed retrospectively to explore its influence on socio-economic inequalities in adult health. Data were were obtained from a postal survey in the baseline of a prospective cohort-study (the Longitudinal Study on Socio-Economic Health Differences in The Netherlands). Childhood health was measured as self-reported periods of severe disease in childhood. Relationships between childhood health on the one hand and adult educational level on the other were analyzed using logistic regression models.

A negative association between childhood health problems and adult educational level was found in the youngest age group (25-34 years). In the older age groups however, a lower adult socio-economic status was not clearly associated with more health problems in childhood. In view of what we know about socio-economic inequalities in childhood health in the past, it is likely that the lack of association between educational level and childhood health in the older age groups is (partly) caused by a recall bias. Using simple questions on self-reported childhood health problems, the measurement of childhood health in older age groups will be biased by differential recall between socio-economic groups. Other possibilities to use retrospective data in studying childhood health problems should be explored.

4.1.1 INTRODUCTION

Health inequalities between people from different socio-economic classes have been found in many Western European countries[1-3]. Childhood health is mentioned as a factor that should be introduced in the explanation of socio-economic inequalities in health[4]. This chapter deals with some methodological problems in studying the role of childhood health.

For measuring childhood health the most ideal method is a prospective design, like the British birth cohort studies[4-6]. Problems with this design however are obvious: it takes a long time before cohort members are adults, and even longer before they get ill or die. Studies using methods producing answers in a shorter time period are necessary, for example retrospective studies[7]. In the Longitudinal Study of Socio-Economic Health Differences (LS-SEHD) in the Netherlands retrospective data are available in a population of 25-74-year-olds. Childhood health is directly measured by questions on disease and hospital admission in childhood. During the analysis of these data we found evidence for serious recall bias which is different between educational groups.
The idea that studying (determinants of) diseases retrospectively leads to significant recall bias is very common[8]. Recall bias may be defined as differences in the accuracy of recall across compared groups[9]. Research focussing on recall bias specifically however is limited. These studies mostly deal with differences between cases and controls in the recall of determinants. Differential recall however can arise in any observational study design[10]. Some studies examining recall bias found evidence supporting its existence[11-15], others however found no or little evidence[16-21]. Also with respect to socio-economic differences in recall, results are inconclusive[13,16,22-24,25-27]. Hardly any research has been done with respect to socio-economic differences in recall bias of childhood events, which is why we decided to describe our experience in this chapter.

4.1.2 METHODS

The design and objective of the LS-SEHD have been described in detail elsewhere.[28] The study is based on a cohort of 15-74-year-old, non-institutionalized Dutch nationals who live in the city of Eindhoven and surroundings (a region in the South East of the Netherlands). At the time of the start of the survey a random sample of ca. 27,000 people was drawn from the population registries of the participating municipalities, stratified by age and postcode (45-74 year old people and people from the highest and lowest SES-groups, as indicated by post code, were overrepresented). In this analysis cross-sectional data were used, which were obtained from a postal survey in the baseline measurement (1991). The response rate was 70.1 per cent, which resulted in a study population of 18,973 respondents. There were no significant differences in response rate with respect to sex, age, marital status, degree of urbanization and socio-economic status (measured by postcode).
In the LS-SEHD, several indicators of socio-economic status and (self-reported) health were measured. In this analysis the highest level of education attained was used as indicator of socio-economic status. Students were classified on the basis of their current course. Educational level was divided into 7 categories (university, higher vocational, intermediate general, intermediate vocational, lower general, lower vocational, primary school).
Childhood health was assessed retrospectively by answering of the following question: "Did you suffer from a severe disease or accident in childhood?". If the answer was 'yes', the subsequent questions were: "Have you been admitted to hospital for that disease(s) or accident(s)?" and "What was your age at the time of hospital admission?". Only hospital admissions at the age of 24 or under were included as hospital admissions at older ages were not regarded as 'childhood' health.

The study population was limited to persons of 25 and over, since the influence of childhood health on both the socio-economic status in adult life and on adult health, is expected not to be completed in younger persons. This resulted in a study population of 16,721 respondents, which was divided into 4 age groups: ages 25-34, ages 35-49, ages 50-64, ages 65-74.

In our study, in which we want to explore the possibility of differential recall bias, the association between childhood health and adult socio-economic status was examined. Only when childhood health is related to adult socio-economic status, can it play a role in the explanation of socio-economic health differences in adult life. Logistic regression was used to estimate these association. The demographic variables age (5-year categories), sex, marital status, degree of urbanization and religious affiliation were added as confounders to the model. The reduction in deviance due to the inclusion of educational level was used as an overall statistical test of its effect.
The possibility of differential recall bias by educational level was studied by estimating the prevalence of childhood illness and hospital admission by age in different educational groups.

4.1.3 RESULTS

We firstly studied the distribution of respondents according to current educational level and health in childhood for each different age group. This is presented in Table 1. As the results for men and women were highly comparable, the analyses do not distinguish between the sexes.
The percentage of people who reported severe disease or hospital admission in childhood *de*creases with each age group. With respect to severe disease, the results show a decrease from 23 per cent in the youngest age group to 15 per cent in the oldest, with respect to hospital admission the percentage decreases from 15 per cent to 7 per cent.

Table 1. Men and women, ages 25-74, current educational level and health in childhood by age group

		25-34 years		35-49 years		50-64 years		65-74 years	
		N	%	N	%	N	%	N	%
Current educational level[1]	1 (low)	131	5.3	648	14.2	1,843	29.2	1,201	42.6
	2	492	20.0	1,355	29.6	1,631	25.8	546	19.4
	3	320	13.0	751	16.4	987	15.6	375	13.3
	4	528	21.4	634	13.9	627	9.9	257	9.1
	5	274	11.1	290	6.3	316	5.0	155	5.5
	6	485	19.7	679	14.8	698	11.0	205	7.3
	7 (high)	235	9.5	217	4.7	220	3.5	80	2.8
Severe disease in childhood	no	1,927	77.4	3,638	78.7	5,159	80.6	2,433	84.7
	yes	563	22.6	986	21.3	1,238	19.4	439	15.3
Hospital admission in childhood	no	2,120	85.2	3,962	85.9	5,681	89.1	2,660	92.7
	yes	368	14.8	648	14.1	694	10.9	210	7.3

1 Educational levels: 1 primary school; 2 lower vocational; 3 lower general; 4 intermediate vocational; 5 intermediate general; 6 higher vocational; 7 university

Table 2 shows the association between childhood health and educational level. This association is the strongest in the youngest age group and decreases gradually throughout the older age groups. Surprisingly, in the older age groups an opposite relationship was found: there were more severe diseases in higher socio-economic groups. Only in the youngest age group (25-34 years) the lower educational levels show a statistically significantly increased risk of severe disease and hospital admission in childhood.

Table 2. Men and women, ages 25-74, health in childhood by age-group and current educational level[1], Odds Ratios (95% CI)

	Severe disease in childhood	
Current educational level[2]	25-34 years	35-49 years
1	2.34 (1.39-3.91)	1.18 (0.80-1.73)
2	1.55 (1.03-2.34)	0.87 (0.60-1.26)
3	1.40 (0.90-2.18)	1.13 (0.77-1.66)
4	1.31 (0.87-1.97)	0.88 (0.59-1.30)
5	1.56 (1.00-2.44)	1.10 (0.71-1.70)
6	1.35 (0.91-2.03)	1.07 (0.73-1.57)
7	1	1
RD[3]	11.87 (df 6)	11.10 (df 6)
p[4]	**	*

	Hospital admission in childhood	
Current educational level[2]	25-34 years	35-49 years
1	3.78 (2.06-6.95)	1.27 (0.81-1.99)
2	2.28 (1.38-3.79)	0.94 (0.61-1.45)
3	1.80 (1.03-3.13)	1.19 (0.76-1.86)
4	1.81 (1.09-3.00)	0.97 (0.62-1.52)
5	1.80 (1.02-3.18)	1.17 (0.70-1.94)
6	1.50 (0.90-2.50)	1.05 (0.68-1.64)
7	1	1
RD[3]	22.96 (df 6)	6.588 (df 6)
p[4]	***	n.s.

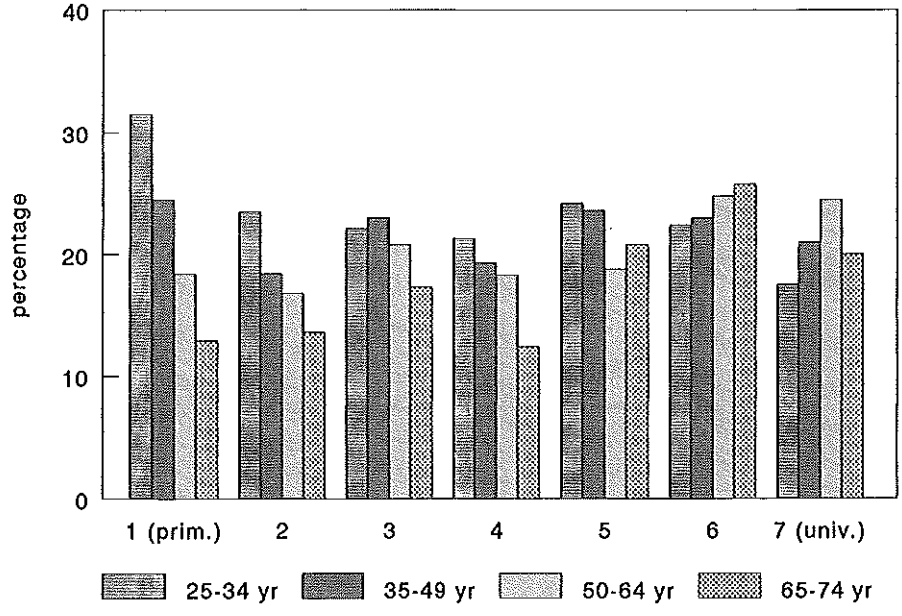
1. Controlled for sex, age, marital status, religious affiliation and degree of urbanization
2. Educational levels: 1 primary school; 2 lower vocational; 3 lower general; 4 intermediate vocational; 5 intermediate general; 6 higher vocational; 7 university
3. Reduction in Deviance compared to model without educational level
4. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; n.s.: not significant $p > 0.05$

50-64 years	65-74 years
0.75 (0.52-1.07)	0.69 (0.37-1.27)
0.71 (0.49-1.01)	0.73 (0.39-1.37)
0.89 (0.62-1.29)	0.92 (0.48-1.75)
0.76 (0.52-1.12)	0.61 (0.30-1.22)
0.77 (0.50-1.19)	1.15 (0.58-2.30)
1.12 (0.78-1.62)	1.53 (0.80-2.94)
1	1
20.43 (df 6)	22.08 (df 6)
***	***

50-64 years	65-74 years
1.05 (0.68-1.64)	1.09 (0.44-2.66)
0.83 (0.52-1.31)	1.21 (0.48-3.04)
0.93 (0.58-1.49)	1.20 (0.50-3.08)
0.94 (0.58-1.52)	0.88 (0.32-2.40)
0.96 (0.56-1.66)	1.53 (0.56-4.14)
0.99 (0.62-1.59)	2.22 (0.88-5.64)
1	1
2.387 (df 6)	10.27 (df 6)
n.s.	n.s.

The results from Table 2 indicate that underreporting in older age groups may be differential by educational level. This is explored in Figure 1. The percentage of respondents that reported severe disease in childhood is represented with respect to educational level and age group. Results for hospital admission were comparable. The Figure shows a clear difference between educational groups. As was expected, in the higher educational group the percentage of respondents that reported severe disease in childhood increases with age. In the lowest educational group however, this association changed into a lower percentage of persons that reported severe disease in childhood in the oldest age group.

Figure 1. Severe disease in childhood, by educational level and age-group (m/f)



4.1.4 DISCUSSION

The results show that the percentage of people that report severe disease and hospital admission in childhood differs by educational level and age. Surprisingly, among adults the frequency of self-reported severe disease or hospital admission in childhood was found to decrease with age. These results suggest an underestimation of childhood illness in older age groups, due to a reporting bias. Underreporting in older age groups leads to biased results of the contribution of childhood health to the explanation of socio-economic inequalities in adult health, if it is differential by educational level. Our data indicate a considerable difference in reporting bias between educational groups: the underestimation of disease and hospital admission in childhood at older age, is higher in lower educational groups; in the higher educational groups the percentage of childhood health problems increased, as expected, with age. Therefore, our conclusion is that the lack of an association between childhood health and adult socio-economic status in older age groups is (partly) caused by a differential reporting bias. The established relationship in older generations between infant mortality and socio-economic status supports our hypothesis. This can be explained as follows. Several authors in Western Europe and the United States noted a persistent inverse relationship between infant mortality and socio-economic status during the period from ca. 1900 until the present[29-36]. This relationship was also found in the Netherlands[37,38]. As infant mortality reflects infant and childhood health of a population, the established relationship between infant mortality and socio-economic status throughout the whole 20th century also suggests an association between childhood health and adult socio-economic status in older generations. Health differences between children from different socio-economic groups in older age cohorts are even expected to be larger in the absolute sense. This is suggested by the fact that the health status of children increased substantially during this century (e.g. the infant mortality rate in the Netherlands decreased from approximately 30 per 1,000 live-births in 1950[39] to approximately 6 in 1992[40]. Due to the poorer overall health status of children in the past, absolute inequalities in infant mortality fell during this period. This implies larger childhood health differences in older generations.

Before further discussing the possibility of recall bias in older age groups, two other possible sources of bias should be considered. Firstly, selective mortality might (partly) explain the decreasing frequency of reports of severe disease and hospital admission in childhood with age. Persons who died between 25-34 and 65-74 years were not included in the study population. This may have occured more among those who experienced health problems in childhood[41], especially in the cohorts of the current elderly who have been exposed to higher rates of mortality over a longer period of time than current young adults. A mathematical exercise (see note 1), using survival tables of the last 40 years in The Netherlands, shows that selective mortality may play a role, but cannot explain the whole phenomenon.

Secondly, the contribution of childhood health could also be under- (or over)estimated in the youngest age group. We did not have the disposal of (childhood) medical records of our study-population, so an independent validation of our data was impossible. We compared our prevalence rates of childhood illness with other, prospective, studies in similar age cohorts[42-45]. Unfortunately we are not aware of such studies in the Netherlands. Our results (e.g. 23 per cent childhood illness) seem to be in accordance with these studies, and an serious under- (or over)estimation in the youngest age group is not likely to have occurred. It is however still possible that socio-economic differences in reporting exist in the youngest age group. As our overall prevalence rates are comparable to other studies, this effect is probably not substantial.

The results suggest substantial reporting bias in older age groups. Firstly, to a great extent reporting bias is probably caused by omitting to report (or forgetting) events from the past, such as diseases or hospital admissions. There is no doubt that forgetting shows a relationship with time. It was shown that this relationship is a logarithmic function: e.g. the correct recall of events decreases from 85 per cent after 1 year to 70 per cent after 30 years and 50 per cent after 45 years[46]. Secondly, forgetting occurs not only because of spontaneous deterioration of memory with time, but also by interference from other information. This is most obvious when the event to be remembered has been followed by other information. This type of forgetting is known as retro-active interference[46]. Thirdly, there is also evidence that emotionally laden events are least likely to be recalled accurately, as well as events which are socially undesirable[7,47]. Memory failure however is not equivalent to recall bias. Bias will only occur if forgetting is differential. The types of forgetting described are likely to be differential according to educational group.
A differential reporting bias according to socio-economic status has also emerged from other studies, although the evidence is not unambiguous. Many studies on the cognitive functioning of the elderly show that the decline of memory-functions is more severe among people who received less education[48,49]. Memory tests described in these studies, however, usually deal with the ability to retrieve recently acquired information and not to recall events from the past. Some authors found an association between long-term memory of e.g. food intake[22] or time to pregnancy[26] and educational level. Others did not find this with respect to food-intake[24], job history[16] or specific childhood illnesses[18]. In the latter study, however, only people with very good memory (those who could also remember the exact age of occurence) were included. Education is reported to be a significant factor in the efficiency to recall autobiographic events in childhood among persons of 55 years and over[23]. Blane[7] reported that retrospective data are useful however. Using the so-called life-grid method, he found a comparable complex relationship between cigarette smoking, socio-economic status and health as reported by Blaxter[50]. Blane's study however was a pilot study among only 29 respondents.

As reporting bias is much higher in the older age groups and is unequally distributed among socio-economic groups, it is not possible to determine in our data-set the

contribution of childhood health to the explanation of socio-economic inequalities in adult health in older age groups. Using simple questions on self-reported childhood health problems, the influence of childhood health can only be studied in the youngest age group, in which a recall bias is expected to be less important. Childhood health problems should be measured by more extensive questionnaires. Even better is the use of childhood medical records. Such more objective data-sources are however not always available. Other possibilities are the use of a list of possible responses or other interview settings like an oral examination in which the interviewer can assist the respondent[47]. Since prospective data are expensive and takes to much time, it is worthwhile to explore these and other possibilities to use retrospective data.

NOTES

1. Can the decrease in reported childhood illness between the age groups 25-34 and 65-74 be attributed to selective mortality? We did a mathematical exercise to answer this question.
Pless et al.[51] reported a Relative Risk of mortality of 2.5 in an age-cohort of 0-34 years old, but Schwartz et al.[52] found no increased risk of mortality in a cohort of 20-80 years old. The latter study covers the same age cohort as our retrospective study, in which we found no significant association between severe disease in childhood and mortality either (RR 1.15). Based on these figures, we assumed the Relative Risk of mortality among those reporting a severe disease in childhood to be max. 1.5.
Survival tables of the years 1950-1990 in the Netherlands showed that the cumulative mortality risk between age 30 (25-34 years) and age 70 (65-74 years) was 24 per cent for the cohort of people that was 65-74 years in 1991[3].
Starting from a prevalence of childhood illness of 22.6 per cent in the age group 25-34 years (Table 1), we calculated the prevalence in the age group 65-74 years, on the basis of a Relative Risk of mortality of 1.5 and a cumulative mortality risk of 24 per cent.
With an average cumulative mortality risk of 24 per cent, 1,892 of the total group of 2,490 respondents in the age-group 25-34 years would be alive at age 65-74. Assuming a Relative Risk of mortality of 1.5 among those who suffered from childhood disease, this means a cumulative mortality risk of 32.4 per cent among those who suffered from childhood disease and of 21.6 per cent among respondents who did not suffer from disease. In that case 381 persons who suffered from childhood disease and 1,511 persons who did not suffer from childhood disease would be alive in the age group 65-74 (out of a total of 1892). The prevalence of childhood disease in the age-group 65-74 would then be 20.1 per cent (381 from 1892). So, on the basis of a Relative Risk of mortality for those who suffered from childhood disease of 1.5, and a cumulative mortality risk between 25-34 years and 65-74 years of 24 per cent, a prevalence of 22.6 per cent in the age group 25-34 would decrease to 20.1 per cent in the age group 65-74 years. This is much higher than the 15.3 per cent that we found. Thus, we can conclude that selective mortality does not (fully) explain the decrease in reported childhood illness.
In addition, a comparison of the survival tables between men and women shows that for men, the cumulative mortality risk was 33 per cent and for women, this was 17 per cent. In our study, the prevalence of reported childhood disease was the same for both sexes in all age groups, however. If selective mortality would fully explain the decrease in reported childhood illness, prevalences of reported childhood illness in the oldest age group would have been substantially lower for men than for women.

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4.2

THE ROLE OF CHILDHOOD HEALTH IN THE EXPLANATION OF SOCIO-ECONOMIC INEQUALITIES IN EARLY ADULT HEALTH

ABSTRACT

Study objective - To examine the contribution of childhood health to the explanation of socio-economic inequalities in health in early adult life.

Design - Retrospective data were used, which were obtained from a postal survey in the baseline of a prospective cohort-study (the Longitudinal Study on Socio-Economic Health Differences in The Netherlands). Adult socio-economic status was indicated by educational level, whilst health was indicated by perceived general health. Childhood health was measured by self-reported periods of severe disease in childhood. Relationships were analyzed using logistic regression models. The reduction in Odds Ratios of less-than-"good" perceived general health for different educational groups after adjustment for childhood health was used to estimate the contribution of childhood health.

Setting - The population of the city of Eindhoven and surroundings in the South-East of the Netherlands in 1991.

Participants - 2,511 respondents, aged 25-34 years, men and women, of Dutch nationality, were included in the analysis.

Main results - There was a clear association between childhood health and adult health, as well as an association between childhood health and adult socio-economic status. Approximately 5 to 10% of the increased risk of the lower socio-economic groups of having a less-than-"good" perceived general health can be explained by childhood health.

Conclusions - Childhood health contributes to the explanation of socio-economic inequalities in early adult health. Although this contribution is not very large, it cannot be ignored and has to be interpreted largely in terms of selection on health.

4.2.1 INTRODUCTION

During this century, impressive improvements have been made in the areas of health and physical development of children[1]. It is generally accepted that higher standards of living, advances in sanitation and nutrition are the major determinants of these improvements[1-3]. However, socio-economic inequalities in health among children still exist in developed societies, and these have changed surprisingly little[1,4,5].
Socio-economic inequalities in health among children may have an impact in adult life in terms of the effect that they could have on socio-economic health differences (SEHD) among the adult population. However, it is still unknown to what extent this plays a part.

The impact of childhood health on class differences in health among adults may act in two different ways: social causation and health selection. In the theory of social causation[6] childhood health may contribute to the explanation of SEHD in adult life by the following mechanism. Children from families with lower socio-economic status (SES) are likely to become lower SES adults, children from lower SES families are less healthy, and childhood illness is related to health status in adult life[7].
In addition there may also be an effect of childhood health by means of health selection. The selection mechanism assumes health related social mobility: health problems in childhood influence the socio-economic status when adult life begins. Evidence about the importance of social mobility related to health in childhood is however ambiguous[6-13].

Evidence for the contribution of childhood health to the explanation of SEHD in adult life is mainly of an indirect nature. Hardly any direct research has been undertaken to study the importance of this contribution. Examples of these rare studies are the British birth cohort studies. Adjustment for childhood health (at the ages of 7 and 11) did not reduce class differences in health in early adulthood (age 23)[14], but some reduction occurred after adjustment for health in adolescence. Results from the first British cohort study[15] however show that serious illness in childhood explained a part of the social class differences in health status at age 36.

In the Longitudinal Study of Socio-Economic Health Differences (LS-SEHD) retrospective data are available to investigate this issue for the age group 25-34 years in the Netherlands. The research question is the following: "What is the contribution of health in childhood to the explanation of SEHD in early adult life?".
In the LS-SEHD the contribution of several aspects of childhood health is directly measured by questions on disease and hospital admission in childhood. This study offers the opportunity to explore the contribution of childhood health to socio-economic inequalities in adult health for different (adult) health indicators and different measures of socio-economic status.

4.2.2 METHODS

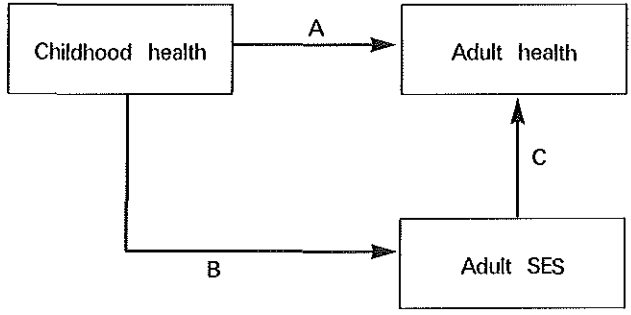
The design and objective of the LS-SEHD have been described in detail elsewhere[16]. The study is based on a cohort of 15-74-year-old, non-institutionalized Dutch nationals who live in the city of Eindhoven and surroundings (a region in the South East of the Netherlands). At the time of the start of the survey a random sample of ca. 27,000 people was drawn from the population registries of the participating municipalities, stratified by age and postcode (45-74 year old people and people from the highest and lowest SES-groups, as indicated by postcode, were overrepresented). In this analysis cross-sectional data were used, which were obtained from a postal survey in the baseline measurement (1991). The response rate was 70.1%, which resulted in a study population of 18,973 respondents. There were no significant differences in response rate with respect to sex, age, marital status, degree of urbanization and socio-economic status (measured by post code).

In this analysis, early adulthood was defined as the period between 25 and 34 years. Older age groups were not analyzed because of considerable recall bias. The percentage of people who reported childhood health problems decreased, contrary to expectations, with age group. This underreporting of childhood health problems among older people was higher in lower educational groups[17]. Persons under 25 were excluded since the effect of childhood health on both the socio-economic status in adult life and on adult health, is expected not to be completed in younger persons. This resulted in a study population of 2,511 respondents.

In the LS-SEHD, several indicators of socio-economic status and (self-reported) health were measured. In this analysis the highest level of education attained was used as indicator of socio-economic status. Students were classified on the basis of their current course. Educational level was divided into 7 categories (university, higher vocational, intermediate general, intermediate vocational, lower general, lower vocational, primary school). Self-reported health at adult age was indicated by perceived general health, measured by the question "How do you rate your health in general?". A dichotomous variable was constructed ("very good, good" versus "fair, sometimes good and sometimes bad, bad").

Childhood health was assessed retrospectively by answering of the following question: "Did you suffer from a severe disease or accident in childhood?". If the answer was 'yes', the subsequent questions were: "Have you been admitted to hospital for that disease(s) or accident(s)?" and "What was your age at the time of hospital admission?". Only hospital admissions at the age of 24 or under were included as hospital admissions at older ages were not regarded as 'childhood' health. Childhood socio-economic status was indicated by the occupational level of the father at the respondents' age of 12. Fathers' occupational level was classified according to the Erikson, Goldthorpe and Portocarero (EGP)-scheme[18] into 5 categories: higher grade professionals, lower grade professionals and routine non-manual, self-employed, high and low skilled manual and unskilled manual.

The research model is visualized in the following figure:



The analysis is carried out in two steps. The first step in the analysis was to study the association between childhood health and adult health (A), as well as that between childhood health and adult socio-economic status (B). Only when childhood health characteristics are related to both health and socio-economic status in early adulthood, they can play a role in the explanation of SEHD in early adult life. Logistic regression was used to estimate these associations. The demographic variables age (5-year categories), sex, marital status, degree of urbanization and religious affiliation were added as confounders to the model. The reduction in deviance due to the inclusion of childhood health characteristics (A) or educational level (B) was used as an overall statistical test of their effect.

The next step in the analysis was to establish the association between adult socio-economic status and adult health (C) and to estimate the contribution of childhood health to the explanation of this relationship, thereby using logistic regression models. Health differences between socio-economic groups are expressed in Odds Ratios with 95% confidence intervals. The highest level was used as the reference category. Childhood health characteristics were added separately to a model with educational level and confounders only. The contribution of childhood health was measured by the percentage reduction in the Odds Ratios of educational level compared to the first model. Again the reduction in deviance due to the inclusion of childhood health characteristics was used as an overall statistical test of their effect.

4.2.3 RESULTS

First of all, Table 1 represents the distribution of respondents according to educational level, health in childhood and health in early adulthood. As the results for men and women were highly comparable, the analyses do not distinguish between the sexes.

Table 1. Men and women, aged 25-34, current educational level, current health and health in childhood

		N	%
Current educational level[1]	1 (low)	131	5.3
	2	492	20.0
	3	320	13.0
	4	528	21.4
	5	274	11.1
	6	485	19.7
	7 (high)	235	9.5
Current perceived general health	(very) good	2,127	85.7
	less-than-good	354	14.3
Severe disease in childhood	no	1,927	77.4
	yes	563	22.6
Hospital admission in childhood	no	2,120	85.2
	yes	368	14.8

1 Educational levels: 1 primary school; 2 lower vocational; 3 lower general; 4 intermediate vocational; 5 intermediate general; 6 higher vocational; 7 university

Table 2 shows the association between childhood health and health in early adulthood (A in Figure 1). Respondents reporting severe disease or hospital admission in childhood reported more health problems at adult age. For example, the Odds Ratio for a less-than-"good" perceived general health is 2.21 among respondents that reported a severe disease in childhood.

The association between childhood health and educational level (B in Figure 1) is represented in Table 3. Lower educational levels show a statistically significantly higher risk of severe disease and hospital admission in childhood. For example, the Odds Ratio for severe disease in childhood is 2.34 among respondents who only attended primary school, and for hospital admission it is 3.78.

Table 2. Men and women, aged 25-34, less-than-"good" current perceived general health by health in childhood[1], Odds Ratios [95% CI]

Health in childhood	Odds Ratio less-than-"good" current perceived general health	RD[2]	p-value[3]
Severe disease in childhood[4]	2.21 [1.72-2.84]	36.22 (df 1)	**
Hospital admission in childhood[4]	2.29 [1.72-3.04]	30.06 (df 1)	**

1. Controlled for sex, age, marital status, religious affiliation and degree of urbanization
2. Reduction in Deviance compared to model without severe disease/hospital admission in childhood
3. ** $p < 0.01$
4. Reference group is no severe disease/no hospital admission in childhood

Table 3. Men and women, aged 25-34, health in childhood by current educational level[1], Odds Ratios [95% CI]

Current educational level[2]	Odds Ratio severe disease in childhood	Odds Ratio hospital admission in childhood
1	2.34 [1.39-3.91]	3.78 [2.06-6.95]
2	1.55 [1.03-2.34]	2.28 [1.38-3.79]
3	1.40 [0.90-2.18]	1.80 [1.03-3.13]
4	1.31 [0.87-1.97]	1.81 [1.09-3.00]
5	1.56 [1.00-2.44]	1.80 [1.02-3.18]
6	1.35 [0.91-2.03]	1.50 [0.90-2.50]
7	1	1
RD[3]	11.87 (df 6)	22.96 (df 6)
p-value[4]	*	**

1. Controlled for sex, age, marital status, religious affiliation and degree of urbanization
2. Educational levels: 1 primary school; 2 lower vocational; 3 lower general; 4 intermediate vocational; 5 intermediate general; 6 higher vocational; 7 university
3. Reduction in Deviance compared to model without educational level
4. * $p < 0.05$; ** $p < 0.01$

In order to estimate the contribution of childhood health to the explanation of educational differences in early adult health a multiple logistic regression analysis was carried out. Severe disease and hospital admission in childhood were added to a model which includes educational level and confounders only. The results are shown in Table 4.

Table 4. Men and women, aged 25-34, less-than-"good" current perceived general health by current educational level[1], contribution of health in childhood, Odds Ratios [95% CI]

Current educational level[2]	Model A (education + confounders)	Model A + severe disease in childhood		Model A + hospital admission in childhood	
	Odds Ratio [CI]	Odds Ratio [CI]	Diff with A (%)[3]	Odds Ratio [CI]	Diff with A (%)[3]
1	8.77 [4.50-17.05]	7.98 [3.99-15.74]	10	7.76 [3.87-15.27]	13
2	4.86 [2.70-8.74]	4.67 [2.59-8.40]	5	4.56 [2.51-8.15]	8
3	3.00 [1.59-5.57]	2.89 [1.54-5.40]	5	2.87 [1.53-5.35]	7
4	2.21 [1.20-4.05]	2.15 [1.16-3.93]	5	2.11 [1.14-3.85]	8
5	1.89 [0.96-3.66]	1.80 [0.92-3.48]	10	1.80 [0.93-3.51]	9
6	1.57 [0.83-2.91]	1.52 [0.80-2.82]	8	1.53 [0.81-2.85]	7
7	1	1	–	1	–
RD[4]		77.078 (df 6)		73.993 (df 6)	
p-value[5]		**		**	

1. Controlled for sex, age, marital status, religious affiliation and degree of urbanization
2. Educational levels: 1 primary school; 2 lower vocational; 3 lower general; 4 intermediate vocational; 5 intermediate general; 6 higher vocational; 7 university
3. OR model A – OR model A + severe disease, hospital admission in childhood/ (OR model A – 1)*100%
4. Reduction in Deviance compared to a model without educational level
5. ** p<.01

Educational differences in perceived general health decrease when childhood health is added to the model. For example, the Odds Ratio of the lowest educational group for a less-than-"good" perceived general health is 8.77. When severe disease in childhood is added to the model the Odds Ratio decreases to 7.98. This means that an estimated 10% of the increased risk of the lowest educational group can be attributed to this factor. With respect to the inclusion of hospital admission, a reduction in Odds Ratio of 13% was found in the lowest educational group. In the other educational groups the reduction in Odds Ratio varies between 5% and 10% with respect to severe disease and between 7% and 9% with respect to hospital admission. The reduction in deviance due to the inclusion of childhood health characteristics to the model with educational level and confounders was statistically significant.

4.2.4 DISCUSSION

The contribution of childhood health to the explanation of socio-economic inequalities in health was studied in the age group 25-34 years. An association between health in childhood and health in early adulthood could be established. The risk of early adult health problems is approximately 2 times higher among people who reported health problems in childhood, as compared to those reporting no such problems.
A (statistically significant) negative association between childhood illness and adult socio-economic status is found: the risk of health problems in childhood in the lowest educational group is approximately 2.5 times higher for severe diseases and approximately fourfold for hospital admission. Childhood health explains approximately 5 to 10% of the increased risk of having a less-than-"good" perceived general health.
The analyses were repeated for occupational level. As the results were highly comparable to those obtained from analyses for educational level (results not shown), they do suggest that the results can be generalized to other SES-indicators.

When interpreting the data, there are some limitations of the study design that need some consideration. Firstly, the contribution of childhood health could be underestimated due to reporting bias. Reporting bias is probably caused by omitting to report (or forgetting) events from the past, such as diseases or hospital admissions. We compared our prevalence rates of childhood illness with other, prospective, studies in similar age cohorts (born between approximately 1955 and 1970). Unfortunately we are not aware of such studies in the Netherlands. Results from the offspring of the first British birth cohort study and results from the second British birth cohort study show prevalence rates of 20% for hospital admission[19] and 15% and 19% for chronic conditions and injuries respectively[14,20]. Results for the United States were comparable[21]. Our results (e.g. 23% childhood illness) seem not be in conflict with this figures, and serious underestimation is not likely to have occurred.
Secondly, the choice for perceived general health as the indicator for adult health status may cause bias, because perceived general health as subjective health indicator may be more related to reported childhood illness than objective health measurements are, due to a common background factor as e.g. a tendency to complain. In that case, the contribution of childhood health would be overestimated. To explore this hypothesis we carried out the analysis on the basis of a more objective health indicator: suffering from one or more chronic condition at the time of the survey. The results with respect to chronic conditions were comparable to those for perceived general health (results not shown). This indicates that our conclusion applies also to less subjective health indicators. Our results should be verified further using e.g. mortality data. At present however we are not able to check this, because the number of deaths in this age group in the LS-SEHD cohort is too small to study mortality differences.

As mentioned earlier, the contribution of childhood health can be partly interpreted in terms of social causation (through unfavourable circumstances in childhood) and

partly in terms of health selection. In order to distinguish between these two mechanisms we adjusted for the causation mechanism by taking into account the occupation of the father as the indicator for childhood socio-economic status. As stated above, a reduction in Odds Ratio of approximately 5 to 10% was found when the association between educational level and less-than-"good" perceived general health was corrected for childhood illness. After occupation of the father had been adjusted for, we found similar percentages reduction in Odds Ratio when childhood illness was added to the model. Thus, the contribution of health in childhood cannot be explained by the occupation of the father. This means that the importance of the social causation mechanism is likely to be small. Consequently, selection on health in childhood seems to account mainly for the contribution of childhood health to the explanation of socio-economic health differences in early adult life. We tested this by estimating the relationship between health in childhood and educational level, adjusted for occupation of the father. Adjusting for occupation of the father did not change the relationship significantly. This confirmed our hypothesis. Although the literature suggests a minor role of direct selection on health in childhood in the explanation of socio-economic health differences in adult life[6,21-24], different studies have reached different conclusions. For example, Wadsworth[7] reported a direct effect of health status on intergenerational mobility, but Lundberg[6,13] found no evidence that severe childhood illness increases the risk of downward intergenerational mobility. However, the effect of childhood illness on social mobility is likely to be seriously underestimated in Lundberg's study. This underestimation is probably caused by a very low prevalence rate for childhood illness (approximately 2%), based on a question on childhood illness that regards the family and not the interviewee per se. Other evidence of the absence of direct selection is based on the effect of 'childhood' health measured among 15 to 20 year-olds on the socio-economic status between ages 21-26[6]. This period obviously is very short in view of social mobility. Moreover, the influence of childhood health is likely to also appear earlier in life. Our results suggest that it seems possible that the role of direct selection is small but relevant, at least in early adult life. The role of the selection mechanism should be explored in further research.

In this study the reductions in Odds Ratio vary between approximately 5% and 10% when severe disease or hospital admission were added to a model that includes educational level and health in early adulthood. As mentioned before, results from two British studies about the contribution of childhood health were ambiguous[14,15]. Our results indicate that health in childhood plays a role in the explanation of socio-economic health differences in early adult life. This contribution, although not very large, cannot be ignored. Our results emphasize the need for efforts to improve health in childhood in a policy which aims at reducing SEHD in the total population. For example, preventive child and school health services can play a role in monitoring the educational career of children who are severely ill or are admitted to hospital. To achieve WHO's target number 1 to reduce health inequalities by 25%[25], intervening in childhood health may be helpful.

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CHAPTER 5

THE ROLE OF SELECTION PROCESSES

5.1

THE INFLUENCE OF ADULT ILL HEALTH ON OCCUPATIONAL CLASS MOBILITY AND MOBILITY OUT OF AND INTO EMPLOYMENT IN THE NETHERLANDS. RESULTS FROM A LONGITUDINAL STUDY

ABSTRACT

In the debate about the explanation of socio-economic health inequalities one of the important issues is the relative importance of health selection. The aim of this study was to investigate to what extent occupational class mobility and mobility out of and into employment are health-related, and in addition, to estimate the contribution of health-related social mobility to socio-economic health differences in the working population. Data were taken from the Longitudinal Study on Socio-Economic Health Differences in the Netherlands, which started in 1991; follow-up data were collected in 1995. The analysis is based on 2,533 persons aged 15-59 at baseline.

The influence of health problems in 1991 (perceived general health, health complaints and chronic conditions) on changes in occupational class between 1991 and 1995 was negligible. Neither upward nor downward mobility was affected by health problems. However, health problems in 1991 were significantly associated with a higher risk of mobility out of employment and a lower risk of mobility into employment in 1995. For example, for mobility out of employment among persons that reported at least one chronic condition in 1991, the Odds Ratio was 1.46. Health-related mobility out of employment substantially influences the estimate of socio-economic health inequalities in the working population (measured by current occupation). For manual workers, as compared to non-manual workers, the Odds Ratio for a less-than-good perceived general health was underestimated by 34% in 1995. Selective mobility into employment overestimates socio-economic inequalities in health in the working population by 9%. Respondents that moved into and out of employment were healthier than those that remained economically inactive, but their health was worse than of those that remained employed (both manual and non-manual).

Implications for health policy are that the prospects for people with health problems to stay in paid employment should be improved.

5.1.1 INTRODUCTION

Differences in health between socio-economic groups were established in several industrialised countries, for different socio-economic indicators and different health measurements. One of the issues discussed in the explanation of these differences is the relative importance of two mechanisms: social causation and selection[1]. Social causation means that socio-economic inequalities in health are caused by the unequal distribution of lifestyle factors, structural factors or psycho-social factors across socio-economic groups. The health selection mechanism implies that health affects social mobility: healthy people may move up, and unhealthy people may move down in the social hierarchy. This hypothesis is also referred to as the 'drift hypothesis'[2].

Most literature suggests that the relative importance of selection on physical health in the explanation of socio-economic inequalities in health is small[3-7], although it has also been argued that the contribution might be substantial[1]. More research on selection was done with respect to mental illness. Evidence is in favour of the existence of a certain degree of mental health-related social mobility, both in the Netherlands and in other countries[8,9]. However, evidence in this field is also ambiguous[10], and so far, its contribution to the explanation of socio-economic inequalities in health remains unknown.

Although in the Black Report[2] the health selection explanation focuses on intragenerational class mobility (mobility of an individual compared to his or her own occupational class earlier in life), much of the recent selection debate refers to intergenerational class mobility (mobility of an individual compared to the occupational class of his or her parents) (e.g. West[1], Rahkonen et al[11]). Evidence with respect to intragenerational class mobility is mostly based on cross-sectional data or mortality follow-up studies, while longitudinal studies on this subject are scarce. Results from the British OPCS longitudinal study suggest that health-related mobility between classes has little effect on mortality differentials[5]. Others, however, defend that selective mobility could play a role (a.o. Carr-Hill[12]).
Hardly any evidence is available on intragenerational class mobility with respect to health indicators other than mortality. Most of these studies used a case-control design. E.g. support was provided for downward class mobility among bronchitis and asthma patients[13,14].

There are only a few studies in which the relation between health and intragenerational class mobility is studied directly, i.e. using prospective longitudinal data. Lundberg [7,15] studied occupational class mobility in a Swedish cohort, covering a period of about 10 years and using questionnaires about health and occupational status. He concluded that intragenerational mobility was not influenced by health status. Power et al [4], who used data from the 1958 British Birth Cohort, found that class mobility between the ages 23 and 33 was influenced by health status. They concluded, however, that health selection was not important in the explanation of adult health

differences. This is mainly due to the small number of people with poor health who are mobile between classes.

The scarcely available literature suggesting that intragenerational health selection *is* important focuses on health-related mobility into and out of employment[16]. This is also called the 'healthy worker effect' (a.o. Vinni and Hakama, 1980[17]; Dahl, 1993a[18]), which implies that this mobility causes the working population to be healthier than those who are economically inactive. Selection into and out of paid employment due to health reasons is suggested to be the most important form of health-related social mobility[11]. Rather than taking up a lower status of occupation, those in poor health may leave employment[6]. It may be that this mobility out of employment occurs more in lower occupational classes. If so, health selection out of employment will influence the extent of class differences in health in the working population.
Effects of health emerge in different forms of mobility out of employment, i.e. unemployment, early retirement, becoming a housewife or receiving a disability pension. Results from a Swedish study show that illness had an obvious effect on mobility out of employment before the normal age of retirement[7]. Data from The Netherlands show that the risk of disability and unemployment was higher among workers with more sick leave[19]. Research among housewives in the USA and Sweden showed that good health was related to taking up employment, and ill health was related to leaving employment[20,21]. Most research, however, focuses on (un)employment. Several authors suggest that health selection plays a role in the association between (un)employment and health outcomes[22-25] but others found no or only limited support for this hypothesis[26,27]. An effect of ill health on duration of employment and the chance of re-employment has also been reported[28,29].
Similar to research on occupational class mobility, however, many designs of the studies described above show shortcomings because they use cross-sectional or retrospective data.

It is recommended that further studies on health-related social mobility should not only examine occupational class mobility but also health-related mobility into and out of employment, preferably on the basis of a longitudinal design[11]. The Longitudinal Study on Socio-Economic Health Differences (LS-SEHD) in the Netherlands offers such an opportunity, because data on adult health, occupational status and position in employment are available at different points in time. Effects of health-related occupational class mobility and mobility out of and into employment can be examined in a prospective cohort study among men and women, aged 15-59 year at baseline.

The research question in this chapter is as follows: to what extent are health problems at adult age related to downward or upward occupational class mobility and mobility out of and into employment? In addition, we estimated the contribution of health-related selection to the explanation of socio-economic health differences in the working population.

5.1.2 DATA AND METHODS

The Longitudinal Study on Socio-Economic Health Differences (LS-SEHD) is a prospective cohort study of the explanation of SEHD in The Netherlands. The design and objective of the LS-SEHD are described in detail elsewhere[30]. The study is based on a cohort of 15-74 year-old, non-institutionalized Dutch nationals, living in the city of Eindhoven and surroundings (a region in the South-East of The Netherlands). At the time of the start of the survey a random sample of approximately 27,000 people was drawn from the population registries of the participating municipalities, which was stratified by age and post code (45-74 year old people and people from the highest and lowest socio-economic groups, as indicated by post code, were overrepresented). Respondents were contacted even after they moved away from the study region. People in the sample received a postal questionnaire in 1991. The response rate was 70.1%, resulting in a study population of 18,973 respondents. Among two subsamples of respondents on the postal survey additional data were collected with an oral interview. The first subsample was formed by an a-select group (approximately 3,500 persons, again stratified by postcode) taken from respondents to the postal survey. The response rate for this oral interview was 79.4% (2,802 respondents). For the second subsample (also taken from respondents to the postal survey), chronically ill people were overrepresented (approximately 4,000 persons). The response rate in this second group was 72.5% (2,878 respondents). No significant differences in response rate for the postal survey or the first oral interview were found by sex, age, marital status, degree of urbanization and socio-economic status (measured by post code). For the second subsample, the response was slightly less among younger people, unmarried persons and respondents living in the city[31]. In 1995 a postal follow-up questionnaire was sent to respondents of the 1991 oral interview (response rate approximately 80%).
The study population used in this analysis was restricted to persons aged 15-59 in 1991, who were not in early retirement in 1991, and who responded on both surveys in 1991 and 1995. Soldiers, students and rentiers were excluded. This resulted in a study population of 2,533 persons for whom information on employment status in 1991 and 1995 was available (missing values approximately 4%). The reason for excluding persons of 60 years and older, is because in a follow-up period of 4.5 years, a population of 15-59 year old persons does not include respondents who reach normal age of retirement (65 years), the oldest persons being 59 years old at baseline. Persons in early retirement in 1991 were excluded from the analyses because they were not expected to start work again.

The occupational class of respondents in 1991 and 1995 was based on their current occupation. Occupations were classified according to the Erikson and Goldthorpe (EG)-scheme[32] into 8 categories: higher grade professionals, lower grade professionals, skilled non-manual, semi/unskilled non-manual, self-employed, high skilled manual, low skilled manual and semi/unskilled manual. Labour market position was categorised into paid employment versus economically inactive (unemployed, disability, pension,

housewives/househusbands and early retirement). Health in 1991 was measured by three indicators measured in 1991: perceived general health, health complaints and chronic conditions. Perceived general health was measured by the question "how do you rate your health in general". A dichotomous variable was constructed ("very good, good" versus "fair, sometimes good and sometimes bad, bad"). Health complaints were measured by a 13-item questionnaire, divided into two categories: 0-3 and 4 or more complaints. Chronic conditions were measured by a list of 23 conditions, dichotomised into 0 and 1 or more conditions. Age (5-year categories), sex, marital status and educational level were included in the study as possible confounders.

We studied the influence of health in 1991 on changes in occupational status and mobility out of and into employment between 1991 and 1995. With respect to occupational class mobility analyses were done separately for upward and downward mobility. Occupational class mobility was determined among persons who reported to be in paid employment in both 1991 and 1995, and occupational class was based on the current occupation. The EG-code is not strictly hierarchical[32]. The self-employed were therefore excluded from the analyses with respect to occupational class mobility (N=69). In addition, a change between the lower skilled/unskilled non-manual class on the one hand and high skilled manual class on the other hand was not classified as social mobility, but as 'stable' (N=10). In the period between 1991 and 1995, 72 persons showed downward mobility and 114 upward mobility.
Mobility out of employment was measured among respondents who reported to have a paid job in 1991 (N=1,506): in the period 1991-1995, 361 respondents moved out of employment and 1145 stayed in paid employment. Mobility into employment was measured among respondents who were not in paid employment in 1991 (N=1027): 142 moved into employment, and 885 stayed economically inactive.

The effect of health on occupational class mobility and mobility out of and into employment is presented in Odds Ratios, using logistic regression models. The risk of downward and upward mobility is compared to those that remained stable in the same social class (reference category). In the analysis on mobility out of and into employment, respondents moving out were compared to those that stayed in paid employment; respondents that moved in were compared to those that stayed economically inactive. Since the relation between health and social mobility was expected to be different for men and for women, analyses were carried out separately for both sexes, and also for the total population.

In addition we estimated the contribution of health-related social mobility to the explanation of socio-economic health differences in the working population (15-59 years). We restricted this analysis to the contribution of mobility out of and into employment, because the results showed (see below) that health-related occupational class mobility had not occurred. As an example, we examined to what extent the higher risk of a less-than-good health for the manual classes (that is EG-classification high

skilled manual, low skilled manual and semi/unskilled manual) could be attributed to mobility out of and into employment between 1991 and 1995. Non-manual workers were used as the reference category.
First, we estimated the Odds Ratio for a less-than-good perceived general health in 1991 among manual workers in the working population in that year. Second, we estimated the Odds Ratio for a less-than-good perceived general health among manual workers in the working population in 1995, who were also in paid employment in 1991. We excluded persons who were mobile between manual and non-manual groups between 1991 and 1995, so that manual and non-manual workers that stayed in paid employment are the same groups in 1991 and in 1995. The Odds Ratio in 1995 in the working population is 'underestimated' by health-related mobility out of employment in the period 1991-1995. In comparing the two Odds Ratios we were able to calculate this underestimation by the formula (Odds Ratio 1991 - Odds Ratio 1995)/(Odds Ratio 1991 - 1).

The contribution of mobility into employment was estimated with the same procedure. We estimated the Odds Ratio for a less-than-good perceived general health in 1995 among manual workers in the working population in that year. Second, we estimated the Odds Ratio among manual workers in the working population in 1991, for those who were also in paid employment in 1995. The Odds Ratio in 1995 in the working population is 'overestimated' by health-related mobility into employment in the period 1991-1995. In comparing the two Odds Ratios we were able to calculate this 'overestimation' by the formula (Odds Ratio 1995 - Odds Ratio 1991)/(Odds Ratio 1991 - 1).

5.1.3 RESULTS

For ease of reference results are shown for the total population, as no major differences were found between men and women. Significant differences between both sexes will be indicated. Table 1 gives the absolute numbers with respect to occupational class mobility and mobility out of and into employment.

Table 1. Occupational class mobility and mobility out of and into employment 1991-1995. Men and women, 15-59 years, absolute numbers

occupational class mobility	N (937)[1]	mobility out of and into employment	(N=2,533)
down in occupational class	72	out of employment	361
up in occupational class	114	into employment	142
stable occupational class	751	stayed in paid employment	1,145[1]
		stayed economically inactive	885

1. for 208 persons of those who stayed in paid employment (1,145 - 937) information about occupational class was missing in 1991 and/or 1995

In Table 2 occupational class mobility in the period 1991-1995 is presented in relation to the three health indicators. In general mobility of people turned out to be more upward (N=114, 12% of all people in paid employment in 1991 and in 1995) than downward (N=72, 8%). However, most people remained stable (N=751, 80%). Significant differences in the Odds Ratios were not found between healthy and unhealthy people in 1991 for neither upward, nor downward mobility. None of the health indicators showed an effect on moving up or down the occupational ladder. Only with respect to chronic conditions there was a difference between men and women: for men there was no significant effect of one or more chronic conditions, for women the risk of moving up or down the occupational ladder was significantly higher (Odds Ratio resp. 2.47 and 2.86) among those that reported at least one chronic condition in 1991 (results not shown).

Table 3 shows mobility out of and into employment in relation to health. Between 1991 and 1995 24% (N=361) moved out of employment, while 76% (N=1,145) remained employed. 14% moved into employment (N=142) and 86% (N=885) remained economically inactive. All health indicators showed a significant effect on mobility out of employment. The Odds Ratio among those that reported a less-than-good perceived general health was 1.42, among those that reported at least one chronic condition the Odds Ratio was 1.46 and among those that reported three or more health complaints it was 1.70. Only with respect to one or more chronic conditions there was a difference between men and women: for men the Odds Ratio was 1.77 and statistically significantly different from unity, for women it was 1.18 (CI including unity) (results not shown).

All health indicators showed an effect on mobility into employment; among those that reported a less-than-good perceived general health this effect was statistically significant; the Odds Ratio was .49. The effect was stronger for men than for women: the Odds Ratio among men that reported a less-than-good perceived general health was .18, for chronic conditions the Odds Ratio was .12 and for health complaints it was .34. Among men, the Odds Ratios were statistically significantly different from unity, while among women no significant effect was found (results not shown).

Table 2. Occupational class mobility 1991-1995 by health problems in 1991. Men and women, 15-59 years[1]

		down in occupational class[2]		up in occupational class[2]	
health problems 1991		% (N=72)	Odds Ratio[3]	% (N=114)	Odds Ratio[3]
perceived general health	(very) good	7.2	1	12.1	1
	less than good	8.3	1.05 [.55-2.00]	12.4	1.05 [.61-1.80]
chronic condition	0	6.8	1	11.3	1
	>=1	8.6	1.25 [.75-2.08]	13.1	1.29 [.85-1.97]
health complaints	<=3	7.5	1	12.7	1
	>=4	8.3	.99 [.56-1.75]	10.9	.81 [.49-1.33]

1. respondents that stayed in paid employment in 1991 and 1995
2. reference category: respondents that stayed in same occupational class
3. adjusted for age (5-year cat.), sex, educational level and marital status

Table 3. Mobility out of and into employment in 1995 by health problems in 1991. Men and women, 15-59 years

		out of employment 1995[1]		into employment 1995[2]	
health problems 1991		% (N=361)	Odds Ratio[3]	% (N=142)	Odds Ratio[3]
perceived general health	(very) good	21.7	1	18.6	1
	less than good	32.1	1.42 [1.00-2.02]	8.5	.49 [.31-.79]
chronic condition	0	18.2	1	17.9	1
	>=1	28.9	1.46 [1.08-1.98]	12.2	.80 [.53-1.22]
health complaints	<=3	20.9	1	17.2	1
	>=4	31.8	1.70 [1.24-2.33]	10.9	.70 [.46-1.06]

1. out of employment = respondents in paid employment in 1991: unemployed, working disability, early pension, housewife in 1995 compared with paid job in 1995
2. into employment = respondents not in paid employment in 1991: paid employment in 1995 compared with unemployed, working disability, housewife in 1995
3. adjusted for age (5-year cat.), sex, educational level and marital status

The contribution of mobility out of employment to the explanation of socio-economic health differences in the working population is presented in Table 4. Among the working population, socio-economic health differences are measured by current occupation. Among manual workers, the Odds Ratio for a less-than-good perceived general health in the working population in 1995 is 1.74. This Odds Ratio is 'underestimated' by approximately 34% due to health-related mobility out of employment between 1991 and 1995 (2.12-1.74/2.12-1).

Table 4. Less-than good perceived general health 1995 by occupational class in 1991 and 1995. Men and women 15-59 years, paid job in 1991

	Odds Ratio[1] less-than-good perceived general health 1995	
occupational class[2]	1995 (N=1,210)[3]	1991 (N=1,210)[3]
non manual	1	1
manual	1.74 [1.17-2.57]	2.12 [1.53-2.87]
self-employed	.39 [.09-1.65]	1.34 [.60-2.99]
not in paid employment 1995	2.02 [1.36-2.98]	-

1. adjusted for age (5-year categories), sex and marital status
2. mobility between manual and non-manual in the period 1991-1995 was excluded
3. numbers are different from Table 1 because of missing values

Table 5 shows the contribution of mobility into employment to the explanation of socio-economic health differences in the working population. The Odds Ratio among manual workers for a less-than-good perceived general health in 1995 is 1.82. This Odds Ratio is 'overestimated' by approximately 9% due to health-related mobility into employment between 1991 and 1995 (1.82-1.75/1.75-1).

Table 5. Less-than good perceived general health 1995 by occupational class in 1991 and 1995. Men and women 15-59 years, paid job in 1995

	Odds Ratio[1] less-than-good perceived general health 1995	
occupational class[2]	1995 (N=1,009)[3]	1991 (N=1,009)[3]
non manual	1	1
manual	1.82 [1.24-2.62]	1.75 [1.18-2.59]
self-employed	.98 [.40-2.42]	.41 [.10-1.73]
not in paid employment 1991	-	1.95 [1.12-3.35]

1. adjusted for age (5-year categories), sex and marital status
2. mobility between manual and non-manual in the period 1991-1995 was excluded
3. numbers are different from Table 1 because of missing values

Results in Tables 4 and 5 suggest that people who moved out of and into employment between 1991 and 1995 are less healthy than those who remained employed during that period. It is possible that both groups are more healthy, however, than those that remained economically inactive between 1991 and 1995. To examine this, we compared the risk of a less-than-good perceived general health of different groups (those that remained economically inactive, those that moved out of and into employment, and those that remained employed). Table 6 presents the Odds Ratios. Non-manual workers were used as the reference category. The figures show that manual workers are less healthy than non-manual workers, persons that moved into and out of employment are less healthy than manual workers, and people that stayed economically inactive were the most unhealthy.

Table 6. Less-than good perceived general health 1991 and 1995 by occupational class in 1991 and 1995. Men and women 15-59 years

	Odds Ratio[1] less-than-good perceived general health (PGH) 1995 and 1991	
occupational class 1991/1995[2]	PGH 1995 (N=2,177)[3]	PGH 1991 (N=2,177)[3]
non manual	1	1
manual	1.61 [1.07-2.39]	1.70 [1.17-2.48]
self-employed	.40 [.09-1.70]	.72 [.24-2.11]
out of employment '91 -> '95	1.93 [1.35-2.77]	1.94 [1.37-2.74]
into employment '91 -> '95	2.32 [1.42-3.78]	2.61 [1.64-4.15]
not in paid employment 1991 and 1995	5.28 [3.84-7.25]	5.60 [4.12-7.62]

1. adjusted for age (5-year categories), sex and marital status
2. mobility between manual and non-manual in the period 1991-1995 was excluded
3. numbers are different from Table 1 because of missing values

5.1.4 DISCUSSION

Health in 1991, after a follow-up time of 4,5 years, is not related to occupational class mobility, neither upward nor downward. However, health is related to mobility out of and into employment. Health inequalities among the working population (measured by current occupation) are substantially influenced by mobility into and out of employment. We estimated that socio-economic inequalities in health among the working population are 'underestimated' by approximately 34% due to mobility out of employment, and 'overestimated' by approximately 9% due to mobility into employment. Respondents that moved into and out of employment were healthier than those that remained economically inactive, but their health was worse than of those who remained employed (both manual and non-manual).

When interpreting the data, there are some limitations to the study design that need consideration.

First, non-response might have biased the results. At baseline, non-response was not significantly related to demographic variables. In addition, a short oral interview was held among a sample of the non-respondents to the postal survey (30% response). This group was representative of the total group of non-respondents with respect to demographic variables. With respect to health problems no differences were not found compared to respondents to the postal survey. This confirms the assumption that non-respondents do not differ significantly from respondents. Response to the follow-up questionnaire was somewhat less in lower socio-economic groups. However, response in 1995 was the same among persons with and without paid employment in 1991 (see chapter 2.3). Therefore, it can be concluded that non-response in the follow-up period probably does not influence our results to a great extent.

Second, the use of self-reported health may cause bias. If different social classes or people with or without paid employment report their health differentially (given the same 'objective' health) the relation between ill health and social mobility could be under-estimated or overestimated. We tried to tackle this problem by using various health indicators which ranged from more subjective to more objective indicators. As the effect was comparable for all three health indicators we do not expect this bias to be considerable. Even so, other measurements that are not self-reported need to be examined.

Third, one might argue that the period for health-selective occupational class mobility in this study is too short, because health selection may operate slowly. However, Lundberg[15] did not find evidence for health-related occupational class mobility even over a period of 13 years. This supports the idea that health selection is not very important for mobility between occupational classes.

Fourth, our findings may be influenced by characteristics of the study region where certain types of industry are overrepresented (electro-technical industry and at the start of the study, car industry). During the study period unemployment rates in this region increased, because some factories closed and their entire workforce was fired. As this

type of unemployment is not health-related, our estimation of health selective mobility out of employment might be underestimated.
Fifth, the EG-classification may be too crude to measure occupational class mobility. One could assume that health-related occupational class mobility operates mainly within classes and not between classes. It is plausible that people with health problems will stay in their own occupation (usually with the same employer), moving down the ladder only in function. This is not always reflected in mobility between EG-classes. However, there are no international classifications which are more sensitive to upward or downward mobility in functional level.
Finally, one might assume that the risk of health-related occupational class mobility and mobility out of and into employment differs for different educational groups. We tested ($p < 0.05$) if the interaction between educational level and health in 1991 significantly changed the model. Since this was not the case, it can be concluded that the effect of illness on social mobility does not depend on educational level.

Although with respect to occupational class mobility almost none of the relations were statistically significant (except for chronic conditions among women), patterns for men were somewhat different than those for women (results not shown). Among women with health problems, the risk of moving down seemed greater than of remaining stable, which was not the case among men. An explanation for this difference between the sexes may be that for men, a lower occupational status normally means a physically more demanding job. Therefore, ill health will generally not lead to a lower status. Among women the opposite might be the case. Also among women with health problems there was a tendency of a greater chance to move up.This cannot be explained by this phenomenon.
In general, patterns between men and women were not different with respect to health-related mobility out of employment. It is nevertheless possible, that the nature of this movement is different for the sexes. One might assume that for women, the risk to move into the category of housewives or early retirement is greater, whereas for men (who is usually the breadwinner in the Netherlands) mobility into unemployment or disability pension is more likely. With our data it was not possible to distinguish between these groups because the numbers are too small.
The influence of health problems on mobility into employment was stronger for men than for women, although not statistically significant for all health indicators. This suggests that for men with health problems it is more difficult to find a job than for women. This might be explained by a difference in the nature of occupations: the average jobs for men may be more physically demanding than the average jobs for women.

In line with Lundberg[7] we studied the impact of illness on occupational class mobility between two moments in time for all respondents, regardless of whether it is their first job or not, and compared this to the current job. Lundberg argues that this method is a better measurement of class mobility during adult life than comparing only first jobs

with current jobs. In his opinion the latter is closer to intergenerational mobility. It would be even better, in a prospective design to take into account both the first as well as subsequent jobs, as it might give a better estimation of the contribution of selective class mobility to the explanation of socio-economic health differences in adult life during the life course. Power et al[4] studied occupational class mobility between ages 23 and 33, and concluded that occupational class mobility did not have a major effect on health inequalities. Our results in a population of 15-59 year-old people confirm their conclusion for a broader age range.

In our study, we could not make a distinction between full-time and part-time jobs. In the Netherlands, 14% of men and 62% of women work less than 35 hours a week[33]. It may be hypothesized that people with health problems decide or are forced by their employers to work part-time. If so, this might underestimate both the health-selective effect on occupational class mobility and on mobility out of employment. Therefore, in future studies the change from full-time to part-time jobs should also be taken into consideration.

The drift hypothesis suggests that illness has an impact on intragenerational mobility, which may be explained by several mechanisms. Ill persons will have problems holding a job in 'higher' occupational classes because a) ill persons are more inclined to seek less demanding jobs or b) they are forced by their employers. Health-related class mobility will then move towards lower non-manual jobs (because they are both physically and mentally less demanding)[15]. The literature shows some evidence to support this hypothesis. Ostlin[34] showed that there is a negative health selection into physically light occupations, resulting in an overestimation of illness at that level. Results presented by Dahl[35] show the same phenomenon: the SMR's for unskilled manual workers who moved to the category 'lower salaried employees' were higher than for stable unskilled manual workers. In addition, Bartley and Owen[16] showed that manual occupations have become more 'health selective' than other occupations over the last 20 years. These results do not support the idea that unhealthy people move into lower, i.e. manual occupations. On the contrary, one has to be 'healthier' to remain employed in manual classes. This effect may influence the measurement of class mobility using the EG-scheme, because physically light occu-pations, like administrative work are classified higher than heavy manual work. We dealt with this problem by considering mobility between EG-class semi/unskilled non-manual to high skilled manual as neither a move up or down the occupational ladder. It is nevertheless still possible that this phenomenon influences mobility between other classes of the EG-scheme. Therefore, we studied the nature of the occupations in which mobility took place. Taking into account the health status in 1991, in the non-manual classes, the risk of downward mobility was greater for unhealthy than for healthy people. For the manual classes no such effect was found. Health-related upward mobility (i.e. into the lower non-manual) did not emerge in the manual classes. This does not seem to be in conflict with results of other

researchers. Results have to beinterpreted with caution, however, because the numbers were small, especially in the manual classes (results not shown).

In many studies on socio-economic inequalities in health, measurements are based on current occupation, so only the working population is included. Results are often generalized to the total population. Our results show that inequalities among the working population can be considerably biased by mobility out of and into employment. This is in agreement with the results of another study which showed a serious underestimation of socio-economic inequalities in mortality when only the working population was taken into account[36]. Therefore, one cannot draw conclusions about the extent of socio-economic inequalities in health among the total population based on current occupation alone.
In addition, we showed that the contribution of health-related social mobility to the explanation of socio-economic inequalities in health is much more complicated than is usually suggested. We found that although the healthier people among the economically inactive have a greater chance to find employment, their health is still poorer than that of people who were already employed. This is supported by the result of other researchers. Martikainen and Valkonen found that the mortality rate of the re-employed was higher than mortality of the working population, but lower than that of the unemployed[37]. In a recent study Bartley and Plewis showed that the prevalence of ill health in mobile men was somewhere between that in the group they left and the group they joined[38]. Since people that move into employment more often start with manual than with non-manual work, the health of the destination class (i.e. the manual class) will decline. Similarly, people with health problems showed a greater risk of mobility out of employment. Their health was still better, however, than the health of the permanent economically inactive. As these people more often come from manual classes, the average health of the manual class will improve. The health decline and improvement are, however, a 'healthy worker' effect, and not a real deterioration or improvement in health among the lower socio-economic groups.

Until now, ill people have left employment instead of seeking a lower classified job. It is interesting whether this phenomenon will change in the future, because criteria for obtaining a disability pension were recently intensified by the Dutch government. Until 1994, the numbers of persons receiving a disability pension increased each year. In 1994, a decrease occurred for the first time[33].
In our society, paid employment is seen as a major source of both material and social welfare. Given this context, staying in paid employment, even at a lower level, is preferred above becoming economically inactive, even in welfare states such as the Netherlands, with a relatively well developed social security system. Since ill health seems to result in exclusion from employment, it may also result in a lower status and a lower income, which in turn may cause a poorer health. This downward spiral will increase socio-economic health differences in the population. The health policy implications of our findings are therefore, that the prospects for people with health problems

to stay in paid employment should be improved. This means that structural measures by the government are needed (e.g. financial support for employers who employ persons with a partial disability pension), as well as measures by employers in order tocreate working conditions (both physical and social) that make it possible for ill persons to stay in paid employment, without further damaging their health.

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5.2

IS THERE INDIRECT SELECTION? DETERMINANTS OF INTRAGENERATIONAL SOCIAL MOBILITY. FINDINGS FROM THE DUTCH GLOBE STUDY

ABSTRACT

Background - Research on the explanation of socio-economic health inequalities focuses on two mechanisms: social causation and health selection. A mechanism, which is also mentioned in the literature (usually regarded as part of the selection mechanism), is that of 'indirect selection'. This mechanism implies that common background factors influence both health and social mobility. The assumption is that downward or upward social mobility is selective by determinants of health. Therefore, the aim of the study is to investigate to what extent occupational class mobility and mobility out of and into employment is influenced by health-related factors.

Methods - Data were used from the Longitudinal Study on Socio-Economic Health Differences in the Netherlands. This cohort study of 15-74 year-old people (men and women) started in 1991; baseline and follow-up data in 1995 were used with respect to occupational class mobility and mobility out of and into employment. The analysis is based on 2,533 persons aged 15-59 at baseline.

Results - We found hardly any evidence for a significant influence of health-related behaviour, psychosocial stressors and psychological attributes on occupational class mobility and mobility into and out of employment. Only adverse psychological attributes show a trend towards a higher risk of mobility out of employment and a lower risk of mobility into employment. However, only few associations were statistically significant.

Conclusions - Our study does not support the idea which is suggested in the literature that mechanisms of intragenerational indirect selection play an important role in the explanation of socio-economic inequalities in health at adult age.

5.2.1 INTRODUCTION

In research on the explanation of socio-economic inequalities in health most attention is paid to two mechanisms: social causation and health selection[1]. Social causation means that socio-economic inequalities are caused by life-style factors, structural factors or psychosocial factors, which are unequally distributed among socio-economic groups. The health selection hypothesis assumes that health affects social mobility: healthy people may move up, and unhealthy people may move down the social ladder.
Another mechanism, which is usually regarded as part of the selection mechanism, is that of 'indirect selection'[2]. This mechanism assumes a downward or upward social mobility, not because of ill health but because of health-related factors. For example behavioural factors, personality, cultural factors and psychosocial factors may act as common background factors that influence both health and socio-economic status. Recently, the mechanism of indirect selection has received more attention[3], but has not yet been studied extensively[4].

In a life-course perspective on the onset of socio-economic health differentials, indirect selection may play an important role. Although social mobility occurs at adult age, the onset of the indirect selection mechanism already starts earlier in life. Childhood socio-economic circumstances are shown to have an independent effect on adult health[5-9]. Childhood socio-economic circumstances influence other factors in childhood and youth, which in turn may influence both adult health and adult socio-economic status. For example, psychological attributes are (partially) shaped in youth[10,11] and are related to both adult health[12] and adult socio-economic status[13,14]. The question is whether the association with adult socio-economic status is causal or selective, or both. Only little literature is available about the influence of psychological attributes on social mobility. An example is the positive association found between ego-defence mechanisms in childhood and upward social mobility[15]. In addition, it is hypothesized that specific personality traits may be related to educational and occupational achievements and preferences[16,17].
Furthermore, health behaviours also have their roots partly in youth[18]. It has been shown that the independent influence of childhood socio-economic circumstances on adult health partly acts through behavioural factors[9]. These factors may also influence social mobility. If so, behavioural factors act as the 'common background' causing indirect selection. One might assume that e.g. excessive alcohol consumption negatively influences career chances. It was found that the negative effect of early onset of alcoholism on income partly operates through reduced educational attainment[19]. With respect to other behavioural factors, most evidence is found for the association between obesity and social mobility, especially among women. Research from Britain and the US showed that obesity is more common among women that showed downward mobility (with respect to occupation, education and income), while slimmer women were more likely to show upward mobility[20-23]. But also among men it was suggested that thinness played a role in occupational class mobility[24].

A last category which may influence social mobility and which is related to health is that of psychosocial stressors. Stressors in youth (e.g. financial deprivation in childhood) and in adulthood (e.g. the occurrence of life events, such as death of a spouse, and long-standing difficulties, such as chronic disease of a relative or adult financial deprivation), might be factors that negatively influence someone's socio-economic career. Only little evidence is known about the impact of stressors on social mobility. For example, it was found that life events in childhood, such as parents' divorce, are associated with lower educational attainment and occupational status, a higher risk of unemployment and lower income in adult life[25-27].

To what extent might the hypothesis of indirect selection account for the social gradient in health? A distinction has to be made between intergenerational and intra-generational social mobility. Both processes may act over the life course. Most of the studies described above refer to intergenerational mobility. Little is known about the influence of health-related factors on intragenerational social mobility. In this chapter we will focus on intragenerational social mobility.
To answer the question to what extent indirect selection at adult age (i.e. intragenerational) can explain socio-economic inequalities in health, we first need insight into a preceding question. What are the factors that influence both adult socio-economic position and adult health status? The factors described above are known as health-related factors. The question that has to be answered is whether these factors would cause social mobility.
The Longitudinal Study of Socio-Economic Health Differences (LS-SEHD) in the Netherlands offers an opportunity to study this question. Data on health-related factors, occupational status and position on the labour market are available at different points in time. The impact of behavioural factors, psychological attributes and psychosocial stressors on occupational class mobility and mobility out of and into employment can be examined in a prospective cohort study among men and women, aged 15-59 year at baseline.

The research question in this chapter is as follows: to what extent are health behaviour, psychological attributes and psychosocial stressors related to downward or upward occupational class mobility and mobility out of and into employment at adult age?

5.2.2 DATA AND METHODS

The Longitudinal Study on Socio-Economic Health Differences (LS-SEHD) is a prospective cohort study of the explanation of SEHD in The Netherlands. The design and objective of the LS-SEHD are described in detail elsewhere[28]. The study is based on a cohort of 15-74 year old, non-institutionalized Dutch nationals, living in the city of Eindhoven and surroundings (a region in the South-East of the Netherlands). At baseline a random sample of approximately 27,000 people was drawn from the population registries of the participating municipalities, which was stratified by age and post code (45-74 year-old people and people from the highest and lowest socio-economic groups, as indicated by post code, were overrepresented). Respondents were contacted even after they moved away from the study region. People in the sample received a postal questionnaire in 1991. The response rate was 70.1%, resulting in a study population of 18,973 respondents. Additional data were collected among two subsamples of respondents on the postal survey by means of an oral interview. The first subsample was formed by an aselect group (approximately 3,500 persons, again stratified by post code) taken from the respondents to the postal survey. The response rate for this oral interview was 79.4% (2,802 respondents). For the second subsample (also taken from respondents to the postal survey), chronically ill people were overrepresented (approximately 4,000 persons). The response rate for this second group was 72.5% (2,878 respondents). No significant differences in response rate for the postal survey or the first oral interview were found with respect to sex, age, marital status, degree of urbanization and socio-economic status (measured by post code). Response was slightly less in the second subsample among younger people, unmarried persons and respondents living in the city[29]. In 1995 a postal follow-up questionnaire was sent to respondents of the 1991 oral interview (response rate approximately 80%).
The study population used in this analysis was restricted to persons aged 15-59 in 1991, who were not in early retirement in 1991, and to those who responded to both surveys in 1991 and 1995. Soldiers, students and rentiers were excluded. This resulted in a study population of 2,533 persons for whom information on employment status in 1991 and in 1995 was available (missing values approximately 4%). The reason for excluding persons of 60 years and older, is because in a follow-up period of 4.5 years, a population of 15-59 year old persons does not include respondents who reach normal age of retirement (65 years), the oldest persons being 59 years old at baseline. Persons in early retirement in 1991 were excluded from the analyses because they were not expected to start work again.

Occupational level of respondents was classified according to the Erikson and Goldthorpe[30] (EG)-scheme into 8 categories: higher grade professionals, lower grade professionals, skilled non-manual, semi/unskilled non-manual, self-employed, high skilled manual, low skilled manual and semi/unskilled manual. Position on the labour market was categorized into paid employment versus economically inactive (unemployed, disability pension, housewives/househusbands and early retirement).

Health-related behavioural factors are smoking, alcohol consumption, leisure time physical exercise and Body Mass Index. Smoking was categorized into never been smoker, former smoker and current smoker. Alcohol consumption was classified into four categories: abstainers, light, moderate and (very) excessive drinkers. Body Mass Index was categorized into being underweight (Quetelet-index < 20), normal (Quetelet-index between 20 and 27) and being overweight (Quetelet-index > 27). Leisure time physical exercise was measured by 3 categories: no and light exercise, moderate exercise and heavy exercise.
Psychological attributes were indicated by neuroticism, (external) locus of control, orientation towards the future, parochialism, coping styles and social support. The latter was measured in two subscales: emotional support and instrumental support. We used validated questionnaires[31-36]. Scores were divided into five equal categories. Parochialism and orientation towards the future were measured for only half the study population.
Psychosocial stressors were indicated by life events, longstanding difficulties and financial deprivation in childhood. Life events were measured by an 8-item questionnaire about events in the past year (e.g. death of a spouse, victim of robbery). They were classified into three categories: 0, 1, and 2 or more life events. The number of longstanding difficulties was measured during the oral interview with an adapted version of the Dutch Long Standing Difficulties List[37]. With this list, three different types of difficulties were distinguished. Difficulties with health problems of significant others (5 items) were classified according to whether respondents reported 0, 1, 2 and more problems in the last year. The subscale 'problems with relations', including social contacts with parents, partner, neighbours, etc., consisted of 8 items. The subscale 'situational problems' consisted of 4 items including problems with housing, financial situation, etc. The scores for each item of the two last subscales ranged from 0 (no problem or not applicable) to 4 (serious problem). The scores for each item were added up, resulting in a score of min. 0 and max. 32 on the subscale 'problems with relations', and min. 0 and max. 16 on the subscale 'situational problems'. We divided these scores into 5 categories for relational problems (1, 2, 3, and 4 or higher) and 4 categories for situational problems (0, 1, 2, 3 or higher). The total score on the list of all longstanding difficulties (all three sub-scales) was divided into 0, 1, 2, 3, 4 or more difficulties. Life events and problems concerning work or (un)employment in the original scales were left out because these might be a precursor of social mobility instead of a determinant. Financial deprivation during childhood was measured with one question on shortage of money for buying food, clothes etc., divided into 2 categories: never and sometimes/often. Financial deprivation during childhood was measured for only half the study population.

The demographic variables age (5-year categories), sex, marital status (4 categories) and educational level (7 categories) were added as confounders. We adjusted also for occupation of the father (measured at the respondents' age of 12, classified into 5 categories, because associations between health-related factors and social mobility may be partly or completely based on childhood socio-economic conditions.

We studied the influence of background factors measured in 1991 on changes in occupational status and mobility out of and into employment between 1991 and 1995. With respect to occupational class mobility analyses were done separately for upward and downward mobility. Occupational class mobility was determined among persons who reported to be in paid employment in both 1991 and 1995, and occupational class was based on current occupation. The EG-code is not strictly hierarchical[30]. The self-employed were therefore excluded from the analyses with respect to occupational class mobility (N=69). In addition, a change between the lower skilled/unskilled non-manual class on the one hand and high skilled manual class on the other hand was not classified as social mobility, but as 'stable' (N=10). In the period between 1991 and 1995, 72 persons showed downward mobility and 114 upward mobility.
Mobility out of employment was measured among respondents who reported to have a paid job in 1991 (N=1,506): in the period 1991-1995, 361 respondents moved out of employment and 1,145 stayed in paid employment. Mobility into employment was measured among respondents who were not in paid employment in 1991 (N=1,027): 142 moved into employment, and 885 stayed economically inactive.

The effect of health-related factors on occupational class mobility and mobility out of and into employment is presented in Odds Ratios. Logistic regression models were used to analyze the data. The risk of downward and upward mobility is compared to the risk of remaining stable in the same social class (reference category). In the analysis on mobility out of and into employment, respondents moving out were compared to those that stayed in paid employment; respondents that moved in were compared to those that stayed economically inactive. The reduction in deviance (likelihood ratio test) due to the inclusion of health-related factors was used as an overall statistical test of their effect.
We expect a higher risk of downward occupational class mobility and mobility out of employment (Odds Ratios higher than 1) and a lower risk of upward occupational class mobility and mobility into employment (Odds Ratios lower than 1) for unhealthy behaviour, adverse psychological attributes and a higher burden of stressors. Analyses were carried out for men and women separately, and also for the total population.

5.2.3 RESULTS

Results are shown for the total population, as no significant differences between the sexes were found. Table 1 gives the absolute numbers with respect to occupational class mobility and mobility out of and into employment. Tables 2, 3 and 4 refer to occupational class mobility, and table 5,6 and 7 to mobility out of and into employment. For ease of reference only Odds Ratios are presented for the category which is, according to the literature, the most adversely related to health, e.g. current smoking, no physical exercise or highly neurotic. Significant differences for other categories will be indicated in the text. Also significant reductions in deviance will be indicated ($p < 0.05$).

Table 1. Occupational class mobility and mobility out of and into employment 1991-1995. Men and women, 15-59 years, absolute numbers

occupational mobility	N (937)[1]	mobility out of and into employment	(N=2,533)
down in occupational class	72	out of employment	361
up in occupational class	114	into employment	142
stable occupational class	751	stayed in paid employment	1,145[1]
		stayed economically inactive	885

1. for 208 persons of those who stayed in paid employment (1145 - 937) information about occupational class was missing in 1991 and/or 1995

Occupational class mobility

In Table 2 Odds Ratios with respect to behavioural factors are given. Generally, results are not consistently in the hypothesized direction (higher risk of downward and lower risk of upward occupational class mobility for adverse health behaviour). None of the Odds Ratios was statistically different from unity, nor were any of the p-values for the reduction in deviance.

Table 2. Occupational class mobility 1991-1995 by health behaviour measured in 1991, Odds Ratios[1]. Men and women, 15-59 years[2]

health behaviour		down in occupational class[3] Odds Ratio (N=72)	up in occupational class[3] Odds Ratio (N=114)
smoking[4]	current smoker	1.01 [.48-2.14]	1.36 [.79-2.32]
physical activity[4]	none or light	1.02 [.46-2.24]	.85 [.43-1.68]
alcohol consumption[4]	abstainers	.66 [.24-1.84]	.44 [.17-1.13]
	(very) excessive	.42 [.14-1.27]	.54 [.24-1.21]
BMI[4]	QI <20	.36 [.07-1.74]	1.54 [.76-3.13]
	QI >27	1.10 [.55-2.19]	1.08 [.58-2.02]

1. adjusted for age (5-year cat.), sex, educational level, marital status and father's occupation
2. respondents that stayed in paid employment in 1991 and 1995
3. reference category: respondents that stayed in same occupational class
4. reference category: never been smokers, heavy exercise, light drinkers, QI > 20, < 27

Table 3 presents Odds Ratios with respect to psychological attributes. A systematic trend cannot be found. Some aspects show a trend in the expected direction of either downward or upward occupational class mobility, but others do not. Only the coping styles 'active problem focusing' and 'avoidance behaviour' show with respect to upward mobility a statistically significant Odds Ratio in the hypothesized direction.
Other detailed results are not tabulated, but will only be described. For 'palliative reaction pattern' the reduction in deviance was statistically significant. None of the Odds Ratios confirmed the hypothesized direction, however. Also for 'disclosure of emotions' the reduction in deviance was statistically significant, although Odds Ratios were not consistently in the hypothesized direction. With respect to downward occupational class mobility just one Odds Ratio was statistically significantly different from unity in the hypothesized direction (Odds Ratio 3.49 for the fourth quintile of 'active problem focusing'). The reduction in deviance was statistically significant for 'orientation towards the future' and 'active problem focusing'. For both variables the Odds Ratios generally confirmed the hypothesized direction (i.e. higher than 1).

Table 3. Occupational class mobility 1991-1995 by psychological attributes measured in 1991, Odds Ratios[1]. Men and women, 15-59 years[2]

psychological attribute	quintile	down in occupational class[3] Odds Ratio (N=72)	up in occupational class[3] Odds Ratio (N=114)
neuroticism[4]	highest	.83 [.29-2.40]	.90 [.43-1.88]
external locus of control[4]	highest	.71 [.24-2.10]	1.11 [.47-2.61]
future orientation[5]	lowest.	52 [.10-2.66]	.72 [.29-1.79]
parochialism[4]	highest	3.25 [.83-12.73]	1.16 [.39-3.45]
coping: active problem focusing[5]	lowest	2.67 [.95-7.51]	**.34 [.13- .86]**
coping: depressive reaction pattern[4]	highest	1.09 [.49-2.46]	1.00 [.50-1.99]
coping: avoidance behaviour[4]	highest	.64 [.22-1.82]	**.38 [.15-1.00]**
coping: social support seeking[5]	lowest	1.18 [.43-3.22]	.57 [.26-1.26]
coping: palliative reaction pattern[4]	highest	.66 [.22-1.96]	1.43 [.57-3.56]
coping: disclosure of emotions[5]	lowest	.83 [.36-1.92]	.51 [.24-1.10]
coping: optimism[4]	highest	.88 [.29-2.62]	1.09 [.45-2.65]
emotional social support[5]	lowest.	73 [.32-1.65]	.70 [.31-1.56]
instrumental social support[5]	lowest	.99 [.43-2.26]	.91 [.46-1.83]

1. adjusted for age (5-year cat.), sex, educational level, marital status and father's occupation
2. respondents that stayed in paid employment in 1991 and 1995
3. reference category: respondents that stayed in same occupational class
4. reference category: lowest quintile
5. reference category: highest quintile

Table 4 presents results for psychosocial stressors. For some stressors a trend emerged in the hypothesized direction. For some categories of longstanding difficulties and also for a higher burden of life events, a higher risk of downward occupational class mobility emerged. This was only statistically significant for one longstanding difficulty related to health of others (results not shown). For the other stressors no statistically significant relation was found (neither in Odds Ratios nor in reduction in deviance). None of the stressors showed a (statistically significant) influence on upward occupational class mobility in the expected direction.

Table 4. Occupational class mobility 1991-1995 by stressors measured in 1991, Odds Ratios[1]. Men and women, 15-59 years[2]

stressor		down in occupational class[3] Odds Ratio (N=72)	up in occupational class[3] Odds Ratio (N=114)
financial deprivation during childhood[4]	sometimes/often	.64 [.18-2.33]	.42 [.12-1.48]
life events[4]	3 or more	2.97 [.73-12.08]	1.02 [.21-4.93]
longstanding difficulties health others[4]	2 or more	.80 [.31-2.05]	1.31 [.65-2.66]
longstanding difficulties relational problems[4]	4 or more	1.28 [.52-3.15]	1.00 [.49-2.03]
longstanding difficulties situational problems[4]	3 or more	1.98 [.61-6.49]	1.33 [.42-4.16]
longstanding difficulties total[4]	4 or more	1.68 [.68-4.14]	1.23 [.61-2.47]

1. adjusted for age (5-year cat.), sex, educational level, marital status and father's occupation
2. respondents that stayed in paid employment in 1991 and 1995
3. reference category: respondents that stayed in same occupational class
4. reference category: none stressors

Mobility out of and into employment

Table 5 refers to behavioural factors. None of the Odds Ratios was statistically different from unity with respect to mobility out of employment. Trends were not consistently in the hypothesized direction (i.e. Odds Ratio higher than 1). With respect to mobility into employment the Odds Ratio for moderate physical activity was statistically significantly different from unity only (OR .61) (not tabulated). Also the reduction in deviance for physical activity was statistically significant (not tabulated). However, Odds Ratios for the categories of physical activity did not confirm the expected trend. Trends for the other factors were not consistently in the hypothesized direction (i.e. Odds Ratio lower than 1).

Table 5. Mobility out of and into employment 1991-1995 by health behaviour measured in 1991, Odds Ratios[1]. Men and women, 15-59 years

health behaviour		out of employment[2] Odds Ratio (N=361)	into employment[3] Odds Ratio (N=142)
smoking[4]	current smoker	1.51 [.99-2.30]	1.27 [.73-2.20]
physical activity[4]	none or light	1.36 [.96-1.91]	1.08 [.56-2.06]
alcohol consumption[4]	abstainers	1.15 [.72-1.83]	.88 [.51-1.53]
	(very) excessive	.86 [.51-1.47]	1.75 [.69-4.41]
BMI[4]	QI < 20	.93 [.50-1.75]	1.25 [.66-2.37]
	QI > 27	.72 [.47-1.11]	.94 [.52-1.71]

1. adjusted for age (5-year cat.), sex, educational level, marital status and father's occupation
2. out of employment= respondents in paid employment in 1991: unemployed, working disability, early pension, housewife in 1995 compared with paid job in 1995
3. into employment= respondents not in paid employment in 1991: paid employment in 1995 compared with unemployed, working disability, housewife in 1995
4. reference category: never been smokers, heavy exercise, light drinkers, QI > 20, < 27

Table 6 shows results with respect to psychological attributes. The overall pattern approximates the hypothesized direction: a higher risk of mobility out of employment for adverse psychological attributes (i.e. Odds Ratio higher than 1). The Odds Ratio is statistically significantly higher for the highest quintiles of neuroticism (OR 1.79) and for coping style 'depressive reaction pattern' (OR 1.85), and the sub-lowest quintile of orientation towards the future (OR 2.00) (not tabulated). For orientation towards the future the reduction in deviance was statistically significant, with most of the Odds Ratios of the distinguished categories confirming the expected direction, i.e. higher than 1.

With respect to mobility into employment most factors show an Odds Ratio in the expected direction: a lower risk of mobility into employment for adverse psychological attributes and coping styles (statistically significant for the highest and middle quintiles of neuroticism, for the highest quintile of locus of control, for the lowest quintile of 'active problem focusing', and for the sub-lowest quintile of 'disclosure of emotions'). For neuroticism, locus of control and 'active problem focusing' the reduction in deviance was statistically significant and Odds Ratios for the distinguished categories were generally in the same direction.

Table 6 shows results with respect to psychological attributes. The overall pattern approximates the hypothesized direction: a higher risk of mobility out of employment for adverse psychological attributes (i.e. Odds Ratio higher than 1). The Odds Ratio is statistically significantly higher for the highest quintiles of neuroticism (OR 1.79) and for coping style 'depressive reaction pattern' (OR 1.85), and the sub-lowest quintile of orientation towards the future (OR 2.00) (not tabulated). For orientation towards the future the reduction in deviance was statistically significant, with most of the Odds Ratios of the distinguished categories confirming the expected direction, i.e. higher than 1.

With respect to mobility into employment most factors show an Odds Ratio in the expected direction: a lower risk of mobility into employment for adverse psychological attributes and coping styles (statistically significant for the highest and middle quintiles of neuroticism, for the highest quintile of locus of control, for the lowest quintile of 'active problem focusing', and for the sub-lowest quintile of 'disclosure of emotions'). For neuroticism, locus of control and 'active problem focusing' the reduction in deviance was statistically significant and Odds Ratios for the distinguished categories were generally in the same direction.

Table 6. Mobility out of and into employment 1991-1995 by psychological attributes measured in 1991, Odds Ratios[1]. Men and women, 15-59 years

psychological attribute	quintile	out of employment[2] Odds Ratio (N=361)	into employment[3] Odds Ratio (N=142)
neuroticism[4]	highest	**1.79 [1.10-2.93]**	**.46 [.24- .90]**
external locus of control[4]	highest	1.68 [1.00-2.83]	**.38 [.17- .85]**
future orientation[5]	lowest	.58 [.25-1.33]	.55 [.20-1.56]
parochialism[4]	highest	.86 [.37-1.98]	.95 [.31-2.90]
coping: active problem focusing[5]	lowest	1.21 [.72-2.04]	**.37 [.17- .79]**
coping: depressive reaction pattern[4]	highest	**1.85 [1.14-2.99]**	.71 [.38-1.35]
coping: avoidance behaviour[4]	highest	1.63 [.98-2.72]	.69 [.33-1.44]
coping: social support seeking[5]	lowest	.79 [.45-1.41]	.72 [.36-1.45]
coping: palliative reaction pattern[4]	highest	1.22 [.72-2.08]	1.02 [.48-2.17]
coping: disclosure of emotions[5]	lowest	1.37 [.78-2.38]	.75 [.34-1.64]
coping: optimism[4]	highest	1.07 [.58-1.96]	.80 [.34-1.89]
emotional social support[5]	lowest	1.05 [.63-1.76]	.81 [.40-1.66]
instrumental social support[5]	lowest	.90 [.55-1.47]	1.18 [.57-2.48]

1. adjusted for age (5-year cat.), sex, educational level, marital status and father's occupation
2. out of employment= respondents in paid employment in 1991: unemployed, working disability, early pension, housewife in 1995 compared with paid job in 1995
3. into employment= respondents not in paid employment in 1991: paid employment in 1995 compared with unemployed, working disability, housewife in 1995
4. reference category: lowest quintile
5. reference category: highest quintile

Table 7 refers to psychosocial stressors. The overall pattern with respect to both mobility out of and into employment is unclear. A higher burden of life events and longstanding difficulties related to the health of others showed a statistically higher risk of mobility out of employment. With respect to mobility into employment the associations between longstanding 'situational' problems was significantly related to mobility into employment, albeit in the 'wrong direction'. The reduction in deviance was not statistically significant for any of the psychosocial stressors.

Table 7. Mobility out of and into employment 1991-1995 by stressors measured in 1991, Odds Ratios[1]. Men and women, 15-59 years

stressor		out of employment[2] Odds Ratio (N=361)	into employment[3] Odds Ratio (N=142)
financial deprivation during childhood[3]	sometimes/often	1.53 [.80-2.91]	.52 [.21-1.28]
life events[3]	3 or more	**2.71 [1.15-6.39]**	1.12 [.45-2.78]
longstanding difficulties health others[3]	2 or more	**1.62 [1.04-2.53]**	.73 [.37-1.44]
longstanding difficulties relational problems[3]	4 or more	.99 [.58-1.69]	.81 [.43-1.54]
longstanding difficulties situational problems[3]	3 or more	.87 [.36-2.08]	2.18 [1.08-4.40]
longstanding difficulties total[3]	4 or more	1.52 [.92-2.52]	1.37 [.66-2.83]

1. adjusted for age (5-year cat.), sex, educational level, marital status and father's occupation
2. out of employment= respondents in paid employment in 1991: unemployed, working disability, early pension, housewife in 1995 compared with paid job in 1995
3. into employment= respondents not in paid employment in 1991: paid employment in 1995 compared with unemployed, working disability, housewife in 1995
4. reference category: no stressors

5.2.4 DISCUSSION

In this analysis, hardly any evidence could be found for indirect selection with respect to occupational class mobility and mobility out of and into employment. There are no indications that behavioural factors have any influence on upward or on downward occupational class mobility, or on mobility into or out of employment. Results were generally not significant, and did not even show a consistent trend. Psychosocial stressors might have a minor effect on downward occupational class mobility and mobility out of and into employment. However, since only a few results were statistically significant, and trends were not consistent, the effect will not be substantial. With respect to psychological attributes some evidence is found for an effect on mobility out of and into employment. With respect to occupational class mobility no systematic trend emerged. Adverse psychological attributes show a trend towards a higher risk of mobility out of employment and a lower risk of mobility into employment. However, our results do not indicate that the mechanism of indirect selection at adult age is very important in the explanation of socio-economic inequalities in health.

When interpreting the data, there are some limitations to the study design that need to be considered. This is important, because we have to be sure that our conclusion about the little impact of indirect selection cannot be (entirely) attributed to data problems. Therefore, we will discuss possible imperfections in the study design extensively. Firstly, non-response might bias the results. At baseline, non-response appeared not to be significantly related to socio-economic status. Response to the follow-up questionnaire was slightly related to socio-economic status: response was lower in lower socio-economic groups, response in 1995, however, was the same among persons with and without paid employment in 1991 (see chapter 2.3). Therefore, non-response in the follow-up period probably does not influence our results significantly.
Secondly, the use of self-reported determinants of health may cause bias. If social classes or people with or without paid employment report their health behaviour or the burden of stressors differently (given the same 'objective' behaviour or amount of stressors), or they answer in different ways to e.g. personality questionnaires, the relation between health-related factors and social mobility could be underestimated or overestimated. This can only be the case when people preceding to their social mobility or their mobility out of or into employment report differently from people that remain stable. There is no reason to believe that preceding to mobility, persons underreport or overreport their health behaviour, compared to stable people. One might, however, assume that persons with a bigger 'tendency to complain' will on the one hand report e.g. more longstanding difficulties or less social support, and are on the other hand more inclined to downward occupational class mobility or mobility out of employment. If this occurs, the relation between these factors and mobility may be overestimated. This is only relevant with respect to the very few factors that were related to social mobility, because other factors were not significantly related at all. If 'tendency to complain' was to play a role, however, neuroticism in particular should be highly related to social

mobility, as this factor is also interpreted as 'negative affectivity'[38]. As neuroticism showed only a consistent relation with mobility into employment, it is very unlikely that 'tendency to complain' will substantially bias the association between health-related factors and social mobility.

Thirdly, one might argue that the period for mobility to be selective to health-related factors in this study is too short, because indirect selection may operate more slowly. In the same data-set and for the same time period we found a clear association between health and mobility into and out of employment[39]. This indicates that at least with respect to health-related selection this period is not too short. Nevertheless, it is possible that health-related factors needs more time to have an effect on social mobility than health would need. On the other hand, one might assume that e.g. psychological attributes are more or less stable factors, which means that the influence of these factors had been effective long before they were measured in 1991. We are aware of only one study on intragenerational indirect selection covering a longer time period. In this Danish follow-up study, support was not found either for the indirect selection hypothesis over a period of 11 years: people with a favourable cardiovascular risk profile did not show more socially upward mobility than people with an unfavourable profile[40]. This confirms our results, although a definite answer as to the length of the required follow-up period cannot be given.

Fourthly, as childhood social class and social mobility are related, associations between health-related factors and social mobility may be partly or completely based on childhood socio-economic conditions, since health behaviour and psychological attributes are independently related to childhood social class[9,41-46]. Adjustment for childhood social class gives the remaining, direct effect of health-related factors on social mobility. As, however, childhood socio-economic class was shown to have an independent effect on adult health, it may also in itself act as 'common background factor'. Controlling for childhood social class would then imply overadjustment. Therefore, we repeated our analysis without adjustment for childhood social class. The results hardly changed (results not shown).

Fifthly, our findings may be influenced by characteristics of the study region where certain types of industry are overrepresented (electro-technical industry and, at the start of the study, the car industry). During the study period, unemployment rates in this region increased because some factories closed down and their entire workforce was dismissed. As this type of unemployment is not related to any of the factors under study, our estimation of selective mobility out of employment might be underestimated.

Sixthly, one might argue that the health-related factors studied in this analysis can be influenced by health. For example, health behaviour such as smoking[47], or personality traits[48] can be affected by the occurrence of health problems. Since health was not related to occupational class mobility in our study[39] it cannot have biased the relation between health-related factors and occupational class mobility. Health was, however, related to mobility into and out of employment. Although, the association between health-related factors and mobility into and out of employment might therefore be overestimated, the bias cannot be substantial because hardly any significant relation was

found. Our conclusion that the effect of health-related factors on social mobility is virtually non-existent, can only be reinforced.
Seventhly, the factors that may influence social mobility may be interrelated. Therefore, by analyzing the health-related factors in separate models, the associations between health-related factors and social mobility might be biased. However, adjusting all factors for each of the others would be asking for a much too complicated model. Since adjustment for other factors will usually lower the associations, our conclusion that health-related factors do not substantially influence social mobility will not change.
Eighthly, the EG-classification may be too crude to measure occupational class mobility. One could assume that occupational class mobility caused by health-related factors operates mainly within classes and not between classes. It is plausible that people with adverse health behaviour, a higher burden of stressors, or an adverse personality will stay in their own occupation (usually with the same employer), moving down the occupational ladder only in function. This is not always reflected in mobility between EG-classes. However, there are no international classifications with a more sensitive approach to upward or downward mobility in functional level.
Finally, one might assume that a shortcoming of the study design could be a lack of power due to the small number of persons that show social mobility. However, as was already mentioned above the numbers were large enough to demonstrate significant relations between health problems and mobility into and out of employment[39]. Therefore, the small numbers cannot explain the lack of association between health-related factors and mobility.
Overall, it cannot be completely ruled out that our results are in some way underestimated or overestimated. However, considering all possible sources of bias, which, if they occur at all, operate in different directions, we are convinced that our negative results cannot be explained by data problems alone.

In interpreting our findings with respect to both occupational class mobility and mobility out of and into employment, hardly any evidence for indirect selection was found with respect to behaviour and psychosocial stress. A few Odds Ratios were statistically significant, which was to be expected on statistical grounds, since we tested a large number of models. It seems that, provided there is indirect selection in the first place, psychological attributes are the most important. The number of statistically significant Odds Ratios for psychological attributes was larger than was expected on statistical grounds, bearing in mind the number of models that were tested. As psychological attributes are related also to health at adult age[42], indirect selection by psychological attributes may partly explain socio-economic health differences at adult age. However, since most of the associations were not statistically significant, we did not find strong evidence for an important role in this explanation.

Marmot et al[3] conclude that indirect selection cannot account for inequalities in health. They found that in longitudinal studies in Britain and the US the social gradient still existed after adjustment for parents' social class, lack of intact family during child-

hood and intelligence measured at school. They refer however to intergenerational social mobility. In addition, since causal and selection explanations may both play a role, it was not expected that indirect selection would explain the whole phenomenon of socio-economic health inequalities, but only a part of it. Thus, one might expect an attenuation of the gradient, but not a total abolition of the association. As there are hardly any empirical studies on intragenerational social mobility caused by health-related factors, it is difficult to compare our findings with those of others. In the study of Moller et al[40] described above, evidence for an effect on indirect selection was not found either.

One might argue that other factors, which are also important in the mechanism of indirect selection, are not studied here. The literature, however, focuses on the factors we examined. Other factors might for instance be structural factors such as housing conditions or neighbourhood characteristics. Although these factors cannot be ruled out, a substantial effect on social mobility is not very likely. In further research, however, it might be worthwhile to take these factors into account.

Social inequalities in health can be explained by three mechanisms: health selection (health determines socio-economic position), social causation (socio-economic position determines health) and indirect selection (factors that determine both achieved socio-economic position and health). The idea of indirect selection is based on the hypothesis that common underlying causes influence health development and social achievement. Whether indirect selection is considered to be selection or causation is just a matter of perspective[49]. Marmot et al[3] argue that the distinction between these three classes of explanation has clear policy implications: 'if selection would be the most important, the clear implication is that improvement in features of adult social conditions would have little impact on the worse health of the current generation of adults at relative social disadvantage. Potentially, improving conditions for children could improve the health of future generations of adults.' We suppose however that the mechanisms are not mutually exclusive: the most plausible explanation is that all three mechanisms play a role. Interventions must therefore be aimed at both adult conditions and childhood conditions. Childhood conditions have their influence on adult health through a causal mechanism, or through health selection in childhood, even if indirect selection does not play an important role. Interventions aimed at the reduction of social inequalities in health will, however, have more impact when they focus on the health effects of health behaviour, personality traits and psychosocial stressors than when interventions focus on the effect of these factors on social position.

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CHAPTER 6

GENERAL DISCUSSION AND CONCLUSIONS

6 GENERAL DISCUSSION AND CONCLUSIONS

In this thesis we examined a conceptual model concerning the role of childhood conditions and selection processes in the explanation of socio-economic health inequalities in adult life. We studied three processes: the influence of childhood socio-economic conditions, the influence of childhood health and the influence of (intragenerational) selection on health and on health determinants. These three processes are discussed in paragraph 6.1. Each process is accompanied by an overview of the results. Chapter 3.1 was based on historical data for infant and perinatal mortality. Our results in chapters 3.2 to 5.2 were based on data from the Longitudinal Study of Socio-Economic Health Differences (LS-SEHD). In paragraph 6.2 methodological issues as regards the data, data collection and design of the study will be discussed. Then, in paragraph 6.3, we will discuss our findings against the background of international literature. In paragraph 6.4 we will make a synthesis of the role of the three distinguished processes, and discuss the life-course perspective in the explanation of socio-economic health inequalities. We will finish our conclusions with the implications of our findings for further research in paragraph 6.5, and for policy in paragraph 6.6.

6.1 OVERVIEW OF THE RESULTS

The role of childhood socio-economic status

The first process to be distinguished in our conceptual model is the role of childhood socio-economic conditions to the explanation of socio-economic health inequalities in adult life (relation 1 in the model).

Chapter 3.1 deals with the relation between childhood socio-economic circumstances and childhood health (relation 1a in the model). An overview of data on socio-economic inequalities in perinatal and infant mortality in Amsterdam in the last 150 years, showed that socio-economic inequalities in infant and perinatal mortality decreased in absolute numbers. In relative terms, however, inequalities in infant mortality did not decrease; around 1990, the risk of infant mortality in the lower socio-economic groups was still approximately two times higher than in the highest socio-economic group. With respect to perinatal mortality the relative risk also decreased.

We studied to what extent socio-economic inequalities in adult health are explained by childhood socio-economic conditions. In addition we also studied which childhood socio-economic conditions were the most important in this explanation.

In chapter 3.2 it is shown that about 10% of the relations between adult socio-economic status and adult health can be attributed to childhood socio-economic conditions. The analysis indicated that education of the mother was the most important factor, followed by occupation of the father and financial situation.

Another aspect in unravelling the role of childhood socio-economic status was whether it has an independent effect (i.e. adjusted for adult socio-economic status) on adult

health (relation 1b in the model). In chapter 3.3 this question is discussed. Childhood socio-economic status as indicated by father's occupation has an independent effect on adult health, even after adjustment for the respondent's own occupation. The risk of health problems was greater among respondents that grew up in unfavourable socio-economic circumstances, irrespective of their current socio-economic status.
Our results showed that social disadvantage does exist in the life course: people that grew up in unfavourable circumstances, and that are still in unfavourable circumstances at adult age, run the greater risk. One might assume that the adverse health effect of living in social disadvantage during several periods in the life course is stronger than just the sum of the separate effects of these periods. However, evidence for such an effect was not found, since interaction between childhood and adult socio-economic status did not emerge. This means that the relation between childhood circumstances and adult health is the same in all adult socio-economic groups and that the relation between adult socio-economi status and adult health is the same in all childhood socio-economic groups.

In two subsequent analyses, we examined whether the influence of childhood socio-economic status on adult health operates through intermediate factors (relation 1c in the model). First we concentrated on health behaviour: does childhood socio-economic status (indicated by father's occupation) affect adult health through behavioural factors? Chapter 3.3 shows that relations between childhood socio-economic status and adult health decrease when behavioural factors are added to the model. After adjustment for behavioural factors the effect of the father's occupational level was still statistically significant. This means that the effect of childhood socio-economic conditions on adult health is only partly determined by behavioural factors. Physical activity was the most important factor: an estimated 11.5% of the increased risk of a less-than-good perceived general health for the lowest father's occupational group can be attributed to this factor. Smoking did not contribute to the relation between father's occupation and health. The other behavioural factors together (physical activity, alcohol consumption and BMI) explained a small part (approximately 10%) of the differences in adult health between childhood socio-economic groups.

Besides the role of health behaviour we also studied the role of psychological attributes in chapter 3.4. Does the influence of childhood socio-economic status on adult health operate through psychological attributes (i.e. personality traits and coping styles)? The results show that several psychological attributes contribute substantially to the higher risk of health problems among respondents whose fathers had a lower occupation. When external locus of control, neuroticism and active problem focusing were simultaneously included in a model with occupation of the father and confounders, the Odds Ratios for a less-than-good perceived general health among those with a father in the lowest occupational class decreased by approximately 50%. These factors also explained about a fifth of the associations with self-reported cardiovascular diseases. This was independent of adult social class.

The role of childhood health

The second process in our conceptual model is the role of childhood health in explaining socio-economic health inequalities in adult life (relation 2 in the model). In chapter 4.1 it was shown that recall bias substantially influenced the association between educational level and self-reported childhood health in older age groups. Because retrospective data were used, it was only possible to examine the contribution of childhood health to the explanation of socio-economic health differences in young adults, aged 25-34 years. This analysis was presented in chapter 4.2. It was shown that the risk of early adult health problems is approximately twice as high among people that reported health problems in childhood. Furthermore, the risk of childhood health problems was greater in the less educated groups. Educational and occupational differences in ill health decrease if adjustment to childhood health is applied, although the contribution of childhood health appeared to be rather small. Childhood health explains approximately 5 to 10% of the increased risk of reported health problems.

In order to study the role of selection on health in childhood (intergenerational social mobility) (relation 2a in the model), we tried to distinguish between selection and causation mechanism in our analysis. We adjusted for the causation mechanism by taking into account the occupation of the father as indicator of childhood socio-economic status (see chapter 4.2). We found that the contribution of health in childhood cannot be accounted for by the occupation of the father. This means that selection on health in childhood seems to serve mainly to account for the extent to which childhood health determines socio-economic health differences in early adult life.

The role of selection processes at adult age

The third process we studied in our conceptual model is the role of selection mechanisms at adult age (intragenerational social mobility, relations 3a and 3b in the model). We studied the influence of health and health-related factors in 1991 on social mobility, i.e. changes in occupational status and mobility out of and into employment in the period between 1991 and 1995.

Chapter 5.1 showed the risk of upward and downward occupational class mobility and of mobility into and out of employment to be related to several health indicators. It shows that health in 1991, with a follow-up time of 4.5 years, is not related to occupational class mobility. Neither a decrease nor an increase in occupational level was related to any of the health indicators. We found however that ill health in 1991 was related to both mobility out of and mobility into employment with the same follow-up period of 4.5 years. The Odds Ratio for mobility out of employment among those with health problems was about 1.5, the Odds Ratio for mobility into employment was about 0.7. Socio-economic differences among the working population in 1995 were 'underestimated' for approximately 30% by selective mobility out of employment, and 'overestimated' for approximately 10% by selective mobility into employment in the period 1991-1995.

The contribution of health-related social mobility to the explanation of socio-economic health inequalities may be much more complicated than is generally assumed.

We found no effect of health on occupational class mobility at all. In a subsequent analysis, however, we found that the health of people that left employment and of people that started employment, was worse than the health of people in employment, but better than the health of the economically inactive. As people that start work more often end up in manual than in non-manual classes, the health of the destination class in the working population (i.e. the manual class) will decline. People that left employment more often came from manual classes. Therefore, the health of the manual class in the working population will increase. However, the health decline and increase are a 'healthy worker' effect, and not a real deterioration or improvement in health among the lower socio-economic groups. This indicates that a life-course perspective is needed to further explore the mechanisms through which health selection affects the extent of social inequalities in health.

Chapter 5.2 deals with 'indirect' selection at adult age. It was shown that neither behavioural factors or psychological attributes, nor psychosocial stressors were related to the risk of a rise or fall in occupational status. The results show little evidence for indirect selection with respect to mobility out of and into employment. Some psychosocial stressors show a trend towards a greater risk of mobility out of or into employment. However, no general pattern was found. With respect to psychological attributes some evidence was found for an influence on mobility out of and into employment, but our results do not indicate that these factors are very important in the mechanism of indirect selection. We concluded that although 'indirect selection' is mentioned in the literature as a potential important mechanism in the explanation of socio-economic health differences, its contribution at adult age is not substantial.

6.2 VALIDITY OF THE RESULTS

Before the data of the empirical analyses can be interpreted, a few limitations to the study design need to be considered. First of all, there is the internal validity of the results. Internal validity refers to the extent to which our results are valid for the target population[1], in other words: in what way are the data representative for the original sample? In chapters 3.2 to 5.2 this is discussed in detail with respect to the analyses in those respective chapters. Here, the discussion will be more general. Secondly, a passage will concerned with external validity or generalizibility. This involves the question as to what extent our results can be generalized to other populations, outside the sample[1].

6.2.1 Internal validity

There are several aspects in our study that may threaten the internal validity. These are non-response in the base-line survey (chapters 3.2 to 4.2), non-response and other lost-to-follow-up in the follow-up survey (chapters 5.1 and 5.2), the retrospective and cross-sectional character of the data (chapters 3.2 to 4.2), the use of self-reported data, the selection of mechanisms in our research model, the selection of childhood conditions and childhood health variables, and the limited length of the follow-up period.

Non-response

Non-response to the baseline survey is discussed in detail elsewhere[2,3]. In summary, we observed only small differences in demographic variables between respondents and non-respondents of the postal survey and oral interviews. Small differences were also found with respect to socio-economic status as measured by postcode. An additional survey among non-respondents (see chapter 2.2) showed that non-respondents did not differ systematically from respondents with respect to health and socio-economic variables. As we did not ask for childhood conditions in this survey among non-respondents, we cannot draw any conclusions about the representativeness of non-respondents with respect to childhood variables. Overall, it indicates that the respondents of both postal and oral interviews largely resemble the original sample. Although certain groups are not or only marginally represented in our study population, e.g. people who are illiterate, our results will probably not be substantially biased by selective non-response.

Non-response to the follow-up survey might bias our results with respect to social mobility. The net response to the follow-up was about 80%. 4% percent of the original respondents of the oral interviews in 1991 had died in 1995. As mortality is related to socio-economic status in our cohort[4], our results concerning social mobility might be underestimated, because those in lower socio-economic groups show a higher risk of mortality. The analysis with respect to social mobility was, however, restricted to the age groups 15-59 years old. In these age groups only 1.5.% had died, which means that the underestimation due to selective mortality is negligible. Response to the follow-up

survey in 1995 was slightly related to socio-economic status as measured by educational level: response was somewhat less in lower educational groups. However, response to the follow-up survey was the same for persons with and without paid employment in 1991. Therefore, we expect that non-response in the follow-up period does not influence our results very much.
Other ways of being lost-to-follow-up are migration, mental retardation or being lost from municipality registrations due to administrative errors or unknown reasons. In total this concerns about 1% of the original respondents of the oral interviews in 1991. Even if these reasons for lost-to-follow up were to be selective by socio-economic level, numbers would be too small to substantially influence the results.

In the analyses in this thesis, item non-response needs a special mention, because non-response with regard to items concerning childhood socio-economic background (i.e. occupation of the father) was higher than for other variables (about 12%). Item non-response may bias the results when the non-response for a childhood condition is related to health or when the non-response for health is related to a childhood characteristic. This appeared to be the case with respect to missing values for occupation of the father ($p < 0.05$): respondents whose father's occupation was missing more frequently reported a less-than-good perceived general health. This means that the independent effect of occupation of the father on adult health may be underestimated, if non-response is higher in lower childhood socio-economic classes. With respect to other childhood conditions no effect of item non-response was found (see chapter 3.2).

Retrospective data

Bias may have been introduced by the retrospective character of questions on childhood conditions and childhood health. Chapter 4.1 describes the effect of recall bias on the measurement of childhood illness in detail. We found that self-reported childhood illnesses were positively associated with educational level in older age groups, which is highly unlikely. We concluded therefore that recall bias is greater in the lower educational groups.
This bias might not only occur for *childhood illness*, but also for *father's occupation*. Reporting bias may be caused by three types of memory failure. Firstly, reporting bias is probably mainly caused by omitting to report (or forgetting) events from the past, such as diseases or hospital admissions in childhood. However, it is not likely that occupation of the father is sensitive to this kind of bias, since it is not an 'event' that can be easily skipped from memory. Secondly, forgetting can also occur because of interference from other information. This is most obvious when the event to be remembered is followed by other information, like being ill or living in deprivation in adult life. This type of forgetting is known as retro-active interference[5]. The reporting of, for example, material deprivation might be influenced by this kind of recall bias. It is however not plausible that the reporting of father's occupation would be biased by later events. Thirdly, there is evidence that emotionally laden events are least likely to be recalled accurately, as well as events which are socially undesirable[6,7]. Both the

reporting of childhood health and of childhood socio-economic status (i.e. occupation of the father) might be sensitive to this type of memory failure.
We concluded that the influence of *childhood illness* on socio-economic health inequalities in adult life could only be estimated valid in the youngest age group. Because we were restricted by a retrospective design the reporting of childhood illness may be sensitive to all kinds of memory failures. The contribution of childhood health could also be underestimated or overestimated in the youngest age group. We did not have access to (childhood) medical records of our study population, so an independent validation of our data was impossible. We compared prevalence rates of childhood illness from our study with other, prospective, studies in similar age cohorts[8-11]. As our results seem to be in accordance with these studies a serious underestimation or overestimation in the youngest age group is not likely to have occurred.
Systematic recall bias with respect to *father's occupation* will occur far less because it is less sensitive to the types of memory failure. If it occurs, it may be more likely to underestimate the correlation between socio-economic status in adult life and childhood environment than to overestimate this correlation[12]. The basic assumption is that lower socio-economic groups report childhood conditions less accurately than higher groups, due to the third kind of memory failure described above.

Cross-sectional data

Part of our analyses are based on cross-sectional analyses (chapters 3.2 to 4.2). The ideal design would be to follow a cohort from birth into adulthood, in order to allow a better examination of the causal pathway between childhood conditions and childhood health, behavioural factors and psychological attributes, and adult health. Our research model was based on a number of plausible assumptions concerning the causal order. First, childhood class determines further developments in behaviour and psychological attributes and not vice versa. Secondly, childhood social class influences childhood health and not vice versa. It is theoretically possible that serious health problems as a child influence the socio-economic level of the family. It might be that e.g. the time and money taken up by a child's illness will restrict the father in his chance of upward social mobility or forces him to downward mobility. However, we consider the effect of this reverse mechanism to be negligible. Thirdly, we made the assumption that adult social class is causally prior to health behaviour. Therefore, we adjusted for adult social class when we studied whether the independent effect of childhood social class on adult health operated through health behaviour. With respect to the causal ordering of adult socio-economic class and psychological attributes we made no assumptions. Thus, we presented results with and without adjustment for current social class. Fourthly, we assumed that health behaviour and psychological attributes affect adult health and not the other way around. However, the reverse mechanism cannot be excluded with respect to personality traits[13], nor with respect to behavioural factors. In other analyses of data of the LS-SEHD, the association was studied between behavioural factors and health[2]. As most of these associations were consistent with causal relations in other studies we expect that selection processes with respect to health behaviour (i.e. health problems influences behaviour) will not substantially bias our results.

Self-reported data

The choice for self-reported data may cause bias, because self-reported health indicators could be more strongly related to self-reported determinants than objective (i.e. not self-reported) health measurements are related to objective determinants, due to a common background factor such as a tendency to complain or 'negative affectivity'. It may be that ill health is systematically overreported by people with high neuroticism scores, i.e. with high 'negative affectivity'[14]. The contribution of childhood health and other childhood conditions to the explanation of socio-economic health inequalities could be overestimated if neuroticism also affects the reporting of these factors. This may be the case with respect to self-reported childhood illness. We, however, think that negative affectivity is unlikely to have affected the reports of father's social class substantially. Still, neuroticism appeared to explain much of the relationship between childhood social conditions and self-reported adult health (chapter 3.4). The fact that the contribution of psychological attributes to the relation between childhood social class and adult perceived general health is much greater than between childhood social class and adult self-reported cardiovascular disease suggests that childhood socio-economic status affects the *perception* of (self-reported) health, more than objective health, through psychological attributes. In addition, the contribution of health behaviour seems more important in the relation between childhood social class and mortality than in the relation between childhood social class and subjective health indicators (see chapter 3.3). This may indicate that the role of psychological attributes is overestimated and overrules the role of behaviour in case of perceived general health. On the other hand, one might argue that neuroticism is in fact formed because of adverse childhood circumstances. In that case neuroticism is causally prior to adult health and the contribution is not overestimated because it is part of the causal chain we are interested in. We conclude that, although the contribution of psychological attributes may be overestimated, it is likely to be substantial.

Furthermore, the use of self-reported health may cause bias with respect to the health selection analyses. If people from various social classes or people with or without paid employment report their health differentially (given the same 'objective' health) the relation between ill health and social mobility could be overestimated as one might assume that persons with a higher 'tendency to complain' will on the one hand report more health problems, and will on the other hand be more inclined to be downward mobile or move out of employment.

The same can said for indirect selection. However, if 'tendency to complain' plays a role in the association between health and health-related factors on the one hand and social mobility on the other, neuroticism should be strongly linked to social mobility. As this factor shows only weak relations with social mobility (chapter 5.2), it is very unlikely that 'tendency to complain' will bias the association between health or health-related factors and social mobility.

It is recognised that self-reported health is a useful measure of health status because it is associated with morbidity[15] and it predicts mortality[16,17]. We tried to tackle the problem of self-reported health by using various subjective or objective health indicators. The

results were comparable for all three health indicators. Even so, other health measures, which are not self-reported, need to be examined. Fortunately, we were able to refer to mortality data in one of our analyses (chapter 3.3). Results for mortality were less pronounced, but in the same direction as other health indicators. The relative risk of mortality among the lower childhood socio-economic groups seems somewhat smaller than for e.g perceived general health (Odds Ratio among unskilled manual workers was 1.42 for mortality and 2.24 for perceived general health). Results for mortality were, however, not statistically significant. Therefore, our analyses should be repeated with a longer mortality follow-up period, which will provide more powerful data.

Selection of explanatory mechanisms

In our conceptual model we distinguished three processes, which are subject of this thesis: the influence of childhood socio-economic status, the influence of childhood health and the influence of selection processes. This is only a part of the entire model described in chapter 2.1. We showed in this thesis that childhood conditions and selection processes contribute to the explanation of socio-economic health inequalities. Other causal mechanisms, like the influence of adult socio-economic status through health behaviour, material factors or psychosocial factors were also examined using data from the GLOBE-study, and these are described in detail elsewhere[2]. We did not, however, compare the contribution of the causation and selection mechanisms in one statistical model. The nature of our data does not allow us to make such complicated models. Therefore, we cannot draw any conclusions about the quantitative contribution of these mechanisms in relation to each other. However, the studies showed that both the selection an the causation mechanism contribute to the explanation of socio-economic health inequalities. For the sake of brevity, causal mechanisms with respect to health behaviour, material factors and psychosocial stress were not included in our conceptual model (Figure 1 in chapter 1). Thus, a causal arrow from adult socio-economic status to adult health is missing, because it is not the subject of this thesis.

Besides, not all the arrows which are included in the model (Figure 1 in chapter 1) were studied empirically. Conclusions about the possible effect of accumulation of disadvantage on adult health will be drawn from the relations studied in chapters 3 to 5. It will be useful to support these ideas by empirical analyses in future, for example among persons that reported deprivation in childhood, and still live in that situation in adulthood. Unfortunately, in the LS-SEHD, numbers were too small to carry out such an analysis.

Furthermore, we did not examine the role of health capital directly. For example height can be used as proxy measure for health capital. It might be possible that a (very) good health in childhood and adulthood has a positive effect on adult social class, and so contribute to the explanation of socio-economic health inequalities. The role of selection processes (both intergenerational and intragenerational) could become more important when (positive) health capital is also taken into account.

Thirdly, we did not study the effect of childhood health on socio-economic status in

adult life *through* intermediary factors such as psychological attributes and health behaviour. This would be a subsequent analysis of the analysis we presented in chapter 4.2 about the influence of childhood health. With our data, however, numbers are too small to answer this question because, as we showed in chapter 4.1, analyses need to be restricted to the youngest age group due to considerable reporting bias in older age groups. Finally, we did not examine the role of material factors in the explanation of the independent effect of childhood socio-economic status on adult health. We hypothesized the role of behaviour and personality traits to be more important because these factors are rooted, at least partially, in youth[18-20]. In the literature, no evidence was found that adverse material conditions in adult life (e.g. adverse housing conditions) originate in youth, independent of current social class. Although the operation of this mechanism cannot be excluded, we do not consider its contribution to be substantial.

Selection of the explanatory variables

We had to rely on limited data with respect to childhood conditions, childhood health, behavioural factors and psychological attributes.

The restricted set of childhood conditions used in this study may have influenced the results. Socio-economic circumstances (such as father's occupation and mother's education) were more extensively measured than social factors such as conflicts within the family, as measured by e.g. Lundberg[21], and Power and Matthews[22]. Also biological characteristics like birthweight, which are associated with socio-economic circumstances in childhood[22,23], were not taken into account. Due to this restriction, the contribution of childhood conditions to the explanation of socio-economic health inequalities in adult life may have been underestimated in the present study.

Childhood health was only measured by two crude measures: having had a serious illness in childhood and hospital admission in childhood. Other variables, which could provide information are registers such as medical records from general practitioners about morbidity, records form preventive child and school health services about growth, and data about sick leave from school. In the Netherlands, it is, however, very difficult to link such registers to our data, due to privacy legislation. Whether our results with respect to the contribution of childhood health are underestimated or overestimated is difficult to tell.

A rather broad range of behavioural factors was included in the study (see chapter 2.1). One important factor, dietary habits, was omitted from this thesis. It could be hypothesized that dietary habits are influenced by childhood socio-economic conditions. Since dietary habits are known risk factors for several specific chronic conditions (e.g. several types of cancer and heart disease), our estimation of the role of behavioural factors might be underestimated.

Finally, the inclusion of other psychological attributes could possibly carry an additional contribution. There is evidence that, e.g. childhood conditions have an effect on adult health through hostility[24]. The inclusion of this and other psychological attributes in further research should enable us to obtain a better estimation of the contribution of these factors to the explanation of the childhood socio-economic status-adult health relationship.

Length of the follow-up period

One might argue that the period for mobility selective to health and health-related factors in this study is too short, because selection operates slowly. We found very clear associations between health and mobility into and out of employment. This indicates that at least with respect to this type of health-related selection the study period is not too short. However, we found no health selection with respect to occupational class mobility. Still, the period for this type of health selection in particular might be too short, although Lundberg did not find any health-related occupational class mobility over a period of 13 years[23]. This supports the idea that health selection is not very important for mobility between occupational classes. Nevertheless, with respect to indirect selection, it is possible that the influence of health-related factors on social mobility needs more time than the influence of health. But one might also assume that e.g. psychological attributes are more or less stable factors, which means that the influence of these factors was already effective long before they were measured in 1991. We are aware of only one longitudinal study on intragenerational indirect selection covering a longer time period. In a Danish follow-up study over a period of 11 years, support was not found either for the indirect selection hypothesis[25]. This confirms our results; a definite answer about the length of the follow-up period, however, cannot be given. In future, our analyses should be repeated to cover a longer follow-up period, to find out whether the length of the follow up period was long enough.

6.2.2 External validity

The generalizability of our results to people that were not included in the study population refers to the population in the region (Eindhoven and surroundings), the Dutch population, and the population of other European countries. Some aspects hold for the entire GLOBE-study and have been described in detail elsewhere[2,3]. Here these conclusions will be summarized. In addition, some specific aspects with respect to this thesis will be mentioned as well.

Our study population was restricted to people with the Dutch nationality and non-institutionalized people. As the number of institutionalized people is rather small, it will not have seriously affected our results. Since the socio-economic distribution of health, explanatory factors and childhood conditions among people from ethnic minorities probably differs from people with the Dutch nationality, just like their social mobility, we believe that our conclusions cannot be generalized to ethnic minorities.

The fact that the study was carried out in one specific region in the Netherlands may threaten the generalizability to the country as a whole. With respect to explanatory factors, such as behaviour and psychological attributes, and childhood conditions there is no reason to believe that specific characteristics of the region will affect the distribution of these factors and the associations with social class. Our conclusions with respect to the role of childhood conditions and childhood health are therefore expected to apply to the total Dutch population. As was pointed out in chapters 5.1 and 5.2, the presence of several industries (electro-technical industry and carindustry) and particularly the

high number of job losses during the study period may have affected the results with respect to social mobility. We do not expect, however, that these regional characteristics substantially influence our results. Nevertheless, our conclusions with respect to (indirect) selection are not necessarily applicable to the Dutch population.

The same arguments hold for the generalizability to other European countries. It is hard to say whether specific characteristics of The Netherlands have influenced our results. It could be hypothesized that the distribution of childhood socio-economic conditions and childhood health across social classes differs from country to country, given the different social and economic developments. Since our results with respect to the role of childhood conditions and childhood health are comparable to other countries like Sweden and Great Britain, our conclusions may be generalized to countries with a similar development history. However, one has to be very cautious, and further research is needed with respect to childhood conditions on their comparability in several countries.

Results with respect to (indirect) selection cannot be easily generalized to other European countries, because the extent of social mobility (both occupational class mobility and mobility into and out of employment) will depend on the economic situation (e.g. level of unemployment) and the social security system in respective countries. The conclusion whether mobility *is* health-related or is related to health determinants or not may nevertheless be applicable to other countries, as it is assumed that the same processes underlie this mechanism. The fact that our conclusions are comparable to studies from Great Britain and Scandinavia supports this idea. However, conclusions about the *extent* of (indirect) selection cannot be generalized, given the restrictions described above.

6.3 COMPARISON WITH INTERNATIONAL LITERATURE

The role of childhood socio-economic status

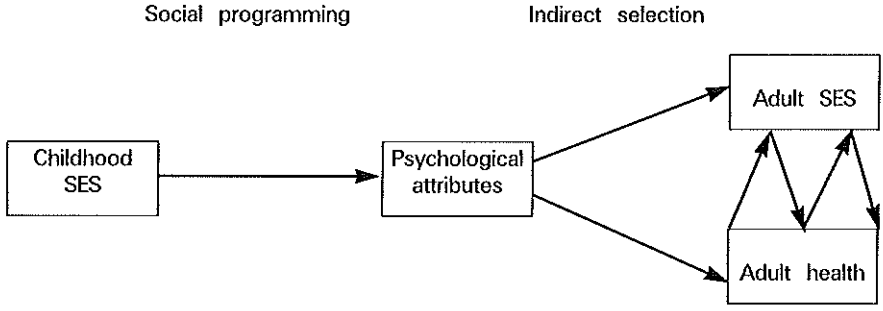
As stated in paragraph 6.1, in our analysis almost 10% of the relation between adult health and adult socio-economic status could be explained by childhood socio-economic circumstances. Others found similar results[12,27]. We will discuss our findings about the influence of childhood socio-economic conditions on socio-economic health inequalities in adult life in line with the concept of Vågerö and Illsley of 'social programming'[28]. This implies that the effect of early social environment on adult health is mediated through social conditions during upbringing, educational achievement, starting employment and adult living conditions and lifestyle.

First of all, social disadvantage may exist throughout the course of life. We found an independent effect of childhood socio-economic conditions on adult health (i.e. irrespective of adult socio-economic status). This is confirmed by several other authors who have shown that both childhood and adult socio-economic status have an effect on adult health and on mortality[12,21,29-31].

One of the pathways in the idea of 'social programming' may run through health-related behaviour. This seems very likely, since some of the backgrounds of health-related behaviour go back to childhood and early adulthood[18]. We found more unhealthy behaviour among respondents from lower childhood socio-economic groups, independent of their current socio-economic status, but the associations were not strong. Physical activity was the most important factor. Results from the literature about this pathway are ambiguous and our results are partly in agreement with other studies. Blane et al found no significant relation between childhood socio-economic status and behavioural factors[32]. Lynch et al found no differences between people with poor and rich parents with respect to smoking and alcohol consumption, but less physical activity and less healthy diet were more common among respondents with parents from lower socio-economic groups[33]. Power and Matthews reported significant associations between father's occupation and BMI, smoking and diet[22].

Vågerö and Illsley describe not only the interconnection between health development and social achievement by a process of 'social programming', but also the idea of common underlying causes[28]. Their definition of 'co-evolution of health and social achievement' encompasses these two processes. In addition, co-evolution assumes a continuous process of mutual influence between socio-economic status and health throughout the life course. The idea of common underlying causes is called indirect selection: not health problems, but common determinants may influence both social mobility and later health[34]. West suggests that indirect processes are likely to have a much greater effect on socio-economic inequalities in health than direct selection on health: health and health potential will be distributed across classes by other associated factors which also influence social mobility[35]. In Figure 1 the processes mentioned above are visualized.

Figure 1. Co-evolution of health and social achievement



Our results indicate that the process of social programming may be quite important: childhood circumstances proved to have an independent effect on psychological attributes. This means that children that grow up in socio-economically deprived groups face a higher risk of developing a neurotic personality and an external locus of control. In adulthood these children will become more orientated on the local culture than other children, and less oriented on a wider future. These factors were also associated with later health. From our analysis it can be concluded that part of the independent effect of childhood socio-economic status on adult health runs through psychological attributes.
What little literature there is on the relation of childhood socio-economic status and personality traits does not give a clear insight. Personality traits may influence adult life-styles and therefore later health, and they may also influence social mobility[36-38]. Personality traits such as hopelessness and hostility were related to childhood socio-economic status; depression and a sense of coherence showed a non-significant trend[33]. Lundberg showed that sense of coherence did not mediate effects of childhood factors on adult health[39].

In the process of indirect selection, psychological attributes may act as common backgrounds, influencing not only adult health, but also social mobility. We explored the latter in chapter 5.2. Against our and others' expectations, this pathway does not seem very important, as an effect of psychological attributes on social mobility could not be found. We did, however, only examined intragenerational social mobility. Still, an effect on intergenerational social mobility may occur.
As we found some evidence for health-related selection with respect to mobility out of and into employment, the idea of a co-evolution of health and social achievement is partly confirmed by our analyses.

In addition to the concept of 'social programming' there are other important explanations about the influence of childhood socio-economic conditions on socio- economic inequalities in adult health. The theory of Barker et al implies that the indepen-

dent effect of childhood socio-economic conditions on adult health may point to biological determinants of health which operate in the early years, particularly via maternal malnutrition. This perspective emphasises the early living conditions, which are not influenced by later socio-economic circumstances[40-44]. Unfortunately, this mechanism could not be empirically explored in this thesis because measurements of early biological risk factors are not available in our study.
In chapter 3.1 we showed that socio-economic differences in infant mortality and perinatal mortality still exist. Relative socio-economic inequalities in infant mortality did not decrease over the last 150 years, but inequalities in perinatal mortality did. As infant mortality is more related to differences in life-style and social environment than perinatal mortality, we concluded that, in addition to biological characteristics, these characteristics still are important in the explanation of socio-economic inequalities in health also. However, since socio-economic inequalities in perinatal mortality have not been eliminated until now, we conclude that socio-economic inequalities in biological risk factors also are likely to make a contribution.
Processes of biological and social programming are not mutually exclusive. Adverse childhood conditions might affect adult health by an increasing vulnerability to disease caused by adverse biological processes early on in life[45]. The same adverse childhood conditions might affect educational careers and life opportunities in general, resulting in 'unhealthy life careers'[39]. In adherence to the idea of Vågerö and Illsley, social and biological associations throughout the life course can be interpreted as co-evolution, i.e. the interface between biology and society[28]. Kuh and Ben-Shlomo reviewed studies with data on life courses[46]. They argue that the periods in life that are least studied in disease epidemiology are childhood, adolescence and early adulthood. From a sociologic perspective, these periods are the most formative for a person's social career. In the idea of co-evolution, these periods are likely to be formative for a person's health too.

The role of childhood health

We found evidence that health selection is more important than causation in the process in which childhood health plays a role for the relation between adult socio-economic status and adult health. Therefore, the literature will be further explored from the perspective of selection.
Health problems in childhood can influence the socio-economic status in (early) adult life. In our analysis, selection on health in childhood seems to be more important than (biological or social) causation, at least with regard to early adult life. We looked at the possible effect of health in childhood on educational achievement. Our results indicate that the role of direct selection with respect to education is small but relevant. Existing literature suggests a minor role of direct selection on health in childhood. However, the estimation of childhood health is often based on very crude measures. Information on childhood health was not gathered with the purpose to examine the role of health-selection. Therefore, researchers had to rely on limited data[35]. For example, Lundberg found no evidence that severe childhood illness increases the risk of downward intergenerational mobility[25,47]. However, the effect of childhood illness on social mobility is

likely to be seriously underestimated in Lundberg's study because the prevalence rate for childhood illness was based on a question about childhood illness in the family and not of the interviewee per se. Other evidence of the absence of direct selection in his studies is based on the effect of 'childhood' health measured among 15 to 20 year-olds. The influence of childhood health, however, is likely to appear earlier in life. Wadsworth found an effect of childhood illness on educational achievement for both men and women, but a downward occupational class mobility for men only[11]. Power et al argue that health-related intergenerational occupational class mobility exists, but that it does not have a major effect on the explanation of socio-economic inequalities in early adult life[48,49]. Although we found a small but relevant role of direct selection with respect to education, it is not necessarily followed (short-term) by a downward intergenerational occupational class mobility. Rahkonen et al found only weak evidence for health-related downward social mobility between father's and own occupational class in a Finnish population, and not for a British population[50]. They conclude that health inequalities in the adult population cannot be explained by intergenerational health-related social mobility. A problem with their analysis is that social mobility between father's and current social class was related to adult health. This means that the association may reflect the causal effect of social mobility on health, instead of the other way around. We examined the influence of childhood health on the explanation of socio-economic health differences in an adult population. Our results indicate that the selection mechanism (with respect to intergenerational social mobility) cannot be ignored and should be further explored in future research to confirm our findings.

The role of selection processes

Health problems may lead to downward social mobility, and very good health to upward social mobility. Our results with respect to intragenerational health selection indicate no effect of health problems on downward occupational class mobility. Literature confirms our findings that the relative importance of direct intragenerational selection on physical health is small[34,37,47,49,51]. But health-related social mobility has not been frequently studied on the basis of empirical data. We are not aware of many studies that *quantify* the effects of selection mechanisms on socio-economic inequalities in health. Yet some authors have tried to obtain an approximate estimate of the contribution of this explanatory mechanism[51,52]. These estimates seem to indicate that the selection mechanism can never provide a comprehensive explanation of existing socio-economic inequalities in health. Our results are in agreement with results from two other empirical studies[25,47,49]. Lundberg also concluded that intragenerational mobility was not influenced by health status. Power et al found that social mobility was influenced by health status. However, health selection was not important in the explanation of adult health differences, due to the small number of people with poor health that are socially mobile, compared to the total population.
Contrary to occupational class mobility, we found that mobility into and out of em-

ployment was affected by ill health. This is in agreement with the literature, in which evidence for such effects was reported by others[47,53,54].

Our findings suggest that the contribution of health-related social mobility to the explanation of socio-economic health inequalities may be much more complicated than is usually suggested. Two questions are frequently confused. First, we have to examine whether there is any health-related social mobility at all. The subsequent question concerns the net effect of health-related social mobility on the extent of social-economic health inequalities. It is generally assumed that social inequalities will grow as a consequence of health-related social mobility. They will, however, shrink if people with downward mobility are less healthy than the class they left but healthier than the class they joined (and people with upward mobility are healthier than the ones they left but less healthy than the ones they joined). We found that the health of people that left employment and of people that started employment, was worse than the health of working people, but better than that of those who stayed economically inactive. This is supported by the findings of other researchers. Martikainen and Valkonen found that the mortality rate of the re-employed was higher than that of the working population, but lower than that of the unemployed[55]. In a recent study Bartley and Plewis showed that the prevalence of ill health in mobile men was somewhere between that in the group they left and the group they joined[56]. As our results suggest that people who started employment more often end up in manual than in non-manual classes, the health of the destination class (i.e. the manual class) will decline in the working population. People that lost employment more often came from manual classes, resulting in an improved health of this manual class in the working population. It is hard to say to what extent these processes cancel each other.

The idea of indirect selection is based on the hypothesis that common underlying causes influence health development and social achievement. The focus of indirect selection is on the impact of early life experience through health-related factors which are rooted in childhood and youth[35]. Early-life experience influences adults' behaviour and the social environments in which they live and work[57].
With our data it is not possible to examine the influence of 'common background factors' on educational achievement, because for most people the highest educational level was already attained at our baseline measurement, and did not change during the follow-up. So, indirect selection with respect to intergenerational social mobility may be apparent, but could not be examined. We found no indirect selection with respect to intragenerational social mobility. As there are hardly any empirical studies on intragenerational social mobility caused by health-related factors, it is difficult to compare our findings with others. In the earlier mentioned 11-year follow-up study in Denmark no effect was found either[26].
Our results do not confirm the idea of indirect selection continuing into adulthood: the factors under study (health behaviour, psychological attributes and psychosocial stress) influence health development, but they do not influence social mobility in adult life.

6.4 A LIFE-COURSE PERSPECTIVE

In our study, current social class is more strongly related to adult health than father's social class (chapters 3.3 and 3.4). This is in accordance with other research[30,49,57,58]. We showed, however, that both childhood and adult socio-economic status are independent predictors for adult health. This implies that, in order to fully understand the explanation of socio-economic health inequalities, processes earlier in life are important. If these processes are ignored, a substantial part of the causal chain will be missed. A life-course perspective is essential in the explanation of socio-economic inequalities in adult health.

In chapter 3.1 we showed that socio-economic inequalities in infant and perinatal mortality decreased in absolute terms. With respect to perinatal mortality the relative risk also decreased, relative inequalities in infant mortality did not decrease, however. The question arises whether, from a life-course perspective, relative differences or absolute differences in childhood health are important. In this example: is the continuation of socio-economic inequalities in health from childhood into adult life dependent on absolute or relative differences in perinatal and infant mortality? If absolute differences in childhood health determine absolute differences in adult health, we may expect that in the future absolute differences in the adult population will decline, because absolute differences in childhood have become rather small. However, one might also assume that the extent of relative differences in childhood health are predictive for the extent of relative differences in adult health, and then the persistence of relative inequalities in infant mortality suggests that relative inequalities in adult health will stay with us for some time. The association between infant mortality and heart disease in adult life as shown by Barker et al supports the latter hypothesis[45].

From a life-course perspective, it is important to examine whether a process of accumulation throughout the course of life exists. Three questions can be distinguished. Firstly, do health risks become greater the longer a person is exposed to poor circumstances? Secondly, is the adverse effect of a period of disadvantage on adult health stronger than just the sum of the separate effects of childhood and adult socio-economic conditions? And thirdly, does a downward spiral occur?

Concerning the first question, an accumulation of disadvantages may increase the effect of childhood socio-economic circumstances. Our results showed that social disadvantage indeed exists in life courses. Adult health behaviour, and psychological attributes were found to be associated with socio-economic conditions in childhood and adulthood. Results of others confirmed that behaviour and psychological attributes were associated with socio-economic conditions throughout the course of life (i.e. socio-economic status in childhood, in adolescence/young adulthood and later life). This was also shown for biological characteristics[22,32,33,59]. Mortality risk for different causes of death also varied between socio-economic groups at all three stages[59]. The cumulative

effect of disadvantage is also clear from the result that the longest held occupation had a greater impact on adult mortality than current occupation[60]. Others showed that measurements of continued poverty during childhood were related to low height and low weight in childhood, while single measurements of poverty were not[61]. Findings from the British 1958 birth cohort study showed that the number of disadvantages experienced was the strongest predictor of a failure to 'escape from childhood disadvantage' via later educational career[62].

Over the life course, an accumulation of disadvantages may increase the effect of childhood socio-economic circumstances. As for the second question, the adverse health effect of living in social disadvantage during more periods in life courses might be stronger than just the sum of the separate effects of these periods. We found, however, that the influence of childhood circumstances on adult health is the same in all adult socio-economic groups. These results do not support the hypothesis that the adverse effect of a period of disadvantage may be stronger than just the sum of the separate effects of childhood and adult socio-economic conditions. Davey Smith et al showed that the risk of mortality was greater for those that had experienced cumulative socio-economic disadvantages[59]. They showed a graded association between cumulative social class and mortality: respondents who reported manual social class for three stages in their life (occupation of father, first job and adult occupation at the time of screening) had the highest mortality rates. Davey Smith et al gave no evidence for an additional effect (i.e. the adverse effect being stronger than the sum of the separate effects), not because evidence was found against it, but simply because they did not study the subject[59]. Therefore, more research is needed to confirm our findings.
In some literature the statistical interaction between childhood socio-economic status and adult socio-economic status is interpreted as a possible effect of health on intergenerational social mobility. Since in these studies no significant interaction was found, the authors concluded that health-related class mobility did not occur[49,50]. In fact, both effects (i.e. on the one hand an additional effect of childhood on adult health above the sum of the separate effects, and on the other hand intergenerational social mobility) are reflected in this interaction. Since in none of the studies the interaction turned out to significantly change the model, we can conclude that neither intergenerational class mobility nor an additional effect of disadvantage emerged.

Regarding the third question, in the idea of accumulation of disadvantage during the life course, the mechanisms of social causation and health selection may act in succession in a downward spiral. Health problems in youth may be followed by a lower socio-economic position upon starting employment. A lower socio-economic status (or, e.g., unemployment) will lead to more health problems in adult life. Since these adult health problems might in turn cause downward social mobility, this downward spiral may lead to an accumulation of both socio-economic and health disadvantages, each affecting the other. We showed that health problems in childhood may influence achieved socio-economic status in adult life. Socio-economic position in adult life

causes health problems, as was shown in other analyses in our study, not reported in this thesis[2]. In chapter 5.1 we showed that health problems in turn did not influence occupational position, but did influence position at the labour market. Therefore, we conclude that our results indicate the occurence of a downward spiral over the life course.

6.5 IMPLICATIONS FOR FURTHER RESEARCH

In this paragraph we will discuss the implications of our findings for future research on socio-economic inequalities in health from a life-course perspective. Implications as regards content are discussed in detail in the respective chapters about the distinguished processes. Here, the implications are considered in a more general way with respect to research design.

Our study is just an attempt to examine the process of accumulation empirically. How can the life-course perspective and the concept of accumulation of disadvantage be studied more extensively? The most appropriate design seems to be a prospective birth cohort study, because one does not has to rely on retrospective data with all restrictions (see paragraph 6.2). However, these studies are extremely expensive. In addition, this design, although theoretically the most ideal[1], has some limitations that need consideration. These limitations also concern other designs such as the LS-SEHD, but they become more important as the study period is longer. First, non-response and lost-to-follow-up might eventually bias the results substantially. Although the response in our study is satisfactory, being approximately 80% for each follow up survey, in 1997 (six year after baseline) about 30% of the original study population of the oral interviews has gone. Secondly, because prospective studies cover a long time span, research questions and topics of interest change. This often implies that the data are only partly suitable for later research questions. Thirdly, methods of measuring change. E.g. at the start of the LS-SEHD study, the SF-36, an at present commonly used questionnaire for perceived health[63], was not available. Fourthly, macro-economic changes or interventions by the government or others, like employers, will change the organization of social and economic society. These aspects make it difficult or even impossible to study the net effect of health-related social mobility. For example, a break out of war would completely disturb normal patterns of mobility. But even a less radical event, like a change in the system for study grants, might influence educational differences in health, as students with health problems might not be able to manage the combination of studying and working (to finance their study). These limitations indicate that it might be better to use other study designs than a prospective (birth) cohort study. A study such as the LS-SEHD, in which data about childhood are asked retrospectively, and measurements of social mobility cover a relatively short time period, does not encounter problems like this. However, important other drawbacks, like the problem of recall bias, shown in chapter 4.1, and the very short period available to determine occupational class mobility referred in chapters 5.1 and 5.2, may bias our results.

For the time being, however, in The Netherlands we have to use imperfect data sets such as the LS-SEHD, as it is the only way to gain at least some insight into the influence of childhood conditions and selection processes, and into the process of accumulation of disadvantage. Given these restrictions, these LS-SEHD data-set is very useful. Moreover, there are possibilities to study the life-course perspective more directly than we have done so far. First, as a simple indicator, an accumulation index can be constructed by counting the periods of disadvantage in a life course, using father's and own occupational level, in line with Davey Smith et al[59]. One has to be very cautious, however, because the position in the social hierarchy as indicated by a certain occupation might be very different nowadays from a few decades ago. For example, a primary school teacher had a far more higher position in the social hierarchy than at present. This implies that, when both father's occupation and adult occupation are coded with the same classification[64,65], one cannot simply add up the occurrence of occupations (including that of the father) at a certain level. Secondly, a similar index could be constructed for financial deprivation. In the LS-SEHD, data are available about financial deprivation for childhood and for adult life at baseline (1991). Moreover, measurement of financial deprivation was included in some follow-up surveys, and data will be available in the near future for several moments in time over a period of six years (1991-1997). Thirdly, until now, in the LS-SEHD there were no data available with respect to people's first job. This is, however, included in the follow-up survey of 1997 and information will be available for analyses in 1998.
Another possibility to study the influence of childhood conditions is to use a retrospective cohort design. For that, the availability of historical data-sets (e.g. 20 á 30 years back in time) is needed, that include information about childhood socio-economic circumstances. Furthermore, we need to track persons that were included in such a data-set as a child. As we know (see chapter 3.1), historical data-sets that included e.g. occupation of the father were available in earlier times. It is worthwhile to explore possibilities to re-use such data-sets (if they still exist) for follow-up.
In addition, more effort is required to link different data sources, which may result in the realization of a data set which include more or less 'objective' data in a relatively short time period. For example, medical records from preventive child health and school health services can in theory be linked to (self-reported) data about adult health. Also data about sick leave from school (monitored by school registrations) should add interesting information to research on childhood health selection. At adult age, sick leave data from services for occupational medicine could be linked to (self-reported) data from empirical studies, to provide more insight into the occurrence of health-related selection. This record linking meets a lot of restrictions given the stringent privacy legislation in the Netherlands. Although, generally, this is a positive development, some exceptions should be made for scientific research.

6.6 IMPLICATIONS FOR POLICY

Our findings have implications for policy measures aimed at the reduction of socio-economic health inequalities in adult life. Interventions are not only necessary in health policy, but also in other sectors, e.g. social security. Measures of intervention should be implemented early in life in order to prevent accumulation of disadvantage and the resulting adverse health effects. Our results give some clues as to what interventions are needed. First, interventions in childhood conditions and childhood health are important not only to reduce socio-economic health inequalities among children, but also to reduce socio-economic health inequalities in adult life. Secondly, socio-economic inequalities in health can be reduced by interventions concerning the influence of ill health on social mobility, especially in the manual classes.

An essential starting-point is that our basic aim is to reduce inequalities. Stronks and Gunning-Schepers argued that equality in health should be conceived as equal opportunities to achieve health[66]. This means that not all inequalities are unjust. As far as inequalities are based on free choice, a reduction is not necessary, or even desirable. As far as childhood conditions are concerned, there can be little doubt about the justice or injustice of these inequalities. Early childhood conditions are never the free choice of a child. We therefore conclude that the objective of policy should be to reduce socio-economic inequalities that are caused by childhood conditions and childhood health, without any restrictions. As far as selection processes are concerned a judgement about free choice is less straightforward. We showed that, until now, ill people are more inclined to leave employment than to seek a lower classified job. This process occurred more in manual than in non-manual classes. This could have two reasons. First, against their will, people in manual classes may be more often classified as medically unfit than people in non-manual classes. On the other hand, people in manual classes might benefit more from being rejected, because their job is physically more demanding than jobs in non-manual classes.

Interventions in childhood

The persistence of relative infant and perinatal mortality differences indicates that efforts made to improve the health of the lowest socio-economic groups have not been fully effective (e.g. infant immunization). Since infant mortality is a reliable indicator of general welfare and deprivation[67] the development of effective interventions on determinants of socio-economic differences in infant mortality is necessary. The health of children has improved markedly over the last 50 years. It is generally accepted that a higher standard of living is one of the major determinants of these improvements[68]. Our results indicate that health inequalities among children still exist. What is more, health in childhood plays a role in the explanation of socio-economic health differences in early adult life. Its contribution, although not very large, cannot be ignored. Our results emphasize the need for efforts to improve health in childhood with a policy that aims to reduce socio-economic health inequalities in the total population.

Over the last two decades, a decline in child welfare has been reported due to economic factors (e.g. increasing unemployment), changes in family structure (a growing number of one-parent families) and social disintegration of communities[69]. These factors may occur more often in lower socio-economic groups. In addition, we showed that the risk of health problems is significantly higher for those respondents whose fathers came from the lowest socio-economic groups. This means that children growing up in the most unfavourable circumstances may be especially at risk. In Breda, a municipality in the South of The Netherlands, it was recently shown that 6% of the children at primary school lived in a situation which is so deprived that it may harm their health. Among one-parent families and families who lived on social security for three years or more, the figure was about 30%[70]. Our results with respect to the contribution of several childhood conditions to the explanation of socio-economic health differences in adult life (chapter 3.2) confirm this. The lower was the socio-economic status, the bigger was the contribution of adverse childhood conditions.

Our findings emphasize the need for a policy which does not rely on a general improvement alone, but which also aims to improve health among the most deprived groups. Children in these groups are e.g. children of broken families, which live on social security. In The Netherlands, almost two-thirds of broken families with children under 18 live on social security[71].

Extra efforts have to be made to achieve WHO's target number 1 to reduce socio-economic health inequalities by 25% by the year 2000[72]. Intervening in childhood conditions and childhood health may be helpful. For example, our results lend support to the importance of preventive child and school health services in monitoring the educational career of children that are severely ill or are admitted to hospital. In the above-mentioned experimental project in Breda, it was possible in the preventive child health services to allocate additional resources to deprived families[70]. In addition, attention should be paid to social and material factors during upbringing, especially for children in the lowest socio-economic groups. From Great Britain recent evidence shows that a number of interventions in the early years which were not necessarily related to health, such as early learning programmes and social support for parents, improve the health of (poor) children[73,74]. The latter authors emphasize however, that interventions in childhood are necessary to improve the health of socio-economically disadvantaged children, but that these interventions are not enough to give them equal chances in life[74]. This means that interventions in the entire life course are needed to reduce socio-economic inequalities in the health of the children and adults in the long run. There is, however, a striking lack of child health services research[75]. As interventions in childhood are an important tool to reduce socio-economic health inequalities it is necessary to build such a research capacity.

Our findings support that also interventions that are aimed at reducing inequalities in later health are needed with respect to (knowledge of) health-related behaviour, particularly among those groups that live in deprived circumstances. In addition, we showed that personality traits and coping styles are shaped differently in varying childhood socio-economic conditions. This suggests a relevant role for parental rearing styles.

Interventions that already started up in The Netherlands in the lowest socio-economic groups which target not the children but their parents, may be helpful in reducing socio-economic health inequalities.

Interventions in selection processes

In our society, paid employment is seen as a major source of both material and social welfare. It should be noted that a discussion about the tenability of this basic principle may be useful in an attempt to increase people's material and social well-being, and thereby probably their health. Given the current political and social context, however, staying in paid employment, even at a lower level, would be preferable above becoming economically inactive. Since ill health seems to result in exclusion from the labour market, this may result in a lower status and a lower income, causing a poorer health. However, in a welfare state like The Netherlands, people who cannot manage to do their job because of illness, have a right to get a disability pension. To prevent the health of these persons from getting even worse, disability pensions and other social security benefits must reach a level that allows for a normal standing of living. Otherwise, a downward spiral will increase the socio-economic health differences in the population. The health policy implications of our findings are therefore, that the prospects for people with health problems to stay in paid employment should be improved, but without further damaging their health. This means that both structural measures by the government are necessary (e.g. financial support for employers who employ persons with a partial disability pension), as well as measures by employers in order to create appropriate conditions (both physical and social) for ill persons. In addition, the right of disability pension must be guaranteed in future. Criteria to obtain a disability pension were recently intensified by the government. Until 1994, the numbers of persons receiving working disability pension increased each year. In 1994, a decrease occurred for the first time[76]. It is interesting to ask whether the phenomenon that ill health will lead to people leaving employment will change in future.

Final remark

Inequalities in health, to be continued? As said in the introduction (chapter 1), the title of this thesis might suggest that we will predict the existence or the extent of socio-economic inequalities in health in the future. Despite our disclaimer at page 7, some readers may be disappointed that we did not give an answer to that interpretation of the question. However, we provided part of an answer. We showed that health inequalities exist in childhood and in adult life. As far as health inequalities exist in early childhood, they will contribute to the continuation of socio-economic health inequalities in the future. Furthermore, we showed that there is a continuation of processes of causation and selection over the life course; adverse childhood conditions have a long-term negative influence on adult health.

We showed that socio-economic inequalities in health exist throughout the course of life. In addition, when interventions are not made as early as childhood, health inequalities will continue to exist in people's lives. However, the time it takes for any

intervention to have an impact (whether it concerns physical activity support in adolescence, distribution of social security or extra educational support for ill children) is a serious impediment to the measurement of their effectiveness[77]. This is especially true for interventions in childhood conditions aimed to improve adult health. Therefore, it is extremely important for researchers and policy makers in the field of socio-economic health inequalities to implement such interventions, even though they cannot evaluate their effect shortly afterwards. Otherwise, health inequalities will continue and research in this field may have no impact on the reduction of socio-economic inequalities in health.

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SUMMARY

Introduction

People in lower socio-economic positions are generally worse off with respect to their health than people in higher positions. This thesis stresses the importance of studying these health inequalities over people's life course. A conceptual model which emphasizes the influence of childhood conditions and selection processes was presented in chapter 1. These processes will be explained further on.

The model was examined on the basis of empirical data and is a specification of an extensive theoretical framework which is described in chapter 2.1. It provides an overview of the explanations that have been put forward with regard to the origins of socio-economic inequalities in health. According to the international literature both processes of 'selection' (health influences socio-economic position through health-related social mobility) and of 'causation' (socio-economic position influences health through specific risk factors) play a role in the explanation of socio-economic inequalities in health.

The conceptual model

Three processes were emphasized. Each of the identified processes was discussed separately in different chapters.

The first process concerns the contribution of *childhood socio-economic conditions* to the explanation of socio-economic health inequalities in adult life (chapters 3.1 to 3.4). The central question was: are adult people in lower socio-economic groups less healthy than people in higher socio-economic groups because they grew up in relatively poor socio-economic conditions?

A second process concerns the contribution of *childhood health* to the explanation of socio-economic health inequalities in adult life (chapters 4.1 and 4.2). Are people in lower socio-economic groups less healthy than people in higher socio-economic groups because they experienced more health problems in childhood?

The third process in the model concerns *selection on health and health-related factors* in adult life (chapters 5.1 and 5.2). Two questions were examined. Firstly: are people in lower socio-economic groups less healthy than people in higher socio-economic groups because they are more likely to experience downward social mobility due to health problems (with respect to e.g. occupation or employment position), or less likely to experience upward social mobility due to health problems? Secondly: are people in lower socio-economic groups less healthy than people in higher socio-economic groups because they experience downward mobility or upward mobility due to health-related factors, such as health behaviour, psychological attributes and psychosocial stressors?

Design of the study

Except for chapter 3.1 this thesis is based on data from the Longitudinal Study of Socio-Economic Health Differences (LS-SEHD) in the Netherlands, which started in 1991. In chapters 2.2 and 2.3 the objectives, design, data-collection procedures and enrollment rates of the study are described.

The design of the LS-SEHD is that of a prospective cohort study. An aselect sample, stratified by age, degree of urbanization and socio-economic status, of approximately 27,000 persons was drawn from the population registers of 17 municipalities in a region in the South-East part of the Netherlands (the city of Eindhoven and surroundings). The persons in this sample received a postal questionnaire. Two smaller subsamples of approximately 3,500 persons and 4,000 persons respectively were drawn from the respondents to the postal questionnaire. These persons were approached for an additional oral interview. The follow-up uses routinely collected data (mortality by cause of death, hospital admissions by diagnosis, cancer incidence), as well as repeated postal questionnaires and oral interviews. The response rate to the baseline postal questionnaire was 70.1% (N=18,973), and that to the baseline oral interviews 79.4% (N=2,802) and 72.5% (N=2,878 respondents) respectively. The response rate to follow-up surveys in 1993 and 1995 was approximately 80%.

Results

In chapter 3.1 trends in socio-economic differences in infant and perinatal mortality in Amsterdam were studied for the period 1854-1990, using published and unpublished material, at the aggregate and at the individual level. Absolute and relative socio-economic mortality differences per data-set were calculated. The results showed a decrease of the absolute differences in both infant and perinatal mortality. Relative differences in infant mortality did not decrease during the study period. Although socio-economic differences in infant and perinatal mortality have declined in an absolute sense, they still continue to exist and the relative position of deprived groups concerning infant mortality did not ameliorate during the study period.

In chapter 3.2 the contribution of childhood environment to the explanation of socio-economic inequalities in health in adulthood was examined. Childhood environment was measured using indicators of social, socio-economic and material aspects. Indicators for socio-economic status at adult age were educational and occupational level, whilst health indicators included perceived general health and self-reports of chronic conditions.
The results suggested that a substantial part of differences in health between educational and occupational groups can be attributed to differences in childhood environment (approximately 10 to 20%). Educational level of the mother, occupation of the father and financial situation of the family were the most important childhood characteristics in the explanation of socio-economic health differences in adult life.

The purpose of chapter 3.3 was to assess to what extent the effect of childhood socio-economic status on adult health could be explained by a higher prevalence of unhealthy behaviour at adult age among those with lower childhood socio-economic status. Childhood socio-economic group was indicated by occupation of the father, and adult health was indicated by perceived general health, self-reported health complaints and mortality. Adult socio-economic status was measured by current occupation.

Behavioural factors were smoking, alcohol consumption, Body Mass Index and physical activity. A clear association between childhood socio-economic circumstances and adult health was shown, as well as an association between childhood socio-economic circumstances and health-related behaviour, even after adjustment for current socio-economic status. Physical activity showed the strongest relation with childhood socio-economic circumstances. The independent effect of childhood circumstances on adult health operates for a small part through unhealthy behaviour: behavioural factors explained the relation between childhood socio-economic status and adult health for approximately 10%.

In chapter 3.4 the contribution of psychological attributes (personality traits and coping styles) to the association between childhood social class and adult health was determined. Health outcomes were perceived general health, self-reported health complaints, and self-reported cardiovascular diseases (myocardial infarction and stroke). Independent of adult social class, low childhood social class was related to ill health in adult life. A higher prevalence of negative personality profiles and adverse coping styles in people who grew up in lower social classes explained part of the childhood social class - adult health association (50% with respect to perceived general health and 15% with respect to cardiovascular diseases). This result underlines the importance of psychological mechanisms in the examination of the negative effects of adverse early life and childhood conditions on adult health.

Chapter 4.1 examined the impact of recall bias on self-reported childhood health. Childhood health was measured as self-reported periods of severe disease in childhood. A negative association between childhood health problems and adult educational level was found in the youngest age group (25-34 years). In the older age groups, however, a lower adult educational level was not clearly associated with more health problems in childhood. It is likely that the lack of association between educational level and childhood health in the older age groups is (partly) caused by a recall bias. Using simple questions on self-reported childhood health problems, the measurement of childhood health in older age groups will be biased by differential recall levels between socio-economic groups.

Because in our study the measurement of childhood health in the older age groups was probably biased by differential recall, chapter 4.2 studies the contribution of childhood health to the explanation of socio-economic inequalities in health in early adult life (25-34 years). Adult socio-economic status was indicated by educational level, whilst health was indicated by perceived general health. Childhood health was measured by self-reported periods of severe disease in childhood. People that reported more childhood health problems also reported more adult health problems. In addition, childhood health problems were reported more among people from lower (adult) socio-economic class. Although this contribution is not very large (5 to 10%), it cannot be ignored and has to be interpreted largely in terms of selection on health.

The aim of chapter 5.1 was to investigate to what extent occupational class mobility and mobility out of and into employment are health-related, and in addition, to estimate the contribution of health-related social mobility to socio-economic health differences in the working population. We therefore compared the surveys of 1991 and 1995. The influence of health problems in 1991 (perceived general health, health complaints and chronic conditions) on changes in occupational class between 1991 and 1995 was negligible. However, health problems in 1991 were significantly associated with a higher risk of mobility out of employment and a lower risk of mobility into employment in 1995. Health-related mobility out of and into employment substantially influenced the estimate of socio-economic health inequalities in the working population (measured by current occupation). For example, selective mobility out of employment underestimated socio-economic inequalities in health in the working population with approximately 30%. Respondents that moved into and out of employment were healthier than those that remained economically inactive, but their health was worse than of those that remained employed throughout.

In chapter 5.2 it was investigated to what extent occupational class mobility and mobility out of and into employment is influenced by health-related factors. Hardly any evidence was found for a significant influence of health-related behaviour, psychosocial stressors and psychological attributes on occupational class mobility and mobility into and out of employment. Only adverse psychological attributes showed a trend to a higher risk of mobility out of employment and a lower risk of mobility into employment. However, only few associations were statistically significant. Our study does not support the idea, which is suggested in the literature, that the mechanisms described (also called 'indirect selection') in adult life play an important role in the explanation of socio-economic inequalities in health at adult age.

Conclusions and discussion

Both childhood and adult socio-economic circumstances play a part in the explanation of socio-economic health inequalities in adult life. From a life-course perspective, the onset of socio-economic inequalities in health is a continual process. Over the life course, mechanisms of social causation and health selection may act in succession in a downward spiral. Interventions in childhood health and childhood socio-economic circumstances may help to reduce socio-economic health inequalities in the total population. For example, preventive child and school health services play an important role. In addition, interventions in selection processes in adult life are needed. This means that prospects should be improved for people with health problems to stay in paid employment, but without further damaging their health. In this thesis it is shown that the life-course perspective is essential in the explanation of socio-economic inequalities in adult health.

SAMENVATTING

Inleiding

Mensen in lagere sociaal-economische klassen hebben doorgaans een slechtere gezondheid dan mensen in hogere klassen. Dit proefschrift benadrukt het belang van een levensloopperspectief bij de verklaring van deze gezondheidsverschillen. In hoofdstuk 1 wordt een conceptueel model gepresenteerd, waarin de invloed van omstandigheden in de jeugd en van zgn. selectieprocessen wordt behandeld. Deze processen worden hieronder uitgelegd.

Het conceptuele model is in dit proefschrift onderzocht met behulp van empirische gegevens. Het is gebaseerd op een theoretisch kader dat geschetst wordt in hoofdstuk 2.1. Hierin wordt een overzicht gegeven van mogelijke verklaringen die worden gegeven voor het ontstaan van sociaal-economische gezondheidsverschillen. Volgens de internationale literatuur spelen zowel selectieprocessen (gezondheid beïnvloedt sociaal-economische positie) als causatieprocessen (sociaal-economische positie beïnvloedt gezondheid) een rol in de verklaring van sociaal-economische gezondheidsverschillen. Hieronder wordt eerst een korte beschrijving van het model gegeven. Daarna worden per hoofdstuk de resultaten toegelicht.

Het conceptuele model

In het model worden drie processen behandeld. Ieder van deze processen komt aan de orde in een apart hoofdstuk.

Het eerste proces heeft betrekking op de bijdrage van *sociaal-economische omstandigheden in de jeugd* aan de verklaring van sociaal-economische gezondheidsverschillen op volwassen leeftijd (hoofdstuk 3.1 tot en met 3.4). De centrale vraag in deze hoofdstukken is: zijn volwassen mensen in lagere sociaal-economische groepen ongezonder dan mensen in hogere sociaal economische groepen omdat ze zijn opgegroeid in relatief slechte sociaal-economische omstandigheden?

Het tweede proces heeft betrekking op de bijdrage van *gezondheid in de jeugd* aan de verklaring van sociaal-economische gezondheidsverschillen op volwassen leeftijd (hoofdstuk 4.1 en 4.2). Zijn mensen in lagere sociaal-economische groepen ongezonder dan mensen in hogere sociaal-economische groepen omdat zij meer gezondheidsproblemen in hun jeugd hebben gehad?

Het derde proces betreft *selectie op gezondheid en gezondheidsgerelateerde factoren* in het volwassen leven (hoofdstuk 5.1 en 5.2). Het gaat hierbij om twee vragen. Ten eerste: zijn mensen in lagere sociaal-economische groepen ongezonder dan mensen in hogere sociaal-economische groepen omdat ze door gezondheidsproblemen een grotere kans hebben te dalen op de maatschappelijke ladder, of een kleinere kans hebben te stijgen op de maatschappelijke ladder? Ten tweede: zijn mensen in lagere sociaal-economische groepen ongezonder dan mensen in hogere sociaal-economische groepen omdat ze door gezondheidsgerelateerde factoren (zoals gezondheidsgedrag, psychologische kenmerken en psychosociale stress) een grotere kans hebben om te dalen of een kleinere kans hebben te stijgen op de maatschappelijke ladder?

Opzet van de studie

Met uitzondering van hoofdstuk 3.1 is dit proefschrift gebaseerd op gegevens afkomstig van de Longitudinale Studie naar Sociaal-Economische Gezondheids-Verschillen (LS-SEGV) in Nederland. Deze studie is gestart in 1991. In hoofdstuk 2.2 en 2.3 worden de doelstellingen, de opzet, de methoden van dataverzameling en respons beschreven.

De opzet van de LS-SEGV is een prospectief cohortonderzoek. Er werd een aselecte steekproef getrokken uit de bevolkingsregisters van 17 gemeenten in Zuid-Oost Brabant (Eindhoven en omstreken) van ca. 27.000 mensen, gestratificeerd naar leeftijd, urbanisatiegraad en sociaal-economische status. Iedereen in deze steekproef ontving een postenquête. Uit de respondenten op deze postenquête werden twee kleinere steekproeven getrokken van resp. ca. 3.500 en ca. 4.000 personen, die aanvullend een mondeling interview kregen. In de follow-up wordt zowel gebruik gemaakt van routinematig verzamelde registratiegegevens (sterfte naar doodsoorzaak, ziekenhuisopnamen naar diagnose en kankerincidentie), als van herhaalde postenquêtes en mondelinge interviews. Het respons percentage van de postenquête in 1991 was 70,1% (N=18.973), en van de mondelinge interviews resp. 79,4% (N=2.802) en 72,5% (N=2.878). Het respons percentage van de follow-up enquêtes in 1993 en 1995 was ca. 80%.

Resultaten

In hoofdstuk 3.1 wordt een overzicht gegeven van sociaal-economische verschillen in perinatale en zuigelingen sterfte in Amsterdam, in de periode 1854-1990. Hierbij is gebruik gemaakt van zowel gepubliceerd als ongepubliceerd materiaal, op individueel niveau en op buurtniveau. Er werden absolute en relatieve sterfteverschillen berekend per data-set. De resultaten laten een afname zien voor absolute verschillen in perinatale en zuigelingen sterfte. Voor zuigelingen sterfte namen de relatieve verschillen echter niet af gedurende de studieperiode. Hoewel sociaal-economische verschillen in perinatale en zuigelingen sterfte in absolute zijn afgenomen, bestaan deze verschillen nog steeds. M.b.t. zuigelingen sterfte is de relatieve positie van gedepriveerde groepen niet verbeterd tijdens de studieperiode.

In hoofdstuk 3.2 is de bijdrage van factoren in de jeugd aan de verklaring van sociaal-economische gezondheidsverschillen op volwassen leeftijd onderzocht. Factoren in de jeugd zijn gemeten m.b.v. vragen naar sociale, sociaal-economische en materiële aspecten. Indicatoren voor sociaal-economische status op volwassen leeftijd waren opleidings- en beroepsniveau; als gezondheidsindicatoren werd gebruik gemaakt van ervaren gezondheid en zelfgerapporteerde chronische aandoeningen.

De resultaten suggereren dat een substantieel gedeelte van verschillen in gezondheid op volwassen leeftijd tussen opleidings- en beroepsklassen kan worden toegeschreven aan factoren in de jeugd (ca. 10 á 20%). Opleiding van de moeder, beroep van de vader en de financiële situatie van het gezin waren de belangrijkste jeugdfactoren in de verklaring van sociaal-economische gezondheidsverschillen op volwassen leeftijd.

Het doel van hoofdstuk 3.3 is om een schatting te maken van de mate waarin het effect van sociaal-economische omstandigheden in de jeugd op gezondheid op volwassen leeftijd verklaard kan worden door het frequenter voorkomen van ongezond gedrag op volwassen leeftijd bij mensen die in slechtere sociaal-economische omstandigheden zijn opgegroeid. Sociaal-economische status in de jeugd werd gemeten via het beroep van de vader; gezondheid op volwassen leeftijd door ervaren gezondheid, zelfgerapporteerde gezondheidsklachten en sterfte. Sociaal-economische status op volwassen leeftijd werd gemeten m.b.v. het huidige beroep. Gedragsfactoren waren roken, alcoholgebruik, over- en ondergewicht en lichaamsbeweging. Er bleek zowel een duidelijk verband tussen sociaal-economische status in de jeugd en gezondheid op volwassen leeftijd, als tussen sociaal-economische status in de jeugd en gezondheidsgerelateerd gedrag, zelfs als rekening werd gehouden met de huidige sociaal-economische status. Lichaamsbeweging liet de sterkste relatie zien met sociaal-economische status in de jeugd. Het onafhankelijk effect van sociaal-economische status in de jeugd op volwassen gezondheid loopt voor een klein deel via ongezond gedrag: gedragsfactoren konden voor ca. 10% de relatie tussen sociaal-economische status in de jeugd en volwassen gezondheid verklaren.

In hoofdstuk 3.4 is de bijdrage van psychologische kenmerken (persoonlijkheidsfactoren en coping stijlen) aan de verklaring van de relatie tussen sociaal-economische status in de jeugd en volwassen gezondheid onderzocht. Gezondheidsuitkomstmaten waren ervaren gezondheid, zelfgerapporteerde gezondheidsklachten en zelfgerapporteerde hart-en vaatziekten (hartinfarct en beroerte). Een lage sociaal-economische status in de jeugd bleek, onafhankelijk van de huidige sociaal-economische klasse, gerelateerd aan ziekte en gezondheid op volwassen leeftijd. Het feit dat ongunstige persoonlijkheidsfactoren en copingstijlen meer voorkomen bij mensen die zijn opgegroeid in lagere sociaal-economische klassen verklaart een deel van de relatie tussen sociaal-economische status in de jeugd en volwassen gezondheid (ca. 50% bij ervaren gezondheid en ca. 15% bij hart- en vaatziekten). Deze bevinding onderstreept het belang van psychologische mechanismen in de bestudering van de negatieve effecten van jeugdfactoren op volwassen gezondheid.

Hoofdstuk 4.1 beschrijft de invloed van geheugenbias op zelfgerapporteerde gezondheid in de jeugd. Gezondheid in de jeugd werd gemeten door te vragen naar perioden van ernstige ziekte in de jeugd. We vonden een negatief verband tussen gezondheidsproblemen in de jeugd en opleidingsniveau op volwassen leeftijd in de jongste leeftijdsgroep (25-34 jaar). Oudere respondenten met een lager opleidingsniveau rapporteerden echter niet vaker gezondheidsproblemen in de jeugd dan ouderen met een hoger opleidingsniveau. Het is waarschijnlijk dat het ontbreken van een verband tussen opleidingsniveau enerzijds en gezondheid in de jeugd anderzijds in oudere leeftijdsgroepen (gedeeltelijk) veroorzaakt wordt door geheugenbias. Bij gebruik van enkelvoudige vragen naar zelfgerapporteerde gezondheidsproblemen in de jeugd zal de meting van gezondheid in de jeugd vertekend worden door geheugenbias die differentieel is naar sociaal-economische status.

Omdat uit hoofdstuk 4.1 bleek dat gezondheid in de jeugd in onze studie alleen op een goede manier was vast te stellen in de jongste leeftijdsgroep, is in hoofdstuk 4.2 bestudeerd wat de bijdrage is van gezondheid in de jeugd aan de verklaring van sociaal-economische verschillen in gezondheid in deze jongste groep (25-34 jaar). Sociaal-economische status op volwassen leeftijd werd gemeten via opleidingsniveau; gezondheid werd gemeten via ervaren gezondheid. Gezondheid in de jeugd werd gemeten via zelfgerapporteerde perioden van ernstige ziekte in de jeugd. Mensen met gezondheidsproblemen in de jeugd rapporteerden meer gezondheidsproblemen op volwassen leeftijd. Daarnaast werden gezondheidsproblemen in de jeugd meer gerapporteerd door mensen uit lagere sociaal-economische klassen. De bijdrage van gezondheid in de jeugd aan de relatie tussen sociaal-economische status en gezondheid op volwassen leeftijd, hoewel niet erg groot (5 á 10%), kan niet veronachtzaamd worden, en blijkt voornamelijk te verlopen via selectie op gezondheid.

Het doel van hoofdstuk 5.1 is te onderzoeken in welke mate mobiliteit tussen beroepsklassen, en instroom in en uitstroom uit het arbeidsproces, gezondheidsgerelateerd is. Daarnaast werd een schatting gemaakt van de bijdrage van gezondheidsgerelateerde sociale mobiliteit aan de omvang van sociaal-economische gezondheidsverschillen in de werkende populatie. Hiertoe werden de metingen van 1991 en 1995 met elkaar vergeleken. De invloed van gezondheidsproblemen in 1991 (ervaren gezondheid, zelfgerapporteerde gezondheidsklachten en zelfgerapporteerde chronische aandoenigen) op mobiliteit tussen beroepsklassen in de periode 1991 en 1995, was te verwaarlozen. Gezondheidsproblemen waren echter significant geassocieerd met een grotere kans op uitstroom uit het arbeidsproces en een kleinere kans op instroom in het arbeidsproces. Gezondheidsgerelateerde instroom in en uitstroom uit het arbeidsproces lijkt de schatting van sociaal-economische gezondheidsverschillen in de werkende populatie (gemeten via huidige beroep) substantieel te beïnvloeden. Zo werden sociaal-economische verschillen in gezondheid in de werkende populatie met ca. 30% onderschat door selectieve uitstroom uit het arbeidsproces. Respondenten die tussen 1991 en 1995 in het arbeidsproces terecht kwamen of daaruit verdwenen, waren gezonder dan permanent economisch inactieven, maar ongezonder dan diegenen die een betaalde baan behielden.

In hoofdstuk 5.2 is onderzocht in welke mate mobiliteit tussen beroepsklassen, en instroom in en uitstroom uit het arbeidsproces, beïnvloed wordt door gezondheidsgerelateerde factoren. Er werden nauwelijks of geen aanwijzingen gevonden dat gezondheidsgerelateerd gedrag, psychosociale stress en psychologische kenmerken van invloed zijn op mobiliteit tussen beroepsklassen of op instroom in en uitstroom uit het arbeidsproces. Alleen ongunstige psychologische kenmerken lijken te leiden tot een grotere kans op uitstroom uit het arbeidsproces en een kleinere kans op instroom in het arbeidsproces. Weinig associaties waren echter statistisch significant. De hypothese, zoals geopperd in de literatuur, dat het hier beschreven mechanisme (ook wel 'indirecte selectie' genoemd), een rol kan spelen in de verklaring van sociaal-economische gezondheidsverschillen op volwassen leeftijd, wordt niet ondersteund door onze resultaten.

Conclusie en discussie

Zowel sociaal-economische status in de jeugd als sociaal-economische status op volwassen leeftijd spelen een rol in de verklaring van sociaal-economische gezondheidsverschillen op volwassen leeftijd. Vanuit een levensloopperspectief kan het ontstaan van sociaal-economische gezondheidsverschillen gezien worden als een continu proces. Mechanismen van sociale causatie en selectie op gezondheid kunnen elkaar gedurende het gehele leven afwisselen in een neerwaartse spiraal. Interventies gericht op gezondheid in de jeugd en op sociaal-economische omstandigheden in de jeugd kunnen sociaal-economische gezondheidsverschillen in de totale populatie verkleinen. Bijvoorbeeld de jeugdgezondheidszorg speelt hierin een belangrijke rol. Daarnaast zijn tevens interventies gericht op selectieprocessen op volwassen leeftijd belangrijk. Dit betekent bijvoorbeeld dat de mogelijkheden voor mensen met gezondheidsproblemen om een betaalde baan te behouden moeten worden verbeterd, maar dan wel zonder hun gezondheid verder te schaden.

Dit proefschrift heeft laten zien dat een levensloopperspectief essentieel is in de verklaring van sociaal-economische gezondheidsverschillen op volwassen leeftijd.

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DANKWOORD

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Dike van de Mheen werd op 9 december 1963 geboren te Rijswijk (Z.H.). Op haar vijfde verhuisde zij naar Apeldoorn, waar zij de lagere en middelbare school zonder kleerscheuren doorliep. Zij behaalde haar Gymnasium β diploma in 1982 aan het Christelijk Lyceum te Apeldoorn. Vanaf 1982 studeerde zij Gezondheidswetenschappen aan de Rijksuniversiteit Limburg (tegenwoordig Universiteit Maastricht), waar zij in 1987 het doctoraal diploma behaalde, met als afstudeerrichting Beleid en Beheer van Gezondheidszorgvoorzieningen. Haar afstudeeronderzoek naar de gezondheid van adolescenten voerde zij uit bij de GGD Rotterdam e.o., afdeling Epidemiologie, alwaar zij van 1987 tot 1988 werkzaam was als onderzoeker. In 1988 kwam zij in dienst van de Erasmus Universiteit bij het instituut Maatschappelijke Gezondheidszorg. Belangrijkste werkzaamheden waren de voorbereiding, coördinatie en uitvoering van het Longitudinale Onderzoek naar Sociaal-economische Gezondheidsverschillen, waarop dit proefschrift grotendeels is gebaseerd. Daarnaast was zij betrokken bij diverse andere onderzoeksprojecten op het terrein van de sociale epidemiologie. Sinds 1990 is zij betrokken bij het onderwijs Sociale Geneeskunde in het medisch curriculum. In eerste instantie in de doctoraalfase, later ook in het co-schap Sociale Geneeskunde. Sinds 1996 is zij t.b.v. het onderwijs aangesteld als wetenschappelijk docent. Vanaf maart 1998 is zij naast wetenschappelijk docent aan de Erasmus Universiteit tevens werkzaam als algemeen stafmedewerker bij de sector Gezondheidsbevordering van de GGD Rotterdam e.o.