Socioeconomic inequalities in smoking in Europe

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CONTENT

Abbreviations

ECHP	European Community Household Panel, an international survey
ESEC	European Socio Economic Classification, a novel occupational classification.
Eurothine	Acronym for European project for Tackling Health Inequalities. This project is the basis of the majority of the papers presented here.
ISCED	International System of Classification of Education, used in this thesis to classify educational level into four levels: primary or no education, lower secondary education, higher secondary education and tertiary education.
GDP	Gross Domestic Product. National figures of GDP per capita are used in this thesis as a measure for economic development.
GEM	Gender Empowerment Measure. The GEM measures gender inequality in economic and political spheres of activity, and is used in this thesis as a proxy for emancipation at country level.
RII	Relative Index of Inequality, where RII = 1 indicates perfect equality. In this thesis, RII > 1 indicates an unfavorable health outcome (in terms of smoking) for those of a lower socioeconomic status.
SES	Socioeconomic Status. Educational, occupational and income level are the aspects of SES that are most commonly used in research.
TCS	Tobacco Control Scale, which was developed to quantify the efforts in the field of tobacco control at country level in Europe.

CHAPTER 1

Introduction

General introduction

Although fears about the effects of smoking on health were expressed in The Lancet as early as 1858, it was not until the early 1950s, when several studies showed a link between smoking and lung cancer, that smoking became associated with health risks. [1-3] Since then many studies have shown that smoking is related to an increased risk of cardiovascular diseases (in particular heart attack), COPD, asthma, emphysema, lung cancer, and cancers of the larynx and tongue.

Nowadays everybody in the Netherlands is aware of the negative effects of smoking on health; the 'danger to health' label is literally attached to all tobacco products in the form of a sticker with warnings. However, smoking did not always have an unhealthy and negative image.

In the early 20th century the health hazards were largely unknown by the general public and smoking became popular among all groups in the society. In the 1960s, at the peak of the smoking epidemic, almost 90% of the men and 40% of the women in the Netherlands smoked. [4] Rates have declined since that time. Today, the prevalence rates are around 30% for men and around 25% for women. [5]

Smoking of cigarettes used to be an innovative behaviour, and was first adopted by higher socioeconomic groups in the early 20th century. Over the years smoking became common in all groups of society and today the highest prevalence rates are found among lower socioeconomic groups. Large differences in smoking behaviour exist between socioeconomic groups. In 2007, prevalence rates in the Netherlands were about 1.5 times higher among less educated groups compared to more educated groups. [5] Not only are lower socioeconomic groups more likely to smoke, they often also smoke more cigarettes a day compared to higher socioeconomic groups.

Smoking is the single most important preventable risk factor for a great number of diseases, and the burden of smoking is disproportionately experienced in lower socioeconomic groups. For example, lung cancer mortality rates in England and Wales were about four times higher among unskilled manual workers compared to professionals. [6] Another study estimated that smoking contributed to about one third of the inequalities in total mortality among men

in England. [7] The large inequalities in smoking behaviour make smoking an important contributor to socioeconomic inequalities in health in many western countries. [8, 9]

Determinants of smoking behaviour

Smoking is a complex behaviour that is affected by several determinants. Socioeconomic status is one of those determinants. In this section we describe the role of socioeconomic status in relation to smoking behaviour and the different determinants. Figure 1 presents a conceptual framework that we developed to visualize smoking behaviour in relation to its determinants.

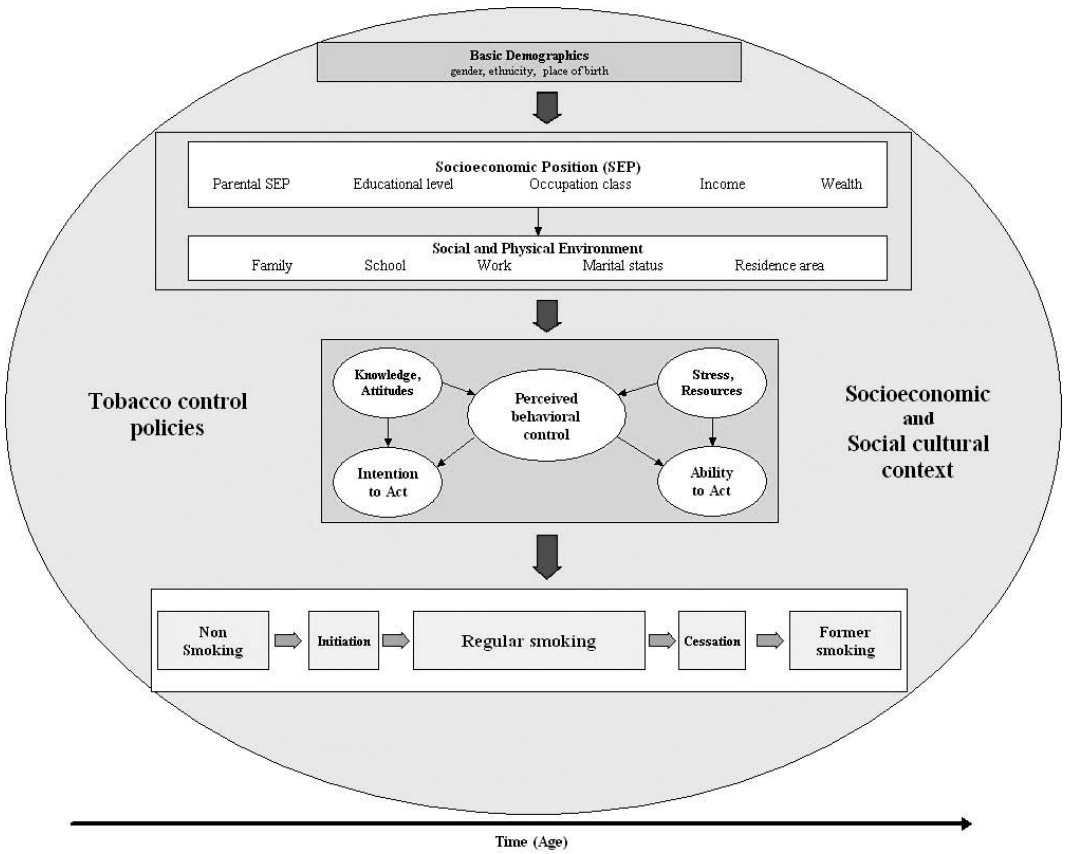

Figure 1. Conceptual model of the smoking process and its determinants.

The bottom part of the diagram emphasises that we should see smoking as a process that develops over the life course of a person. From the perspective of health, the key outcome measure is the duration and amount of smoking, as expressed for example in the number of pack-years that a person has smoked. The diagram shows that this number is determined by two underlying transition processes, i.e. smoking initiation and smoking cessation. While adolescence is a critical period in the life course for smoking initiation, early adulthood (up to age of about 40 years) is critical for stopping with smoking at a relatively early age.

Central to understanding why people smoke are the factors that directly lead to an individual's decision with regard to smoking. Basically, the decisions are a combination of the individual's intention to act (i.e. to start smoking or to resist the temptation to start smoking) and the ability to realise that intended action. This decision process is influenced by a series of cognitive and psychological factors, such as the available information, attitudes and norms, perceived behavioural control and self-efficacy, experienced stress and personal resources. [10-12] This part of the conceptual model is described in more detail by more specific socio-psychological models, such as the ASE model. The ASE model also assumes that a key determinant of behaviour is a person's behavioural intention. [13]

The individual's decision with regard to smoking is also influenced by several more distal determinants, such as social and physical environment, demographic factors, and socioeconomic status. Socioeconomic status changes over the life course, i.e. people have a socioeconomic career. At the moment of birth, this career is determined by the parents' socioeconomic status, while during the adolescence the subject's own educational level becomes of increasing importance. During adult life, the socioeconomic status is increasingly determined by other dimensions, such as the occupational career, the levels of income, and the accumulated wealth. The development of the socioeconomic career is continuously determined by basic personal features, such as gender, ethnicity and place of birth. The effect of socioeconomic status on smoking is determined within a set of specific environments, such as school, working environment, and area of residence. Within these environments socioeconomic status affects the factors that are the 'proximate' determinants of behaviour: intention, attitude, stress, ability to act and perceived behavioural control.

The set of relationships with the smoking process is situated within a broader local, national and international context. All determinants of smoking (including attitudes towards smoking, ability to act, as well as socioeconomic status and working circumstances) are influenced by the socioeconomic and socio-cultural environment. Part of these factors are also affected, often intentionally, by the national tobacco control policies that are in force. This national context also determines the patterns of socioeconomic inequalities in smoking. The importance of the wider context is illustrated by the large extent to which smoking behaviour and inequalities in smoking vary between countries and change over time.
In this thesis we focus on these contextual factors. These can be studied within the framework of an international study which includes many countries.

International variations in inequalities in smoking: patterns and remaining questions.

Although socioeconomic inequalities in smoking are observed in all European countries, large variations exist between countries and regions. In the 1990s several studies reported an interesting geographic pattern in inequalities in smoking in Europe. Especially among women, but also to a lesser extent among men, a clear geographic pattern was revealed, i.e. large educational inequalities in smoking in northern European countries and weaker or even reversed inequalities in southern European countries. Cavelaars et al. were among the first to describe this north-south pattern in inequalities in smoking. [14] In this section we further discuss the international variations from a descriptive as well as from an explanatory point of view.

International variations described

Several researchers were intrigued by the typical north-south pattern and tried to elaborate on it. They found that smoking prevalence rates were initially higher among higher socioeconomic groups, but slowly lower socioeconomic groups took over the lead and became the largest group of smokers. Among women this change occurred later than among men. [4, 15, 16] Huisman et al. showed that the reversal of inequalities in smoking in southern European countries occurred in the 1990s among men in the age group 45-64 years, while among women this shift was about the occur in the youngest age-group, 16-24 years. [15] In northern European countries inequalities were already large in all generations, but mostly in the younger generation. These results heralded bad news: inequalities were not likely to decrease in the coming years, and were expected to even increase among southern European women.

A case study of Italy showed a similar north-south pattern for women, with larger smoking inequalities in the richer and more economically developed North than in the less developed South. [17] It is interesting that the geographic pattern observed at the European level is also found at the regional level in Italy. North and south Italy are clearly distinctive in terms of economic development. Inequalities in smoking change over time and these trends in inequalities also differ between countries. Giskes et al. showed increasing socioeconomic inequalities in smoking in European countries in the period 1985 to 2000. This increase was mainly a result of declining prevalence rates among the more educated groups, while prevalence rates among less educated people remained more or less the same. Among men inequalities in smoking persisted in most European countries between 1985 and 2000. The only positive news came from the United Kingdom, where inequalities decreased over those 15 years, with a greater decline in prevalence rates among lower socioeconomic groups. [18] Inequalities in smoking among women changed substantially between the years 1985 and 2000. In northern and western Europe inequalities widened. In the southern European population, prevalence rates in 1985 were still higher among higher socioeconomic groups, but by the year 2000 inequalities were inversed in the younger generations and smoking was more common among lower socioeconomic groups. [19]

The international variations in inequalities in smoking should be understood in the context of the smoking epidemic. The smoking epidemic describes the diffusion of the smoking habit in four stages. In the first stage, which is relatively short (lasting 10-20 years), smoking prevalence rates are low among men and women and mainly a habit of higher socioeconomic groups. In stage 2 (which may span 20-30 years), prevalence rates increase rapidly among men and rates peak somewhere in the range of 50-80%. Rates among women also rise, but diffusion lags about two decades behind that of men. In the third stage (lasting about 30 years) women reach their peak, while prevalence rates of men start to decline, especially in higher socioeconomic groups. In the last stage of the epidemic smoking prevalence rates continue to decline, but at the same time socioeconomic inequalities increase. [14, 15, 20] The smoking epidemic started earlier in the northern part of Europe. Men in these countries took the lead in the diffusion; women in southern European countries were the last to follow. By the end of the 20th century, most northern and western European countries were already in stage 4, while Spain, Italy and Portugal were still in stage 3. Up until now many studies have explored different aspects of inequalities in smoking in Europe, and much descriptive knowledge about the trends and international variations has been gained. Looking at inequalities in current smoking among women aged 20-45 years (described in the different studies), we can divide Europe into four groups based on the size of the inequalities; Denmark, Norway, Finland, Ireland and Belgium where the inequalities are largest (odds ratios > 2.5) Sweden, England, the Netherlands, Germany and Switzerland (odds ratios 1.5 to 2.5) France, Austria, Italy and Spain where the inequalities are still small (odds ratios1 to 1.5) Portugal and Greece, with inversed inequalities (odds ratios < 1), i.e. higher socioeconomic groups smoke more often than lower socioeconomic groups.

If we draw a map of Europe based on the size of the inequalities, the north-south pattern would become immediately visible among women and to a lesser extent also among men. What would also become visible are the 'white spots' on the map of Europe. First, information about the inequalities in eastern Europe, for example, is still lacking. It is unknown whether socioeconomic inequalities in smoking in this part of Europe are larger or smaller compared to western Europe, or similar to the inequalities in southern Europe. Furthermore,

to our knowledge no international overviews have focused on inequalities in cessation and it remains unclear whether we would observe a similar pattern for inequalities in smoking cessation. Alternatively, perhaps we can conclude that the international patterns in inequalities in smoking prevalence rates are mainly a result of inequalities in smoking uptake. Also, the north-south pattern is demonstrated in most studies using educational level as socioeconomic indicator. However, is the observed pattern typical for educational inequalities in smoking, or will another pattern emerge when we use other socioeconomic indicators, such as income and occupational class, to measure inequalities in smoking? This would provide information about the possible causes of inequalities in smoking. Is it caused by educational level and other closely related factors? Or do working circumstances, or material and financial living circumstances, also affect smoking behaviour?
In this thesis we try to find answers to these kinds of questions and try to 'colour' the 'white spots' in this field.

International variations explained

It was seen that smoking inequalities differ across Europe, with a typical north-south pattern. Studies that observed this pattern hypothesized about the underlying causes of this pattern. Suggestions were made about the possible influence of the national context on inequalities in smoking. Three contextual factors may be particularly important. First, economic development was mentioned as an important contextual factor that affected diffusion of the smoking epidemic and caused the delayed start in southern European countries. Federico et al. showed large differences in smoking behaviour and smoking inequalities between the rich northern part and the less developed southern part of Italy. [17] When we look at the European level, southern European countries have also lagged behind northern European countries in terms of economic development. The observed relationship between purchasing power and smoking behaviour also supports the hypothesis [21, 22].
Next, it is suggested that besides differences in economic development, also cultural differences play a role, such as a delay in the spread of information on health hazards of smoking in southern Europe, or a closer cultural affinity between northern Europe and the USA where social norms with respect to smoking changed first. [14] We hypothesize that the social norms towards

tobacco could be particularly important in the case of women. The uptake of smoking by women is possibly associated with emancipation. For women, smoking used to be socially unacceptable. When women became more independent and emancipated, smoking became a symbol for the liberated woman - as promoted by the tobacco industry. Later, lower educated women followed the models that were set by the higher educated women. [23]

Economic development and emancipation are two processes that may have unintentionally affected smoking behaviour. Tobacco control policies, on the other hand, are specifically implemented to reduce smoking prevalence rates among all groups in society. However, although these policies aim to reduce smoking prevalence rates, it is unknown what the specific role of nation-wide tobacco control policies is in relation to the existing international differences in smoking inequalities. Variation in the comprehensiveness of national tobacco control policies in different countries might explain (part of) the distinctive north-south pattern, and possibly other international variations in smoking inequalities. A common policy tool is a tax on tobacco products. It is known that higher tobacco prices reduce the consumption level of tobacco products (the number of cigarettes smoked). [25-27] Other nation-wide anti-tobacco policies include an advertisement ban, health education programs about the harms of smoking and, more recently, the ban of smoking in most public places.

Policies that reduce smoking prevalence do not necessarily also decrease inequalities in smoking. A few studies focused on the potential effect of tobacco control policies on smoking behaviour among lower socioeconomic groups. [29-31] It is suggested that the first tobacco control policies were more effective among higher socioeconomic groups, because the type of intervention (message and modes of delivery) was unintentionally more directed towards the upper and middle social classes. Nevertheless, the following five tobacco control policies have been considered particularly effective among lower socioeconomic groups: an increase in tobacco price, banning of marketing, work place interventions, free Nicotine Replacement Therapy (NRT), and counselling with regards to smoking cessation. [18] Price increases were found to be especially effective in reducing the number of cigarettes smoked. [27, 32]

Several studies have measured the effect of a single or a few tobacco control policies and/or interventions. These studies were often conducted at a local or regional level. However, the effect of nation-wide policies on smoking behaviour

should also be studied on a national level. This can only be accurately done in an international overview or with trend studies within countries. The ITC study is an international study focusing on the effect of control policies on smoking behaviour in four countries. [33] The study used longitudinal data on different aspects of smoking cessation and tobacco control policies. Only four Anglo-Saxon countries (US, Canada, UK, Australia) were included in the study and the conclusions about the effect of policies were mainly based on longitudinal analyses within the countries. Therefore, the study results could not be used to determine to what extent international variations in socioeconomic inequalities in smoking within Europe would reflect the differences in national tobacco control policies.

In this context, the Tobacco Control Scale could be important. In the last decade many countries in Europe have implemented more or less comprehensive tobacco control policies. The Tobacco Control Scale was developed by Joossens and Raw in 2006 to quantify these efforts in the field of tobacco control at country level in Europe. [34] This scale revealed large international variations in the efforts made at country level. It is likely that such variations, especially with regard to the comprehensiveness of tobacco control policies, explain part of the international variations in socioeconomic inequalities in smoking. We use this scale to examine the extent to which tobacco control policies are correlated with smoking cessation at national level.

Contribution of smoking to health inequalities

As early as the 17th century it was reported that differences in health exist between those who are poor, less educated and work under inferior circumstances, and those who are better off in terms of education, income and working circumstances. Although much has improved in the past century in the field of education, social welfare and working circumstances, the inequalities in health still exist. [35] In all European countries we see that people with lower socioeconomic status experience on average more diseases during life and die at a younger age than people in the higher socioeconomic group. [36] Although health inequalities exist in all parts of Europe, the size of inequalities differs. Inequalities are relatively small in southern European countries, while large differences in health are found in eastern European and Baltic countries. [38] These international variations in inequalities are interesting, and suggest that they may be modifiable.

In the literature, various explanations for health inequalities are proposed. As expected, the differences in health and life expectancy cannot be explained by genetic factors, but are mainly a result of societal processes, environmental exposures, and behavioural determinants. [37] Some argue that the inequalities are mainly a result of differential exposure to material deprivation, [39] whereas others think that inequalities in health behaviour are the main cause of health inequalities. [40-42] One of the most important health behaviours in this context is smoking. The question with regard to smoking is not whether smoking contributes to socioeconomic inequalities in health, but to what extent. How much smaller would the inequalities in health be if inequalities in smoking could be eliminated? And do populations with smaller inequalities in smoking also exhibit smaller inequalities in health? One way to start addressing these questions is to focus on inequalities in lung cancer morbidity and mortality. Cigarette smoking is the major cause of lung cancer, and most lung cancers have historically occurred among current cigarette smokers or recent quitters. One study showed that inequalities in smoking contribute substantially to the educational inequalities in lung cancer mortality among men in most western European populations. Among women, inequalities in lung cancer mortality were still small or even reversed in southern European populations. Interestingly, the geographical north-south pattern in smoking inequalities (described by several studies) was also found for lung cancer mortality. [7] Huisman et al. explored the contribution of different cause-specific mortality rates to inequalities in total mortality among elderly and found a relatively small contribution of lung cancer in the older age groups to inequalities in total mortality [43]. It was hypothesized that this relatively small contribution in older age groups was due to the fact that in this age group both low and high educated groups have historically been exposed to smoking to the same extent. However, because we know that socioeconomic inequalities in smoking have increased in the last decades, [19] it is likely that lung cancer plays an even more important role nowadays in socioeconomic inequalities in mortality in Europe.

We use a recent dataset (including 16 European populations) to assess whether the pattern in lung cancer observed by Huisman and Mackenbach, corresponds to the international patterns in smoking that are described in this thesis.

This thesis

This thesis aims to further describe and explain the international variations in socioeconomic inequalities in smoking in Europe. By means of this international study we aim to contribute to the understanding of national factors and policies that influence the magnitude of inequalities in smoking; we also aim to provide entry points for interventions and policies aiming to reduce health inequalities due to smoking.

More specifically, the following research questions are addressed: What is the association between different socioeconomic indicators and smoking behaviour in different parts of Europe around the year 2000? Can the international variations in smoking behaviour and smoking inequalities be explained by specific characteristics of countries, including tobacco control policies? Are these international differences in smoking inequalities reflected in the international differences in inequalities in lung cancer?

This dissertation starts with two chapters that focus on the first research questions. Chapters 2 and 3 are descriptive studies with a special focus on the methodology. In chapter 2 we present a review of the literature on socioeconomic inequalities in smoking. The main goal is to identify the socioeconomic indicators and smoking indicators found to be most useful for monitoring purposes. In chapter 3 the international pattern in smoking behaviour is reassessed using several socioeconomic indicators. With this analysis, we aim to provide a new overview of international variation in socioeconomic inequalities around the year 2000. In chapters 4, 5 and 6 we explore the effect of national characteristics on smoking behaviour. Each of these chapters focuses on a different aspect of smoking behaviour. All chapters start with a descriptive overview of the socioeconomic inequalities in ever-smoking rates, cessation rates, or consumption level. Special attention is paid to the situation in eastern European countries, for which until recently no international data were available. These analyses will provide information for the first research question of this thesis. In the second part of these three chapters we focus on the effect of different national characteristics on smoking behaviour. Chapter 4 uses information on smoking initiation to address the question: 'What are the contextual factors of smoking uptake and socioeconomic inequalities in

smoking uptake?' In chapter 5 we explore the effect of nation-wide tobacco control policies on smoking cessation and on socioeconomic inequalities in smoking cessation. Chapter 6 focuses on an important starting point for tobacco control: the price of tobacco products. We assess the relation between cigarette price and the amount of cigarettes smoked in European countries, with special attention paid to related socioeconomic differences. The third research question is addressed in chapter 7. The focus of this last chapter is lung cancer, one of the most important smoking-related diseases. The chapter describes the socioeconomic inequalities in lung cancer in Europe and explores the relation between inequalities in smoking and inequalities in lung cancer mortality and in total mortality.

Data and methods

The work in this thesis was carried out as part of two European projects. The first two studies (chapters 2 and 3) were carried out as part of the IMSpTIS project. The IMSpTIS project is an international project, funded by the public health program of the SANCO Directorate General of the European Commission. The project intends to support policies that aim to tackle socioeconomic inequalities in smoking, and to reduce smoking among disadvantaged groups, by developing recommendations for the monitoring of smoking inequalities and tobacco control policies in the European Union.

The studies presented in chapters 4, 5, 6 and 7 were carried out as part of the Eurothine project. Eurothine stands for 'European project for Tackling Health Inequalities'. The Eurothine project is a large international project that is funded by the public health program of the SANCO Directorate General of the European Commission. The project aims to improve the description of health inequalities in Europe and to enhance the evidence base for policies to reduce inequalities in health. Its two principal objectives are: 1) to prepare international overviews that provide bench-mark data on inequalities in mortality, morbidity and health determinants to participating countries, and 2) to assess evidence on the effectiveness of policies and interventions to tackle health inequalities, and to make recommendations on strategies for reducing health inequalities in participating countries.

Data

For the study in chapter 3, data from the European Community Household Panel (ECHP) are examined. The ECHP is an annual longitudinal survey designed for European member states.

The target population of the ECHP consists of all individuals living in the European Union in private households. The survey used a uniform random sampling design, targeting the national household population of countries, using common blueprint questionnaires. The first wave of data was collected in 1994 in 12 European member states and included data on 60,000 households and 130,000 individuals living in private households. We use data from wave 5, which was the first wave that included data on smoking, conducted in 1998. Interviewed individuals were asked whether they smoked daily, smoked occasionally, used to smoke daily, used to smoke occasionally or had never smoked. The ECHP is discussed in more detail elsewhere. [44]

In chapters 4, 5 and 6 micro-level data from national health interview surveys of 19 European countries are used. These data were provided by national statistical offices. Within the project, mortality and national health survey data were collected for 22 European countries. The national data files were created in accordance with an extensive set of detailed specifications that aimed to ensure as much as possible international comparability on the basis of national surveys. Most national health interview surveys were conducted in or after the year 2000, except the German and Portuguese surveys which were conducted in 1998-1999. The study described in chapter 7 uses data on lung cancer mortality and total mortality, also collected within the Eurothine project.

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CHAPTER 2

Monitoring of socioeconomic inequalities in smoking: Learning from the experiences of recent scientific studies

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Abstract

Objectives - To support policies to tackle socioeconomic inequalities in smoking, monitoring systems should include information on smoking according to socioeconomic status (SES). This paper aims to review the methods applied in recent scientific studies on inequalities in smoking, with the aim to draw lessons for the monitoring of smoking inequalities.

Study design – A literature review.

Methods – Seventy studies on socioeconomic inequalities in smoking published since 1990 were selected and reviewed, with particular focus on study design, indicators of SES and smoking outcomes.

Results – Most studies had a cross-sectional design and measured smoking prevalence rates among adults in relation to educational level. In addition to educational level, measures of household wealth and occupational class had strong associations to smoking outcomes. In addition to smoking prevalence, other outcome measures such as initiation rates, cessation rates and consumption level are needed to provide in-depth knowledge on the effect of SES on smoking, especially from a life course perspective.

Conclusions – It is recommended that, as well as educational level, other socioeconomic indicators should be used to identify socioeconomic groups where smoking rates are highest. Estimates of inequalities in initiation and cessation rates are needed to identify the most important age groups and entry points for policies to tackle inequalities in smoking.

Introduction

By the year 2000, smoking was more common among lower socioeconomic groups in most western populations. In all countries, smoking seems to follow the tobacco epidemic diffusion model [1] according to which large socioeconomic inequalities in smoking prevalence appear in the latest phases of the epidemic. In all populations who entered this latest phase, smoking has become a main contributor to socioeconomic inequalities in mortality and morbidity. Tobacco control policies can do much to reverse these unfavourable trends. As smoking is increasingly more concentrated in lower socioeconomic groups, these groups merit special concern, and there is where the fight against tobacco will finally have to be won. Several tobacco control measures (bans on marketing and promotion, increases in tobacco tax, ban on smoking in workplaces, provision of nicotine replacement therapies, intensive counselling for smoking cessation) have been shown to reduce smoking prevalence in lower socioeconomic groups, especially when they specifically targeted at low socioeconomic groups. [2] However, in each European country at least some of these effective tobacco control measures have not yet been implemented fully [3], leaving considerable room for the development of comprehensive strategies of tobacco control that have maximal effects among lower socioeconomic groups. Monitoring of tobacco consumption is important for tobacco control policies in terms of identifying specific groups at risk and factors that are related with smoking among lower socioeconomic groups. Until recently, monitoring of trends in tobacco consumption was usually carried out for national populations at large, without a specific focus on socioeconomic inequalities. Most experiences with the measurement of socioeconomic inequalities in smoking are now documented by scientific studies. The majority of these are cross-sectional studies focusing on educational inequalities in smoking prevalence among adults. Recently however, these studies have applied a greater diversity of methods to describe inequalities in smoking. These recent experiences offer an opportunity to draw new lessons for monitoring purposes.

This review of indicators and methods used in recent scientific studies of socioeconomic inequalities in smoking aimed to identify the socioeconomic and smoking indicators that are most useful for monitoring purposes. Based

on this evaluation, a series of detailed recommendations was formulated for the routine collection of data on inequalities in smoking, and on the analyses of such data for monitoring purposes.

Methods

Seventy studies on socioeconomic inequalities in smoking published in international, peer-reviewed journals since 1990 were selected and reviewed. These studies focused on socioeconomic inequalities in smoking, i.e. variations according to socioeconomic status (SES) with regards to aspects of smoking behaviour. These studies were identified through PubMed and Google Scholar. The following selection criteria were used: (a) the study was published after 1990 in an international journal; (b) it concerned a country in Europe or the USA, Australia or New Zealand; (c) it contained quantitative information on socioeconomic inequalities in smoking; and (d) aspects of smoking were the main outcome measures of the study. The selection of countries reflected the objective of this European Commission-sponsored study to represent the experience of European countries, to which the authors added the experiences of other countries with a similar progression of the smoking epidemic. The following keywords were used in the search: socioeconomic status, socioeconomic position, socioeconomic inequalities, education, income, occupation, parental SES, smoking, smoking status, smoking behaviour, smoking initiation, smoking cessation, cigarette use and tobacco use.

The authors distinguished between seven regions (northern Europe, western Europe, eastern Europe, southern Europe, the United Kingdom, USA and Australia/New Zealand) and one group of international studies. The maximum number of studies per region was set at 14 for the USA and nine for the other regions. When more studies for a specific region were found, the oldest studies were excluded and only one study per data source was included.

All articles were carefully read and classified with regards to the following characteristics: (a) study design (longitudinal, cross-sectional), (b) study population (sample size, time dimension, country/region), (c) socioeconomic indicators used (e.g. educational level, income, occupational class, household wealth, parental SES) and (d) outcome indicators used (smoking status, initiation and cessation measures, consumption level). The quality of the

studies was evaluated systematically with regard to a number of potential data problems. All selected studies were judged to have sufficient quality for further analysis. The results of each study were summarized in tables that focused on the comparison of results obtained using different study designs, different socioeconomic indicators and/or different measures for smoking status.

Results

General overview of reviewed studies

In total 70 studies from seven regions were selected and reviewed; 14 studies were from the USA, [4-17] nine studies were from northern Europe, [18-26] nine studies were from western Europe, [27-35] nine studies were from southern Europe, [36-44] nine studies were from the United Kingdom (UK), [45-53] eight studies were from Australia/New Zealand, [54-61] six studies were from eastern Europe, [62-67] and six studies included more than one country. [68-73] The majority of the selected studies had a cross sectional design (47 out of 70 studies), focused on smoking in adulthood alone (56 out of 70) and had a sample size larger than 1000 respondents (Table 1).

The studies showed a generalized pattern of higher smoking prevalence rates among lower socioeconomic groups. Lower socioeconomic groups were generally found to start smoking at a younger age, to smoke more cigarettes a day, and to quit smoking less often as compared to higher socioeconomic groups.

Table 1. Study characteristics (number per region)

		Northern Europe	Western Europe	Eastern Europe	Southern Europe	United Kingdom	United States	Australia/ New Zealand	Int.[1]	Total
Design	Longitudinal	6	0	0	2	5	9	1	0	**23**
	Cross-sectional	3	9	6	7	4	5	7	6	**47**
Focus of study	Adulthood	7	9	5	8	6	7	8	6	**56**
	Adolescence	1	0	1	0	1	5	0	0	**8**
	Adolescence and Adulthood	1	0	0	1	2	2	0	0	**6**
Sample size	N < 1000	1	2	1	0	2	6	0	0	**12**
	1000 < N > 10.000	5	4	4	3	4	7	4	0	**31**
	10.000 <N> 20.000	2	2	1	2	2	0	1	2	**12**
	N > 20.000	1	1	0	4	0	1	3	4	**14**
	Unknown					1				**1**
Total		9	9	6	9	9	14	8	6	**70**

[1] International comparison studies including several countries

Study design

The data sources that were used to describe smoking according to socioeconomic indicators were commonly health interview surveys at national or local levels. Most scientific studies were based on surveys with a relatively large sample size (n>1000), and had a cross-sectional design. Smaller surveys (n<1000) often were longitudinal studies. Most of these studies were conducted in the USA and northern Europe. A comparison between the results of the cross-sectional and longitudinal studies did not reveal differences in their ability to demonstrate associations between socioeconomic indicators and smoking behaviour. An advantage of longitudinal studies over cross-sectional studies is their ability to follow individual cohorts over time through repeated measurements, and thus to relate SES in the past to current smoking behaviour. This increased the ability to demonstrate causal mechanisms empirically. Longitudinal studies on smoking cessation produced new insights regarding determinants of the relationship between SES and smoking cessation. [7, 9, 21-23, 25, 50] For example, in a random sample of persons aged 18-59 years in Denmark, inequalities in smoking cessation rates could largely be explained by socioeconomic inequalities in smoking intensity and characteristics of the work environment. [23] Longitudinal studies were also able to demonstrate that the impact of SES on smoking accumulates over time; in addition to current SES, SES during childhood and adolescence appeared to affect smoking behaviour in adulthood. [13, 14, 46, 49]Although cross sectional studies do not follow individuals through their lives, the experience with these studies is that they are able to measure smoking inequalities in a life course perspective by including retrospective questions on smoking or SES. [48, 71] Cross-sectional studies including retrospectively collected information on initiation age and cessation age were able to reconstruct the smoking history of birth cohorts, and to study trends over time by comparing subsequent birth cohorts. [15, 39, 41, 48, 71] In most studies, the minimum age of respondents was 16 years or more. Thirteen, mostly longitudinal, studies also included younger age groups. Some of the former studies included retrospective questions on smoking initiation before the age of 16 years.

Table 2. Individual socioeconomic status (SES) indicators (with or without other SES indicators)

	Alone	+ Education only	+ Any other combination	Total
Education	24	-----	34	58
Income	0	3	18	21
Occupation class	2	3	19	24
Wealth[1]	0	0	12	12
Parental SES[2]	4	1	4	9

[1] Wealth includes the following indicators: housing tenure, financial deprivation, material status, other economic or financial related indicators.

[2] Parental SES is socioeconomic status of the subject's parents. It represents educational level, occupational class, income or a combination. Sometimes it is only based on the father's status.

Socioeconomic indicators

Different indicators representing various dimensions of SES were used in the studies reviewed. The most commonly used indicators were educational level, occupational class and income which were used in 58, 24 and 21 studies, respectively. (Table 2) Measures of household wealth were used 12 times, while parental SES was used nine times. In addition to being the most frequently used indicator, educational level was the indicator that was most often used exclusively. Table 3 shows regional preferences for the use of specific socioeconomic indicators. Income was not used in any southern European study and was only used in one UK study, but was used in six of eight studies from Australia and New Zealand. The UK is the only region where occupational class was used more often than educational level as socioeconomic indicator. All socioeconomic indicators showed statistically significant, independent associations with smoking behaviour, although not in all populations. Comparisons of the published inequality estimates for different indicators did not show consistently larger inequalities for one specific socioeconomic indicator. The mean of the odds ratios (calculated for all articles using odds ratios) of the risk of smoking of lower SES compared with higher SES for education, income and occupational class were 2.14, 2.09 and 2.26, respectively. In a series of studies that applied multivariate analyses however, education often appeared to have a larger independent effect than occupational class and income. [7, 9, 30, 31, 46, 63, 73] Indicators of household wealth, such as housing

tenure and financial situation often appeared to have independent effects on smoking when adjusted for at least one of the three core socioeconomic indicators. In one study, housing tenure was even one of the few indicators that remained statistically significant after mutual adjustment for a series of other socioeconomic indicators. Housing tenure may have greater predictive power than income because it may reflect cumulative prosperity and long-term household wealth more accurately. [19]

The independent effects that were found for different socioeconomic indicators suggest that the association between SES and smoking is mediated through different mechanisms, each of which corresponds to a different dimension of SES. [16, 19, 56, 57] An exception is activity status, i.e. being gainfully employed, searching for work or economically inactive. Even in univariate analysis, this variable only showed statistically significant associations with smoking in six out of 16 studies. [27, 28, 42, 54, 56, 58] While most studies used indicators that can be applied at individual level, a few studies also used indicators based on community characteristics. In studies where both individual and community

level information on SES was available, associations with smoking appear to be strongest for the SES indicators measured at individual level, with a small residual effect for community level indicators. [17, 35]

Table 3. Number of times that socioeconomic status (SES) indicators are used in studies per region

	Northern Europe	Western Europe	Eastern Europe	Southern Europe	United Kingdom	United States	Australia/ New Zealand	Int.º	Total
Education	6	8	6	8	6	11	8	5	**58**
Income	2	3	3	0	1	5	6	1	**21**
Occupation class	4	2	1	2	7	4	3	1	**24**
Parental SES	1	1	0	0	4	2	0	1	**9**
Unemployment	1	6	1	1	3	1	3	0	**16**
Material status [1]	0	2	0	0	1	0	0	0	**3**
Housing tenure	1	0	1	0	3	1	4	0	**10**
Financial deprivation [2]	1	2	1	0	1	1	2	0	**8**
Social mobility [3]	1	0	0	0	1	0	0	0	**2**
SES score [11]	0	0	0	0	1	0	2	0	**3**
Neighborhood deprivation [12]	0	1	0	0	1	0	0	0	**2**
Total	**9**	**9**	**6**	**9**	**9**	**14**	**8**	**6**	**70**

º International comparison studies including several countries

[1] Material status represents number of possessions of the subject / household. (e.g. car ownership, computer, dishwasher, second home)

[2] Financial deprivation indicate to which extent the subject experience financial problems

[3] Social mobility: whether an individual has go up or down in the social hierarchy (childhood SES vs. adult SES)

[11] SES score is a combination of several SES indicators.

[12] Neighbourhood deprivation represents the SES of a community (e.g. % unemployment, % lower income, and % lower education)

Smoking measures

Prevalence rates of smoking were used in 90% (63 of 70) of the studies, mainly in combination with other smoking measures. (Table 4) Fifteen studies used only prevalence rates to describe socioeconomic inequalities in smoking. Three studies only investigated inequalities in consumption levels (number of cigarettes smoked), while two studies only measured cessation rates or number of quit attempts. Although information on the prevalence of ex-smokers could be used as a proxy to measure smoking cessation, only six studies used ex-smoking together with ever-smoking to compute the quit ratio. (Table 4) Nine studies with information on ex-smoking did not use it for anything other than describing current smoking status. Several studies used information on smoking initiation and cessation rates to understand the increase of socioeconomic inequality in smoking prevalence rates. These studies concluded that the widening of inequalities was due to an increase in inequalities in both smoking uptake and smoking cessation, with some gender differences.[24, 37, 38, 40, 41, 44] Studies using other outcome measures in addition to the prevalence of current smoking observed that SES is also related to stage of change. Studies on smoking cessation, for example, found no educational differences in the intention to quit but large inequalities in the number and success rates of quit attempts. [7, 29] Substantial socioeconomic inequalities were found in studies that utilized indicators of consumption levels; smokers in lower socioeconomic groups were found to smoke more cigarettes a day on average. Two studies used information on consumption level to indicate that nicotine addiction was more common among smokers in lower socioeconomic groups. [56, 63] Another study showed that socioeconomic inequalities in smoking cessation could be attributed partly to inequalities in smoking intensity. [23] Only two of the 70 studies reviewed specifically assessed socioeconomic inequalities in cumulative smoking exposure. [18-26] The lifetime duration of smoking was calculated using two retrospective questions on age at initiation and age at cessation. Smokers with lower SES were found to have smoked more years on average. Smoking duration was more strongly associated with family income than occupational class or educational level.[18-26]

Table 4. Number of times that outcome measures are used per region

	Northern Europe	Western Europe	Eastern Europe	Southern Europe	United Kingdom	United States	Australia/ New Zealand	Int.º	Total
Smoking status	9	8	5	9	9	11	7	6	64
Current smoker	9	7	5	9	9	11	7	6	63
Ex-smokers	3	6	3	5	2	5	3	3	30
Never smokers	3	4	1	4	2	4	2	2	22
Cessation	6	4	1	7	2	8	3	2	33
Prevalence ratio (ex/all)[1]	0	2	0	3	0	1	0	2	8
Quit ratio (ex-/ever-)	0	1	1	2	0	0	2	0	6
Quit rate during a certain period	6	0	0	0	2	2	0	0	10
Age at cessation	0	0	0	2	0	3	1	0	6
Quit attempts / intention to quit	0	2	0	0	0	2	0	0	4
Initiation	2	1	0	6	0	6	1	0	16
Ever-smokers	1	0	0	0	0	0	0	0	1
Initiation rate during a certain period	1	0	0	2	0	1	0	0	4
Age at initiation	0	1	0	4	0	5	1	0	11
Consumption level	3	2	3	2	4	4	2	1	21
Consumption level - cigarettes / day	3	2	3	2	4	3	2	1	20
Addiction – min. to 1st cigarette in morning	0	0	0	0	0	1	0	0	1
Total	9	9	6	9	9	14	8	6	70

º International comparison studies including several countries

[1] Note: it is the same measure as ex-smokers, but used in a different way. Here the percentage of ex-smokers is explicitly used as a measure of cessation.

Discussion

Although the studies used widely different indicators and methods, the typical study used cross-sectional data to study smoking prevalence rates in the adult population according to educational level. Educational level has been found to be an important predictor of smoking prevalence. Nevertheless, the review showed that several other socioeconomic indicators have independent effects on smoking outcomes. Each of these socioeconomic indicators represented different mechanisms that mediate the association between SES and smoking. Further insights into these mechanisms were obtained in studies that used specific smoking outcome measures, such as age-specific smoking initiation and cessation rates.

This review included 70 papers on socioeconomic inequalities in smoking. This sample of studies is, to the authors' knowledge, representative of the broader set of studies on smoking inequalities that have been published since 1990. A semi-quantitative review was performed instead of a systematic quantitative review. It is believed that this approach was sufficient given the ultimate aim, which was to summarize experiences with recent methods in this developing field in order to draw lessons for tobacco control monitoring systems.

The review is stratified by region, with a prefixed maximum number of studies for each region. Although all available and suitable studies were not included, it is considered unlikely that a larger number of studies would have resulted in different outcomes. A different regional distribution of studies (e.g. more studies from the USA and less from eastern Europe) would probably have affected some of the numerical outcomes. However, only a few results, such as the selection of socioeconomic indicators, were found to differ considerable by region.

Implications for study design

The majority of the studies focusing on socioeconomic inequalities in smoking had a cross-sectional design. Only 17 of 70 studies had a longitudinal design. Both types of studies were able to demonstrate the existence of socioeconomic inequalities in smoking. However, longitudinal studies are preferable if the specific aim of the study is to unravel the causal relations between SES and smoking as they develop over the life course. [18-26] Longitudinal studies would

also be preferable if smoking exposure were to be defined in longitudinal terms, such as in measures of cumulative smoking exposure [18-26] or smoking persistence from adolescence into adulthood. [18-26]

Whereas longitudinal surveys constitute the optimal design for explanatory research, their small sample size and confinement to specific areas or populations make them less useful for monitoring purposes. On the other hand, as most cross-sectional surveys cover large and representative samples, they are the preferred data source for monitoring of smoking inequalities in national populations. When retrospective questions regarding age at initiation and age at cessation are included, cross-sectional surveys also allow for a descriptive study of inequalities in smoking initiation and cessation over the life course. For these purposes, it is important to ensure a reasonably large sample size (at least about 5,000 respondents) in order to facilitate the assessment of socioeconomic inequalities in smoking prevalence within specific age groups or populations such as cities [74].

Implications for socioeconomic indicators

This review showed that educational level is a key socioeconomic indicator for monitoring inequalities in smoking. Information on educational level should therefore be included in all monitoring systems. However, SES is not determined by educational level alone, and other dimensions of SES are also independently related to smoking. Including the other SES indicators is useful, especially if the aim of the analysis is to gain further insights into the mechanisms linking SES to smoking. For example, occupation-based measures of SES may provide clues regarding the possible role of the working environment, and stimulate in-depth explanatory studies that assess the role of work-related factors such as psychosocial stress, physical job strain, and social influence of peers at work; factors that have been shown to impede successful cessation. [18-26] As different measures of SES identify different mechanisms and different populations at risk, it would be useful to apply these different measures to population-based monitoring of smoking. For example, measures of material wealth may be recommended for identifying people who have higher rates of persistent smoking due to problems related to living in material deprivation. [18-26]The choice among SES indicators can best be taken from an explicit life course perspective. The relative importance of different SES indicators is likely

to change over a person's life course, if only because each SES indicator is formed during different phases of life. Educational level, which is formed during adolescence and early adulthood, might be highly predictive of smoking measures rooted in the same phase of life, such as the chance to become an addicted smoker. The relevance of income and occupational class might increase during working ages. Indeed, a recent Estonian analysis observed that smoking initiation was most strongly related to educational level, but smoking cessation was most strongly related to income. [18-26]

A life course perspective not only points to specific phases of life, but also to processes of accumulation of socioeconomic disadvantage over life. Measures that capture these cumulative effects may be especially useful to identify inequalities in smoking. For example, a recent European study observed a strong association between smoking prevalence and measures of accumulated wealth such as housing tenure and household assets. [18-26] Similarly, in analyses of smoking initiation, it may be useful to include measures of parental SES such as mother's education and poverty in childhood.

Implications for smoking indicators

Current smoking status (classified in three categories as current smoker, ex-smoker and never smoker) is a core smoking indicator used to describe socioeconomic inequalities in the prevalence of smoking. None the less, the use of complementary smoking indicators would have significant added value. From a life course perspective, smoking is a process, not a static behaviour. In order to understand the smoking status at any single age, it is important to focus on changes in smoking status during the preceding life course. Studies measuring smoking initiation and/or cessation rates were able to provide a better understanding of changes in smoking inequalities. This applies to changes within birth cohorts over the life course [18-26], and to changes within societies over time. [18-26] Measuring smoking initiation and cessation rates are not only important for understanding change, but also for evaluating interventions that aim to reduce socioeconomic inequalities in smoking prevalence rates. Retrospective data on ages at starting and stopping smoking can be used to analyse inequalities in uptake or cessation of smoking according to age, calendar period or generation. Unfortunately, in many surveys, smoking initiation or cessation rates cannot be measured retrospectively due to a lack of detailed

questions regarding smoking history. Also, small sample sizes often prevent precise measurement of inequalities in smoking transition rates according to age, period and generation. In these cases, the authors recommend the use of information on current smoking status to measure generation-specific initiation ratios (ever- smokers/all respondents) and quit ratios (ex-smokers/ever-smokers). Another class of smoking indicators is needed when the aim is to assess the potential effect of socioeconomic inequalities in smoking on inequalities in health outcomes. For this purpose, indicators are needed for cumulative smoking exposure. Such indicators would take into account both years of smoking and average amount of daily smoking. This literature review, although not exhaustive, suggests that relatively few studies have measured socioeconomic inequalities in smoking in these terms. However, the available evidence suggests that there are important socioeconomic inequalities both in terms of years of smoking [18-26] and in the amount of cigarettes smoked per day. [18-26] Indirect methods suggest that smoking inequalities in the past made substantial contributions to inequalities in mortality in the 1990s. [18-26] Measures of cumulative smoking exposure are needed to predict the extent to which current inequalities in smoking will contribute to inequalities in smoking and health in the future. [18-26]

Remark on odds ratios

Most of the studies used odds ratios to measure the association between SES indicators and smoking indicators. Although odds ratios are adequate to demonstrate the existence and statistical significance of a relationship, they do not provide accurate information on the magnitude of inequalities in smoking. When prevalence rates are moderate of high, as is often the case for smoking prevalence rates, odds ratios cannot be interpreted as ratios comparing low with high groups. An alternative would be to use prevalence rate ratios, which have been successfully applied in recent studies. [18-26]

Conclusions

The scientific reviewed studies applied a variety of socioeconomic indicators and smoking outcome measures. They demonstrated that data sources and indicators are available to monitor socioeconomic inequalities in smoking at national or regional levels. SES indicators of SES such as educational level,

income and long-term household wealth can be used to identify socioeconomic groups where smoking rates are highest. Indicators of smoking initiation and smoking cessation can be used to understand changes over time and to evaluate effects of policies, while measures of cumulative smoking exposure can be used to predict effects on future trends in socioeconomic inequalities in smoking-related mortality and morbidity. Although there is ample room for further methodological progress, there is now sufficient experience from scientific studies to develop monitoring systems to describe socioeconomic inequalities in smoking on a routine basis.

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CHAPTER 3

Identification of socioeconomic groups at increased risk of smoking in European countries: looking beyond educational level

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Abstract

Background – Educational level is most often used to identify social groups with increased prevalence of smoking. Other indicators of socioeconomic status (SES) might, however, be equally or even more discriminatory. This study examines to what extent smoking behaviour is related to other socioeconomic indicators in addition to educational level.

Methods – Data were derived from the European Household Panel. We selected data for 45,765 respondents aged 25-60 years from nine European countries. The association between six different SES indicators and smoking prevalence was examined using prevalence rate ratios (RRs) estimated through log linear regression analyses.

Results – In univariate analyses, most selected SES indicators were associated with smoking. In multivariate analyses, educational level, occupational class, accumulated wealth (measured by household assets), and housing tenure retained independent effects on smoking (RRs about 1.20). The effects observed for activity status and household income were small and insignificant in nearly all populations. In northern Europe, educational level had the greatest predictive value in the younger age groups; occupational class and housing tenure predicted most of smoking prevalence in the older age groups. The results showed a less pronounced and more varied pattern in southern Europe.

Conclusion – Our results indicate that smoking prevalence is related not only to educational level but also to occupational class and measures of accumulated wealth (other than income). These measures should be used in addition to educational level to identify groups at increased risk of smoking.

Introduction

Because of higher initiation rates and lower cessation rates, smoking prevalence is higher among lower socioeconomic groups compared with higher socioeconomic groups in most European countries. Lower socioeconomic groups also smoke more cigarettes per day on average and are more susceptible to nicotine addiction. The inequalities in smoking are somewhat more pronounced in northern Europe than in southern Europe, as a consequence of a more advanced evolvement of the smoking epidemic in northern European countries. [1, 2] To tackle the inequalities in smoking prevalence, interventions and policies should be targeted at groups with an increased risk of high smoking prevalence. Identification of risk groups is therefore important for effective interventions and policies.

Educational level is most often used to distinguish between socioeconomic groups. Recently we reviewed 70 studies in the field of socioeconomic inequalities in smoking and 58 of these studies used educational level as socioeconomic indicator. Socioeconomic status (SES), however, is not determined by educational level only. Different socioeconomic indicators reflect one's position in the socioeconomic hierarchy, but they have specific characteristics that may relate to different pathways through which SES influences smoking, and are therefore not interchangeable when studying socioeconomic inequalities in health. [3] Educational level, for example, reflects knowledge and cognitive skills, whereas occupational class determines most of all someone's working circumstances and social environment during working hours. Income, accumulated wealth and housing tenure are indicators of financial and material situation. One may question whether educational level is the SES indicator most strongly related to smoking or whether other indicators are as important as educational level to identify groups at risk.

Several studies found that educational level showed the largest differences in smoking prevalence compared with other SES indicators, including income and occupational class. [2, 4-9] Other studies also found strong associations between smoking and occupational class, accumulated wealth and housing tenure. [10-13] Laaksonen [14] found not only that smoking was associated with SES indicators other than educational level but also that housing tenure and economic satisfaction showed the largest differences in smoking in multivariate analyses. It is uncertain, though, whether the results of this Finnish study can be generalized to other countries. The smoking epidemic evolved

differently in European countries, and different socioeconomic indicators might be associated with smoking inequalities at the different stages of the epidemic. Furthermore, countries differ in terms of social stratification and smoking-related factors (e.g. attitudes towards smoking by women, tobacco control policies). Results from a country-specific study might therefore not be applicable to other countries. The present study examined the extent to which smoking behaviour is related to socioeconomic indicators other than educational level. We analysed a pooled population of nine countries using data from the European Community Household Panel (ECHP). Because of the large sample size (N=45,765), we were able to look at differences between sexes, regions and age groups in the impact of the different SES indicators on smoking. Educational level, for example, might be the most important indicator of SES among young adults. Accumulated wealth, on the other hand, is likely to be more important among adults aged 40-60 years. In the present study we addressed the following research questions: Does smoking prevalence differ substantially between groups distinguished by educational level, activity status, occupational class, household income, accumulated wealth and housing tenure? Do these associations persist in multivariate analyses, that is, after control for other socioeconomic indicators? How large is the predictive value of other SES indicators over and above educational level in the relationship to smoking?

Methods

Study population

We studied data from the ECHP, an annual longitudinal social survey designed for the member states of the European Union. The survey used a uniform random sampling design, targeting the national household population of countries, using common blueprint questionnaires. Data collection was carried out in most countries by paper-and-pencil interviewing, but in Portugal and Greece, computer-assisted personal interviewing was used. The ECHP is discussed in an extensive descriptive article of the design and procedures. [15] We used data from the fifth wave of the survey, which was the first wave that included data on smoking, conducted in 1998. Nine countries included information on smoking and were included in this study. Because the smoking epidemic is more advanced in northern than in southern European countries,

resulting in different patterns in socioeconomic inequalities in smoking, we distinguished in the analyses between these two geographical regions. Finland, Denmark, Ireland, Belgium and Austria were defined as northern European countries, whereas Spain, Portugal, Italy and Greece were classified as southern European countries. Data from 45,765 respondents, aged 25-60 years, were included in the analyses. There were 22 528 (49,2%) males and 23 237 (50,8%) females, with more respondents from southern European countries (65%) than from the northern European countries (35%). The response percentages at the start of the survey (wave 1) differed from 91% in Italy to 56% in Ireland. Also, the attrition over the follow-up periods (from wave 1 until wave 5) differed largely between countries. Especially Ireland (36%), Denmark (29%), Austria (26%) and Spain (23%) had high attrition percentages. The ECHP deals with non-response and attrition by providing weights for the respondents. Non-response and attrition in the ECHP data set is discussed more in detail elsewhere. [2, 15, 16]

Measures

Smoking status was self-reported using the question 'Do you smoke or did you ever smoke?' with the response categories of "smoke daily", "smoke occasionally" "do not smoke, but used to smoke", "do not smoke, used to smoke occasionally" and "never smoked". Respondents were categorized as either current daily smoker or non-smoker. Occasional smokers were classified as non-smoker. Table 1 shows the socioeconomic indicators and their distribution in the study sample by age, sex and region. SES was measured by six indicators: educational level, activity status, occupational class, household income, accumulated wealth and housing tenure. Educational level represents the respondents highest level of completed education. The level of education was initially classified according to national categories, which were subsequently reclassified into three levels of education (1 = low, 2 = middle, 3 = high), approximately corresponding with the following levels of the International Standard Classification of Education (ISCED): low= ISCED 0–2 (pre-primary, primary, and lower secondary education), middle= ISCED 3 (upper secondary education), and high= ISCED 4–6 (post-secondary education). Activity status defines whether a respondent was at the time of the survey economically active or inactive (e.g. unemployed, work disabled, housewife, pensioner). Using a prototype of the new European Socioeconomic

Classification (ESEC), we assigned respondents to one of the nine occupational classes. Occupational class was based on the occupation of the household member with the 'dominant' ESEC class. In selecting the dominant class, we considered class 1 dominant over class 2, 2 over 5, 5 over 4, 4 over 3, 3 over 6, 6 over 7, 7 over 8 and 8 over 9. [17] ESEC class is determined using information on economic activity status, status of employment (employee, self-employed, supervisor yes/no, establishment size) and occupational title (two-digit code of the International Standard Classification of Occupations). More information about the conceptual framework and derivation of the ESEC classification system can be found elsewhere. [17] Household equivalent income was computed as the net monthly household income divided by the square root of the household size (number of persons living in a household). The study sample was divided into quintiles based on their household equivalent income. The measure of accumulated wealth derived from 13 items of living conditions of the household from the Current Life-Style Deprivation index (CLSD).[18] Five items (car, colour TV, video recorder, micro-wave, dishwasher, telephone) took the form of 'possessed/availed of'. An item was scored as positive on the deprivation scale only if its absence was stated to be related to lack of resources. Six items took the form of one yes/no question: 'Can you just check whether your household can afford these if you want them' (e.g. keeping home warm, new clothes, eating meat/fish every second day). One item related to debts. The CLSD index is the sum of these 13 items. In the index, each item is weighted by the proportion of households possessing that item in each country. Thus, not being able to afford a car, for example, will contribute more to the deprivation index in a society where most people own a car than in a society wherein hardly anybody can afford a car.
The last socioeconomic indicator, housing tenure, was divided into two categories: owner-occupiers and tenants.

Data analyses

First, age-standardized smoking prevalence rates were calculated according to each socioeconomic indicator. The direct method of age standardization was used with the European standard population of 1995 as the standard population structure. In the next step, using regression analysis, we examined the associations of the different SES indicators with smoking status. Prevalence

rate ratios (RRs) and their 95% confidence intervals were estimated with log linear regression with binominal error. [19, 20] For each indicator, rate ratios were calculated in both univariate and multivariate analyses. In univariate analyses, the association between smoking prevalence and one single SES indicator was assessed. In the multivariate analyses, the six indicators were simultaneously included in the model with smoking status as the dependent variable. Previous studies on international patterns of smoking found strong and significant interactions by country, sex and age. [1, 2, 21, 22] We also observed these interactions in our data. Therefore, all analyses were adjusted for the interaction terms of age*sex, age*country and sex*country.

To study the additional predictive value of each socioeconomic indicator in addition to educational level, we performed logistic regression analysis. We constructed a multivariate model wherein we first controlled for age and educational level. With the stepwise method we included the other SES indicators one after another. The order in which the indicators were added to the model was based on the order in which SES indicators are shaped during lifetime: first educational level, then activity status, occupational class, income, and finally accumulated wealth and housing tenure. The Nagelkerke R-square was used to assess the percent variance explained by the independent variables.

All analyses were performed separately for men and women, the two geographical regions and two age groups. We limited our analyses to the adult population aged 25-39 yrs and 40-60 yrs. We made this distinction because we hypothesized, following the life course perspective, that the predictive value of socioeconomic indicators would change with increasing age. Educational level might be most strongly associated with smoking among the younger adults (25-39 yrs), whereas accumulated wealth might become more important in relation to smoking when people get older.

Table 1. Socioeconomic characteristics of the study sample by region, sex, and age (%)

	Northern Europe				Southern Europe			
	Male		Female		Male		Female	
Age (years)	25-39	40-60	25-39	40-60	25-39	40-60	25-39	40-60
Sample (N)								
Total *N*= 45 765	3364	4494	3478	4692	6965	7705	6851	8216
Education								
High	25.8	22.4	33.5	22.3	17.1	13.2	20.3	9.3
Middle	54.5	43.8	46.6	38.4	33.5	20.2	35.5	16.8
Low	19.7	33.9	19.9	39.3	49.4	66.6	44.2	73.9
Activity status								
Active	90.7	81.8	73.4	59.7	85.1	81.7	57.2	44.4
Inactive	9.3	18.2	26.6	40.3	14.9	18.3	42.8	55.6
Occupation								
Higher salariat	24.7	24.6	24.9	24.4	17.4	18.5	17.0	18.0
Lower salariat	18.7	20.0	19.8	20.2	11.2	13.1	13.3	13.2
Higher white collar workers	13.9	11.7	15.8	13.7	11.1	9.4	13.0	10.6
Higher blue collar workers	4.6	4.6	3.8	4.1	3.4	3.0	3.4	2.9
Lower white collar workers	9.0	7.5	11.4	8.9	9.3	7.9	9.8	8,0
Skilled manual	6.9	6.2	4.9	5.1	13.2	11.0	10.1	10.9
Semi or non skilled manual	7.4	7.7	6.9	7.3	9.4	9.0	9.6	9.9
Farmers	7.1	8.2	5.1	7.8	5.8	7.2	4.5	7.9
Self-employed	7.6	9.4	7.5	8.5	19.1	20.1	19.4	18.6
Income								
Highest quintile	20.2	26.4	17.6	25.0	23.0	24.0	21.4	23.6
4	21.4	23.6	19.0	23.3	22.5	22.5	21.4	21.7
3	23.6	19.2	22.6	18.9	20.4	20.1	20.4	19.7
2	21.0	16.7	22.7	17.7	17.7	17.9	19.1	17.9
Lowest quintile	13.9	14.1	18.1	15.1	16.5	15.5	18.0	17.2
Accumulated wealth								
Highest quartile	53.7	59.8	50.9	58.4	23.4	26.0	24.7	24.0
3	8.8	8.3	8.9	8.5	13.1	13.4	14.0	12.9
2	22.6	18.2	23.4	18.5	31.6	30.5	30.8	30.2
Lowest quartile	14.9	13.6	16.8	14.7	31.9	30.2	30.5	32.9
Housing tenure								
Owner	69.5	83.9	67.6	82.1	73.8	82.8	73.7	83.8
Tenant	30.5	16.1	32.4	17.9	26.2	17.2	26.3	16.2

Results

Table 2 reports higher smoking rates among the lower socioeconomic groups in comparison with the higher socioeconomic group for all SES indicators and in each subpopulation. A different pattern was found only among women aged 40-60 years in southern Europe, where older women in the highest socioeconomic group smoked more than those in the lowest socioeconomic group.

Table 2. Smoking prevalence (%) by indicators of SES

	All	Northern Europe				Southern Europe			
		Male		Female		Male		Female	
		25-39	40-60	25-39	40-60	25-39	40-60	25-39	40-60
Education									
High	30.5	28.6	24.5	18.5	17.5	40.1	45.8	34.5	34.2
Middle	37.7	42.3	35.3	32.9	26.2	48.3	48.2	34.2	34.0
Low	40.9	49.8	40.6	46.7	30.7	59.8	50.6	31.2	17.9
Activity status									
Active	35.4	39.3	32.2	28.3	23.4	52.9	49.0	33.6	24.2
Inactive	40.6	50.9	50.8	37.2	28.9	52.6	52.2	31.3	20.8
Occupation									
Higher salariat	30.8	30.0	25.4	20.3	19.2	46.5	47.3	29.7	27.9
Lower salariat	33.2	38.1	32.4	27.2	22.1	41.3	44.3	32.1	28.4
Higher white collar workers	36.9	43.7	39.0	31.9	29.5	48.1	45.0	32.5	25.7
Higher blue collar workers	39.4	43.3	45.4	40.7	24.9	55.5	45.2	38.4	21.9
Lower white collar workers	40.6	44.2	41.3	41.5	32.2	56.8	51.4	36.5	21.1
Skilled manual	42.7	53.4	47.3	44.6	34.7	60.7	54.2	31.3	15.8
Semi or non skilled manual	44.1	54.8	49.2	46.7	37.5	60.7	53.5	33.0	17.3
Farmers	26.6	32.4	24.7	14.7	11.4	53.7	44.3	21.9	9.6
Self-employed	37.2	41.5	32.5	27.6	27.8	55.1	53.0	36.9	23.7
Income									
Highest quintile	33.4	37.1	28.8	23.7	22.3	45.2	46.6	35.0	28.9
4	33.7	36.6	31.0	25.6	22.3	53.1	46.5	31.6	23.3
3	36.8	39.7	36.9	29.4	28.0	52.8	51.7	33.7	21.8
2	37.3	43.7	38.3	35.7	27.2	54.3	49.3	31.4	18.3
Lowest quintile	40.3	46.0	42.0	38.2	32.7	59.9	54.5	31.0	18.1
Accumulated wealth									
Highest quartile	32.8	35.5	31.1	24.4	22.4	44.0	44.6	32.9	27.6
3	34.2	37.2	30.8	31.1	21.2	47.8	46.3	32.6	26.1
2	37.1	43.6	37.5	32.7	28.2	51.8	48.5	33.9	20.3
Lowest quartile	44.1	53.4	47.0	46.6	38.0	61.8	55.6	31.1	19.2
Housing tenure									
Owner	33.4	35.9	31.4	25.1	22.0	50.4	48.0	32.2	22.2
Tenant	44.7	49.7	50.8	42.3	42.3	58.8	55.7	33.8	24.3

In univariate analyses, all socioeconomic indicators, except activity status, were significantly associated with current smoking (Table 3). Educational level, occupational class and accumulated wealth showed the largest differences in smoking prevalence (RR=1.38, RR=1.34 and RR=1.29). In multivariate analyses, the associations of activity status (RR=0.95) and income (RR=0.95) with smoking were substantially attenuated. Occupational class, housing tenure and accumulated wealth retained significant associations with smoking, although the differences between the highest and the lowest category also attenuated for these indicators. Accumulated wealth showed the largest differences between higher and lower SES in the multivariate analyses (RR=1.26).

For northern Europe, the association of the different socioeconomic indicators with smoking was consistent for both men and women and for both age groups (Table 4). In the univariate analyses, all indicators had significant associations with smoking. In the multivariate analyses, activity status did no longer show differences in smoking among women. Neither did income show differences for older men (i.e. 40-60 years) nor for women in both age groups. Educational level showed the largest differences in smoking in multivariate analyses in the youngest (25-39 years) age group (RRmale=1.46, RRfemale=1.92). In the older age group, occupational class displayed the largest inequalities in smoking in men (RR=1.43) and housing tenure in women (RR=1.57).

Table 3. Inequalities in smoking by SES: Individual and adjusted rate ratios and confidence intervals

	Rate Ratios (95% C.I.)			
	Univariate *		**Multivariate ****	
Education				
High	1.00		1.00	
Middle	1.27	*(1.22 - 1.32)*	1.16	*(1.12 - 1.21)*
Low	1.38	*(1.33 - 1.43)*	1.19	*(1.14 - 1.24)*
Activity status				
Active	1.00		1.00	
Inactive	1.01	*(0.98 - 1.04)*	0.95	*(0.92 - 0.99)*
Occupation				
Higher salariat	1.00		1.00	
Lower salariat	1.07	*(1.02 - 1.11)*	1.02	*(0.98 - 1.07)*
Higher white collar workers	1.18	*(1.13 - 1.23)*	1.09	*(1.04 - 1.14)*
Higher blue collar workers	1.23	*(1.15 - 1.32)*	1.14	*(1.07 - 1.22)*
Lower white collar workers	1.28	*(1.22 - 1.34)*	1.15	*(1.10 - 1.21)*
Skilled manual	1.31	*(1.26 - 1.37)*	1.15	*(1.09 - 1.21)*
Semi or non skilled manual	1.34	*(1.28 - 1.40)*	1.17	*(1.11 - 1.23)*
Farmers	0.92	*(0.86 - 0.98)*	0.83	*(0.77 - 0.89)*
Self-employed	1.2	*(1.15 - 1.25)*	1.16	*(1.11 - 1.14)*
Income				
Highest quintile	1.00		1.00	
4	1.02	*(0.98 - 1.05)*	0.93	*(0.89 - 0.96)*
3	1.09	*(1.06 - 1.13)*	0.94	*(0.91 - 0.98)*
2	1.08	*(1.04 - 1.12)*	0.9	*(0.87 - 0.94)*
Lowest quintile	1.16	*(1.12 - 1.20)*	0.95	*(0.91 - 0.99)*
Accumulated wealth				
Highest quartile	1.00		1.00	
3	1.09	*(1.04 - 1.13)*	1.08	*(1.04 - 1.13)*
2	1.15	*(1.12 - 1.19)*	1.13	*(1.09 - 1.16)*
Lowest quartile	1.29	*(1.25 - 1.33)*	1.26	*(1.21 - 1.30)*
Housing tenure				
Owner	1.00		1.00	
Tenant	1.26	*(1.23 - 1.29)*	1.18	*(1.15 - 1.21)*

Note: Rate Ratios are adjusted for age. age*sex. age*country and sex*country

* Results from univariate analyses wherein only one socioeconomic indicator was included in the model ** Results from multivariate analyses wherein all socioeconomic indicators were simultaneously included in the model

The results for southern Europe were less pronounced and differed by sex and age. (Table 4) Young men in southern European countries showed a similar pattern as in northern Europe; the educational level indicator revealed the largest differences in smoking prevalence in both univariate and multivariate analyses (RR=1.57 and RR=1.24, respectively). In multivariate analyses, accumulated wealth showed equally large difference in smoking (RR=1.24). For older men, only accumulated wealth (RR=1.22) and housing tenure (R=1.09) remained significant in multivariate analyses. For young women educational level (RR=0.86) and occupational class (RR=1.19) showed significant associations in multivariate analyses but in opposite directions. The results for older aged women in southern Europe showed a reversed pattern for all indicators except housing tenure. In multivariate analyses, only educational level, income and housing tenure retained significant effects in opposite directions (RR=0.67, RR=0.81 and RR=1.16, respectively).

Table 4. Inequalities in smoking by SES: Individual and adjusted rate ratios (RRs) by region, sex, and age group (with confidence intervals)

	Northern Europe				Southern Europe			
	Male		Female		Male		Female	
Age (years)	25-39	40-60	25-39	40-60	25-39	40-60	25-39	40-60
Education								
RR univariate *	**1.76**	**1.72**	**2.47**	**1.72**	**1.57**	**1.21**	**1.1**	**0.63**
	(1.54-2.01)	*(1.52-1.95)*	*(2.12-2.87)*	*(1.48-1.99)*	*(1.46-1.70)*	*(1.12-1.29)*	*(1.01-1.20)*	*(0.57-0.71)*
RR multivariate **	**1.46**	**1.34**	**1.92**	**1.43**	**1.24**	1.01	**0.86**	**0.67**
	(1.25-1.70)	*(1.16-1.54)*	*(1.62-2.27)*	*(1.21-1.69)*	*(1.14-1.35)*	*(0.93-1.10)*	*(0.77-0.96)*	*(0.58-0.76)*
Activity status								
RR univariate	**1.24**	**1.51**	**1.28**	**1.16**	0.99	**1.07**	**0.87**	**0.78**
	(1.09-1.40)	*(1.36-1.66)*	*(1.15-1.42)*	*(1.05-1.29)*	*(0.92-1.05)*	*(1.01-1.14)*	*(0.81-0.93)*	*(0.72-0.84)*
RR multivariate	1.08	**1.2**	0.93	0.99	0.94	1	0.92	0.97
	(0.94-1.24)	*(1.06-1.34)*	*(0.83-1.05)*	*(0.88-1.10)*	*(0.83-1.05)*	*(0.88-1.10)*	*(0.88-1.02)*	*(0.89-1.06)*
Occupation								
RR univariate	**1.84**	**1.87**	**2.22**	**1.82**	**1.3**	**1.21**	1.13	**0.73**
	(1.57-2.15)	*(1.61-2.18)*	*(1.83-2.69)*	*(1.54-2.19)*	*(1.19-1.42)*	*(1.12-1.32)*	*(0.99-1.30)*	*(0.61-0.87)*
RR multivariate	**1.32**	**1.43**	**1.4**	**1.29**	**1.11**	1.06	**1.19**	0.84
	(1.11-1.58)	*(1.21-1.70)*	*(1.14-1.73)*	*(1.04-1.58)*	*(1.01-1.22)*	*(0.97-1.16)*	*(1.06-1.46)*	*(0.69-1.02)*
Income								
RR univariate	**1.23**	**1.46**	**1.68**	**1.43**	**1.31**	**1.16**	**0.88**	**0.65**
	(1.07-1.42)	*(1.28-1.66)*	*(1.41-1.99)*	*(1.23-1.67)*	*(1.22-1.40)*	*(1.08-1.24)*	*(0.78-0.97)*	*(0.57-0.74)*
RR multivariate	**0.82**	1.04	0.86	0.89	1.07	0.99	0.94	**0.81**
	(0.70-0.96)	*(0.87-1.18)*	*(0.96-1.05)*	*(0.74-1.08)*	*(0.99-1.16)*	*(0.91-1.08)*	*(0.82-1.08)*	*(0.69-0.96)*
Accumulated Wealth								
RR univariate	**1.51**	**1.5**	**1.9**	**1.71**	**1.34**	**1.24**	1.03	**0.76**
	(1.36-1.68)	*(1.36-1.66)*	*(1.69-2.15)*	*(1.53-1.92)*	*(1.25-1.43)*	*(1.17-1.32)*	*(0.94-1.12)*	*(0.69-0.85)*
RR multivariate	**1.23**	1.08	**1.41**	**1.27**	**1.24**	**1.22**	1.04	1.07
	(1.09-1.39)	*(0.96-1.22)*	*(1.22-1.62)*	*(1.10-1.46)*	*(1.15-1.33)*	*(1.13-1.33)*	*(0.93-1.16)*	*(0.94-1.20)*
Housing tenure								
RR univariate	**1.4**	**1.53**	**1.79**	**1.9**	**1.16**	**1.16**	**1.14**	**1.24**
	(1.28-1.52)	*(1.40-1.67)*	*(1.62-1.97)*	*(1.72-2.10)*	*(1.11-1.21)*	*(1.11-1.23)*	*(1.06-1.22)*	*(1.12-1.37)*
RR multivariate	**1.3**	**1.33**	**1.47**	**1.57**	**1.11**	**1.09**	1.05	**1.16**
	(1.18-1.42)	*(1.22-1.47)*	*(1.32-1.63)*	*(1.40-1.76)*	*(1.06-1.16)*	*(1.03-1.15)*	*(0.97-1.13)*	*(1.05-1.29)*

Note: **bold** = significant / * Results from univariate analyses wherein only one socioeconomic indicator was included in the model
** Results from multivariate analyses wherein all socioeconomic indicators were simultaneously included in the model

The bars in figure 1a represent the individual-level variance in smoking explained by SES indicators. In northern Europe, besides educational level, occupational class had a substantial additional predictive value in all subgroups. Housing tenure and accumulated wealth also contributed to the prediction of individual-level socioeconomic variation in smoking in northern Europe. Income and activity status, however, did not make substantial contributions. Educational level explained most of the variance in smoking prevalence in the younger populations, whereas occupational class and housing tenure explained most of the variance in the older age group.

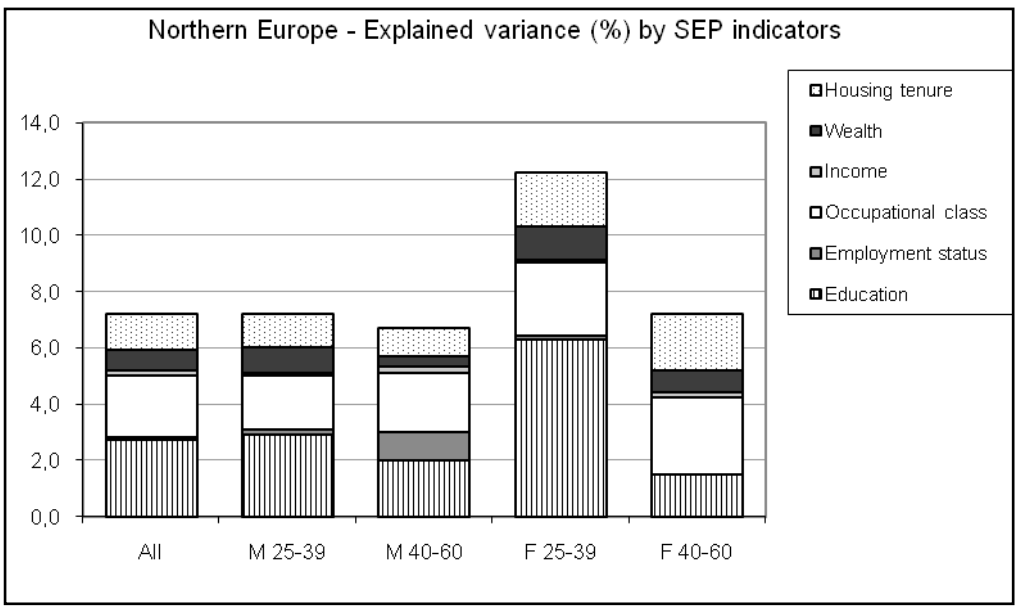

Figure 1a. Explained variance in smoking by different SES indicators – Northern Europe

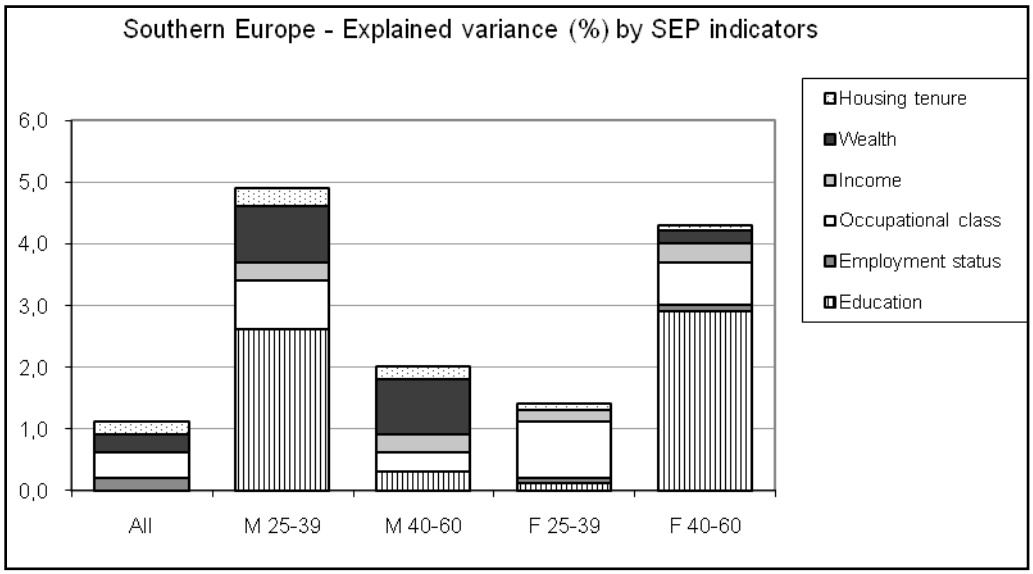

Figure 1b. Explained variance in smoking by different SES indicators – Southern Europe

The socioeconomic indicators explained less of the variance in smoking in southern Europe (Figure 1b) than in northern Europe, especially among older men and younger women. Educational level explained most of the socioeconomic variance in smoking among young men and older women in southern Europe. Accumulated wealth explained most of the socioeconomic variance in smoking among older men, as did occupational class among young women. Surprisingly, educational level had no substantial additional predictive value in these populations.

Discussion

In multivariate analyses, educational level, occupational class, housing tenure and accumulated wealth retained significant associations with smoking in most subgroups. Income and activity status were not independently related to smoking. In northern Europe, educational level had the greatest predictive value in the younger populations, whereas occupational class and housing tenure were the strongest predictors in the older age groups. The results showed a less pronounced and more varied pattern in southern Europe. Educational

level was important in the association with smoking for younger men and older women. Among older men, accumulated wealth predicted most of the SES variance in smoking, as did occupational class among younger women.

Evaluation of data

The non-response and attrition percentages were relatively high in some countries. Non-response and attrition could have biased our study results if one of the socioeconomic groups would be under-represented. However, Eurostat concluded in two evaluation studies that the effects of non-response on the cross-sectional representativeness of the initial wave of the ECHP were small. [15] Watson showed that attrition was only weakly correlated with educational level in the ECHP data.[16] Several other studies concluded that even when non-response is related to socioeconomic status, the association between smoking and socioeconomic status did not greatly differ among non-respondents compared to respondents. [23, 24] Furthermore, non-response and attrition could only explain our results if the non-response and attrition percentages would largely differ among groups identified by different SES indicators (e.g. high non-response among low income groups but not among low educational groups). Although we do not consider it likely that non-response and attrition would be greatly different among the SES indicators, we cannot exclude the possibility that non-response bias is somewhat larger in relationship to education than to, say, income.

Regarding the measurement of occupational class, in the ECHP data, only 200 occupations were distinguished. This may have led to less clear distinctions between the different occupational classes and to misclassification in a large number of cases. As a consequence, smoking differences between nearby occupational classes might have been underestimated. However, this misclassification would probably not greatly affect the difference between the highest versus the lowest occupational classes. In addition, this problem cannot explain our key result of occupational class as being an important, independent predictor of smoking. The inactive group of the variable 'activity status' is heterogeneous. Although large variations in smoking prevalence might have been observed between specific groups of economically inactive people, we used this variable simply to distinguish between those who were

active on the labour market and those who were not. We did not intend to use activity status as a proxy measure of poverty, because other variables were available to measure poverty more directly.

Occasional smokers were classified as non-smokers in our analysis. Several other studies used this same classification. [2, 5, 14, 21, 25-27] We used this classification because important differences in both health consequences and social gradients exist between occasional smokers and daily smokers. Occasional smokers are more likely to have a higher educational and occupational status than daily smokers. [28-31] Nevertheless, the non-smokers group is heterogeneous, and we cannot rule out the possibility that this might have affected our results, but the number of occasional smokers in our sample was small and did not have a large effect on our results (not shown).

Unfortunately, our data did not include information on SES in early life. Other studies indicate that smoking is related to socioeconomic status in early life, although the associations are generally weaker than the associations of smoking of adults with adult SES. [7, 32, 33]

Comparison with other studies

Our results are consistent with findings of other studies on the association of different SES indicators with smoking behaviour. Most studies also emphasized the relevance of SES indicators other than educational level in the relationship of SES with smoking. [11, 14, 34, 35] An Australian study found that all SES indicators except income (educational level, occupational class, housing tenure and socioeconomic disadvantage), were significantly associated with smoking. [34] An international overview of smoking inequalities that compared educational level and income concluded that both indicators were related with smoking, with educational level having the strongest association. [2] However, the association of smoking with income in our study disappeared when indicators as occupational class and accumulated wealth were included in the model.

Explanations

We found occupational class to be an important measure of SES in relation to smoking behaviour. For men in the age of 40-60 years in northern Europe, occupational class showed the largest differences between socioeconomic classes in multivariate analyses. Occupational class as defined in the ESEC

may indicate differences between workers in working environment and social relationships at work. Studies show that social factors are important in relation to smoking and particular in relation to smoking cessation, because of its effect on attitudes, social norm, and social support. [36-38] Negative working circumstances such as stress, physical job strain and less perceived influence on work – hallmarks of lower occupations – have been shown to impede successful cessation. [39]

Accumulated wealth and housing tenure were important predictors of the relationship between SES and smoking in our study, especially among the older age group. Accumulated wealth not only reflects the current material situation but also the financial situation over the previous years. Housing tenure also is an indicator of cumulative prosperity [14], but might as well reflect neighbourhood influences on smoking; tenants live in poor housing circumstances and deprived neighbourhoods more often than do 'owners'. [40] It has been suggested that smoking is a way of coping with deprived living circumstances and (financial) stress. [35, 41, 42]

We found that income itself is not an independent predictor of socioeconomic variance in smoking. We observed income-related differences in smoking prevalence in univariate analyses, but these differences became insignificant when adjusted for accumulated wealth and housing tenure. This suggests that, although income is associated with smoking, it does not represent the broad spectrum of material deprivation as well as do other measures of wealth. Accumulated wealth and housing tenure are indicators of cumulative prosperity, whereas income measures the purchasing power and financial situation at one moment. Income measures (and derived measures such as living below poverty lines) might therefore be less adequate, compared with accumulated wealth and tenure, in measuring the association of material deprivation with smoking. [43] In southern Europe, we found for educational level the previously documented pattern of a positive association with smoking among older women, a reversed pattern among younger men, and weak associations among older men and younger women. These patterns reflect the delayed diffusion of the smoking epidemic in southern Europe. [21, 44] The smoking epidemic model describes the diffusion of the smoking habit within societies in four stages. Higher educated men in northern European countries take the lead in the diffusion; lower educated women in southern Europe are the last to follow.

The time lag between North and South Europe can be explained by differences in economical development, the delay in spread of information on health hazards of smoking in southern Europe; and a closer cultural affinity between North Europe and the USA where social gradients in smoking changed first. Surprisingly, this "southern" pattern of educational inequalities in smoking was not observed when occupational class and accumulated wealth were used as the socioeconomic indicators. These indicators were inversely associated with smoking within almost all southern subpopulations. This indicates that, on top of the southern pattern observed in relationship to educational level, smoking is directly related to a poor occupational position and poor financial situation. Particularly among women aged 40-60 years, these two opposite patterns are observed: higher smoking prevalence rates among higher educated women but also higher rates among those experiencing material deprivation. Among these older female generations, smoking may have been an innovative behaviour, thus explaining the positive association of smoking with educational level. On the other hand, it is also suggested that smoking is a way of coping with deprived circumstances [35, 45], which explains the inverse association of smoking with occupational class and wealth. This finding illustrates the importance of considering different socioeconomic indicators as they may reflect different pathways through which SES influences smoking.

Implications

Many prior published studies used only educational level to examine the relationship of SES with smoking. Our study showed that other SES measures than educational level are important in the relationship with smoking and in some populations are even more important than educational level. In the case of older women it is shown that, as compared with educational level, measures of occupational class and accumulated wealth can be related very differently to smoking. Therefore, studies monitoring socioeconomic inequalities in smoking should preferably use more indicators than educational level alone. Especially among the older age group, occupational class, accumulated wealth, and housing tenure should be used to identify groups with an increased risk of smoking.

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CHAPTER 4

Female ever-smoking by educational level in 19 European countries in relation to economic development and women's emancipation

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Abstract

Background – Large differences in ever-smoking rates among women are found between countries and socioeconomic groups. This study examined the socioeconomic inequalities in female ever-smoking rates in 19 European countries, and explored the association between cross-national differences in these inequalities and economic development and women's emancipation.

Methods – Data on smoking were derived from national health interview surveys from 19 European countries. For each country, age group (25-39, 40-59 and 60+ years) and educational level (4 standard levels), cumulative ever-smoking rates were calculated as the proportion of current and former smokers of the total survey population. A Relative Index of Inequality was estimated for women in the three age groups to measure the magnitude of educational differences. In regression analyses the association of ever-smoking rates of women age 25-39 years with the gross domestic product (GDP) and the Gender Empowerment Measure (GEM) were explored.

Results – Less educated women aged 25-39 years were more likely to have ever smoked than more educated women in all countries, except Portugal. In the age groups 40-59 years the educational pattern differed between countries. Women age 60+ years who were less educated were less likely to have ever smoked in all countries, except Norway and England. The size of inequalities varied considerably between countries and reversed within three age groups. For women 25-39 years, the association of ever-smoking rates with GDP was positive, especially for more educated women. The association of ever-smoking rates with GEM was positive for less educated women, but negative for more educated women.

Conclusion – The results are consistent with the idea that economic development and social-cultural processes related to gender empowerment have affected the diffusion of smoking in different ways for more and less educated women.

Introduction

The habit of smoking spread rapidly in European societies during the 20th century. The smoking epidemic model describes the diffusion of smoking in four stages [1]. In the first stage, which is relatively short (lasting 10-20 years), smoking prevalence is low and mainly a habit of higher socioeconomic groups. In stage 2 (which may span 20-30 years), smoking becomes more fashionable in all socioeconomic groups and prevalence rates of men peak at 50-80%. Rates among women also rise but diffusion lags 1 or 2 decades behind that of men. In the third stage (about 30 years), women reach their peak while prevalence rates start to decline among men, especially among higher socioeconomic groups. In stage 4 prevalence rates keep declining, but at the same time socioeconomic inequalities in smoking prevalence increase [1-3]. In Europe the smoking epidemic started earlier in the North. Men in northern European countries took the lead in the diffusion; women in southern Europe were the last to follow. At the current stage of the smoking epidemic, trends in smoking are most dynamic among women. Large international differences in female smoking prevalence rates are observed (circa 2002) between European countries; low prevalence rates are found in Portugal (9.5%), Latvia (13%), Slovakia (14.7%) and Lithuania (15.8%), whereas prevalence rates are relatively high in Germany (30.6%), the Netherlands (30.2%) and Norway (29.7%) [4]. These international variations in smoking prevalence among women are (in part) a consequence of the variations in diffusion of the smoking epidemic across Europe. It is suggested that the delay in diffusion towards southern European countries might be explained by societal factors such as lagged economic development or cultural differences between the North and South of Europe [2]. In the case of female smoking, factors related to women's emancipation and other social-cultural factors might play an especially important role. In the beginning of the 20th century women's smoking was not socially acceptable, but this changed when women joined the workforce and became more emancipated [5, 6]. However, it is uncertain whether and to what extent women's emancipation and economic development influenced the spread of female smoking across Europe.

Smoking is strongly related to socioeconomic status (determined by e.g. educational level, income and/or occupational status). Women in higher socioeconomic groups started smoking on a larger scale before their

counterparts in lower socioeconomic groups (in stage 1 of the smoking epidemic), but were also among the first to quit (in stage 3 of the smoking epidemic). It is likely that the importance of societal characteristics in relation to women's smoking differs by socioeconomic status. Less educated women are reported to be more responsive to an increase in cigarette price [7-9]. This might imply a relatively large impact of economic factors and national economic development on smoking among women in lower socioeconomic groups compared to higher socioeconomic groups. The relatively low smoking prevalence rates among less educated women in southern Europe (an economically less developed region compared to northern Europe), might reflect such an effect [2, 10].

The aim of this study was to describe the education-related inequalities in ever-smoking among adult women in 19 European countries and to explore the correlation between female ever-smoking rates and two societal characteristics: gross domestic product (GDP) per capita and the gender empowerment measure (GEM). The study was carried out in two steps. First, we assessed the level and variability of national ever-smoking rates and educational inequalities in ever-smoking rates among women in 19 European countries. Next, we explored the relation of GDP and GEM to national ever-smoking rates of people with high and low educational levels. We used data from all European regions (North, West, Central, South, East and Baltic); thus, this is the first study to include the eastern part of Europe in an international overview of smoking inequalities.

Methods

Study population

For 19 European countries, reliable and recent data on smoking prevalence were available from nationally representative surveys. Micro-level data from the surveys of these 19 European countries were studied. Data were mainly provided by national statistical offices, except in the case of Finland and the Baltic states for which data were derived from the Finbalt Health Monitor (Table 1). Most surveys were conducted in or after the year 2000, except for the German and Portuguese surveys, which were conducted in 1998/1999. Sample sizes were above 4500 respondents for each country, except for Estonia, The Czech Republic, Slovakia and Latvia. Non-response rates were relatively low in Italy and Spain (about 15%) and high in Slovakia (49%). Rates in most other

countries were between 20 and 35%. Data from 151,313 female respondents aged 25 years and older were included in the descriptive analyses. In additional explorative analyses, focussing on the age group 25-39 years, data from 45,437 female respondents and from 42,298 male respondents were included.

Table 1. Overview of the surveys used in this study

Country	Year(s)	Name of survey	Non-response rate (%)
Finland	1994/'96/'98/ '00/'02/'04	Finbalt Health Monitor	28.0 - 35.0
Sweden	2000/2001	Swedish Survey of Living Conditions	23.9 / 22.2
Norway	2002	Norwegian Survey of Living Conditions	29.6
Denmark	2000	Danish Health and Morbidity Survey (DHMS/ SUSY)	25.8
England	2001	Health Survey for England (HSE)	33.0
Ireland	1995/2001	Living in Ireland Panel Survey	18.0 / 22.0 *
Netherlands	2003/2004	General social survey (POLS)	41.7 / 38.7
Belgium	1997/2001	Health Interview Survey	41.5 / 38.6 *
Germany	1998	German National Health Examination and Interview Survey	38.6
France	2004	French Health, Health Care and Insurance Survey (ESPS)	30.0*
Italy	1999/2000	Health and health care utilization / Multipurpose Family Survey	13.4 / 18.3 *
Spain	2001	National Health Survey	15.0
Portugal	1998/1999	National Health Survey	NA
Hungary	2000/2003	National Health Interview Survey Hungary	21.0 / 28.0
Czech Rep.	2002	Health Interview Survey	29.3
Slovakia	2002	Health Monitor Survey	49.1
Lithuania	1994/'96/'98/'00/'02/'04	Finbalt Health Monitor	28.0 - 39.0
Latvia	1998/'00/'02/'04	Finbalt Health Monitor	20.0 - 40.0
Estonia	2002/2004	Health Behavior among Estonian Adult Population	33.0 / 38.0

* % non-response households / NA: not available

Measures

Smoking status was self-reported and respondents were classified as 'current daily smoker', 'occasional smoker', 'former smoker' and 'never smoker'. Cumulative ever-smoking rates were calculated as the ratio of the number of ever-smokers divided by the total number of ever and never smokers.

'Occasional smokers' were not included in the analyses because it was not clear from the data from most surveys whether they have ever been daily smokers. Furthermore, occasional smokers differ from current daily smokers in terms of socioeconomic status and health consequences related to smoking [11]. Table 2 shows the number of ever-smokers by country.

Educational level is measured by the highest level of completed education of the respondent. The level of education was initially classified according to national categories, which were subsequently reclassified into four levels of education (1=none or only primary, 2=lower secondary, 3=upper secondary and post secondary non-tertiary, 4=tertiary), approximately corresponding with the following levels of the International Standard Classification of Education (ISCED): 1=ISCED 0-1, 2=ISCED 2, 3=ISCED 3-4, and 4=ISCED 5-6. Table 2 shows the percentage of higher educated (upper secondary education or higher) by age group.

National figures of GDP per capita were used in this study as a measure for economic development [12]. The GEM measures gender inequality in economic and political spheres of activity. Women's economic participation and decision-making is measured by the percentage of female administrators and managers, and professional and technical workers. Political participation and decision-making is measured by the percentage of seats in parliament held by women [13]. In the Human Development Report of the UNDP in 1998 the GEM was for the first time calculated for most European countries; these data were used in our analyses. Table 2 shows the distribution of the national samples by age category and educational level and the national figures on GDP and GEM.

Table 2. Sample characteristics (N) and societal characteristics

	All	25-39 yrs		40-59 yrs		60+ yrs		GDP[2] 1996 (€)	GEM[3] 1998
	N ever[1]	N ever[1]	% high educated	N ever[1]	% high educated	N ever[1]	% high educated		
Finland	3134	1172	*92.7*	1772	*72.9*	190	*44.2*	19800	0.73
Sweden	2440	634	*92.7*	1190	*84.7*	616	*50.5*	24300	0.79
Norway	769	242	*96.3*	387	*83.7*	140	*57.9*	28800	0.79
Denmark	4143	1157	*86.7*	1792	*77.5*	1194	*43.4*	27600	0.74
England	3914	1228	*82.6*	1509	*65.7*	1177	*29.9*	16200	0.59
Ireland	1099	330	*68.5*	470	*44.5*	299	*23.2*	16100	0.55
Netherlands	3931	1005	*76.8*	1932	*57.4*	994	*30.6*	21200	0.69
Belgium	3440	1179	*76.8*	1442	*54.7*	819	*29.9*	21400	0.60
Germany	1202	521	*76.0*	526	*56.1*	155	*22.3*	23500	0.69
France	2231	897	*63.4*	1073	*43.2*	261	*21.1*	20800	0.49
Italy	16299	5992	*58.8*	7156	*34.1*	3151	*8.8*	17400	0.52
Spain	2910	1625	*49.4*	1117	*23.0*	168	*5.9*	12400	0.62
Portugal	2232	1237	*31.4*	806	*11.7*	189	*2.9*	9200	0.55
Hungary	1870	650	*55.8*	944	*48.8*	276	*18.9*	3500	0.49
Czech Rep.	400	126	*62.3*	202	*47.3*	72	*24.0*	4700	0.53
Slovakia	141	45	*77.6*	93	*69.0*	3	*52.6*	3100	0.52
Lithuania	887	501	*73.2*	358	*60.0*	28	*33.3*	1800	NA
Latvia	201	102	*72.7*	96	*72.0*	3	*46.6*	1800	0.44
Estonia	835	311	*70.9*	466	*59.8*	58	*54.7*	2600	0.46

[1] Total number of ever-smokers (current + former)
[2] Gross Domestic Product (€) per capita, source: Eurostat
[3] Gender Empowerment Measure, source: UNDP

Statistical analyses

First, age-standardized cumulative ever-smoking rates were calculated for each country, age group and educational level. The direct method of age standardization was used with the European standard population of 1995 as the standard population structure. Ever-smoking rates were calculated in identical ways for both sexes, but country-specific estimates are only shown for women. Ever-smoking rates for men were used in further correlation analyses. In the next step we quantified the magnitude of educational inequalities in ever-smoking rates for women, using the Relative Index of Inequality (RII) and its 95% confidence interval (CI). RII is a regression-based measure that takes into account all educational groups separately. It facilitates comparisons between countries with different educational classifications, provided that all classifications are hierarchical and sufficiently detailed. The relative index of inequality is the ratio between the estimated cumulative ever-smoking rates among persons at rank 1 (the lowest education, occupation, or income level) and rank 0 (the highest level). The RII can be interpreted as the risk of being an ever-smoker at the very lowest end of the educational hierarchy as compared to the very top of the educational hierarchy. For this paper, the RII was estimated with log linear regression with control for 5-year age group. The regression model had a log link function and assumed a binomial distribution using the Genmod procedure of SAS [14, 15]. Analyses were performed separately for the three age groups (25-39, 40-59 and 60+ years).

Finally, we explored the correlation between national ever-smoking rates for women and the variables GDP and GEM in the age group 25-39 years. Linear regression analysis was applied, with countries as units of observation. We first applied univariate regression analyses wherein the ever-smoking rate was the dependent variable and GDP or GEM the independent variable. Because GDP and GEM are correlated we included GDP and GEM in further analyses simultaneously in the model. The correlation analyses were restricted to the youngest age group because the societal characteristics (GDP and GEM) are from 1996 and 1998, respectively (older data were not available for GEM). Women aged 25-39 years in the year 2000 have mostly started smoking in the 1980s and 1990s. For comparison we explored also the correlation between ever-smoking rates of men (aged 25-39 years) and GDP and GEM.

Sample sizes are small for some countries. This leads to imprecise estimates for these countries, which might influence the correlation analyses. We evaluated this by running regression analyses wherein the country-specific ever-smoking rates were weighted according to the national sample sizes. Application of these country weights did not change the outcomes of the regression analyses. Therefore, results of only the un-weighted regression analyses are presented.

Results

National ever-smoking rates among women aged 25-39 years were relatively low (<30%) in Lithuania, Slovakia, Portugal and Norway, whereas the highest rates were found in Spain (57.1%), France (54.1%), England (53.4%) and Denmark (53.2%) (Table 3). In this age group, less educated women were more likely to have ever smoked than their more educated counterparts in all countries, except Portugal. Relative inequalities were especially large in Norway (RII: 5.54), Finland (RII:2.95) and Ireland (RII:2.99), and small in France and Italy (both RII:1.24).

Among women aged 40-59 years, national ever-smoking rates were low in Portugal (12.3%) and Lithuania (13.8%). The highest rates were found in the Netherlands (67.7%) and Denmark (60.5%). There was much international diversity in educational inequalities in ever-smoking rates among women aged 40-59 years. In most northern and western European countries, less educated women were more likely to have ever started smoking than more educated women. In southern European countries an opposite pattern was observed; less educated women were less likely to have ever smoked compared with women with higher educational levels. The pattern in eastern Europe is diverse; in the Czech Republic less educated women were more likely to have ever smoked than more educated women in the (RII:1.64) and Estonia (RII:1.30), but the opposite pattern was found in Lithuania (RII: 0.52) (Table 3).

Table 3. Educational inequalities in ever-smoking rates in women

	25-39 yrs					40-59 yrs					60+ yrs				
	Ratios (%)			RII	(95% C.I.)	Ratios (%)			RII	(95% C.I.)	Ratios (%)			RII	(95% C.I.)
	Education					Education					Education				
	All	high	low			All	high	low			All	high	low		
Finland	38.6	37.5	59.6	**2.95**	*(2.46-3.53)*	39.1	37.1	46.6	**1.73**	*(1.51-1.98)*	22.7	23.8	21.4	0.83	*(0.53-1.31)*
Sweden	41.7	40.1	63.1	**2.93**	*(2.39-3.59)*	57.6	56.6	63.6	**1.42**	*(1.23-1.62)*	40.7	43.2	38.5	0.87	*(0.71-1.07)*
Norway	29.3	29.0	38.4	**5.54**	*(3.84-7.98)*	36.0	32.7	55.2	**2.99**	*(2.24-3.97)*	18.5	16.8	21.4	1.75	*(0.98-3.13)*
Denmark	53.2	50.7	71.3	**2.06**	*(1.76-2.41)*	60.5	58.8	67.9	**1.29**	*(1.16-1.44)*	57.5	60.3	57.0	0.91	*(0.79-1.04)*
England	53.4	52.0	61.2	**1.79**	*(1.55-2.07)*	55.0	51.7	62.1	**1.38**	*(1.21-1.57)*	52.7	48.2	55.9	**1.28**	*(1.08-1.51)*
Ireland	45.7	37.3	63.5	**2.99**	*(2.31-3.89)*	42.4	36.2	47.9	**1.77**	*(1.36-2.29)*	37.2	38.3	36.8	1.00	*(0.70-1.04)*
Netherlands	50.0	47.6	58.6	**1.56**	*(1.33-1.83)*	67.7	65.5	71.3	**1.24**	*(1.13-1.36)*	49.9	54.8	48.2	0.86	*(0.74-1.06)*
Belgium	50.0	47.4	59.1	**1.52**	*(1.32-1.77)*	54.3	55.0	53.2	0.95	*(0.84-1.08)*	34.3	42.1	30.5	**0.55**	*(0.45-0.66)*
Germany	48.0	44.7	58.4	**1.85**	*(1.46-2.36)*	40.2	37.0	45.0	**1.35**	*(1.05-1.73)*	18.1	27.5	15.7	**0.37**	*(0.20-0.66)*
France	54.1	51.8	58.8	**1.24**	*(1.05-1.48)*	43.6	49.9	39.0	**0.65**	*(0.55-0.76)*	17.4	31.5	13.4	**0.21**	*(0.15-0.30)*
Italy	36.5	35.0	38.9	**1.24**	*(1.13-1.36)*	37.6	46.7	33.2	**0.50**	*(0.46-0.53)*	17.1	35.0	15.3	**0.25**	*(0.22-0.27)*
Spain	57.1	52.8	62.4	**1.33**	*(1.16-1.51)*	36.2	56.1	30.7	**0.36**	*(0.31-0.43)*	5.5	18.2	4.6	**0.10**	*(0.06-0.15)*
Portugal	27.7	36.8	24.4	**0.29**	*(0.25-0.35)*	12.3	40.3	8.3	**0.04**	*(0.03-0.05)*	2.6	22.8	2.0	---	---
Hungary	48.0	38.1	60.6	**2.30**	*(1.91-2.77)*	47.9	48.3	48.9	1.01	*(0.86-1.19)*	16.0	29.2	13.1	**0.27**	*(0.20-0.38)*
Czech Rep.	40.0	33.7	49.8	**2.53**	*(1.51-4.26)*	50.6	45.4	57.2	**1.64**	*(1.16-2.32)*	21.7	35.5	17.8	**0.31**	*(0.16-0.60)*
Slovakia	28.3	24.0	48.9	2.65	*(0.92-7.62)*	37.4	35.8	39.2	1.13	*(0.64-2.00)*	5.3	6.7	3.7	0.83	*(0.02-40.79)*
Lithuania	24.7	21.9	33.3	**2.27**	*(1.66-3.11)*	13.8	15.3	12.3	**0.52**	*(0.36-0.75)*	4.6	5.1	4.6	0.73	*(0.23-2.33)*
Latvia	38.4	35.1	47.9	**2.33**	*(1.37-3.99)*	23.8	23.3	27.2	1.16	*(0.56-2.42)*	2.5	3.6	1.6	0.03	*(0.00-3.38)*
Estonia	47.7	42.9	58.9	**2.17**	*(1.62-2.92)*	44.8	43.6	47.8	**1.30**	*(1.00-1.68)*	24.4	27.6	18.9	0.73	*(0.35-1.52)*

In the age group 60 years and older, national ever-smoking rates of more educated women were particularly low (<6%) in Portugal, Spain, Slovakia, Lithuania and Latvia. Ever-smoking rates were about ten times as high in Denmark (57.5%) and England (52.7%). In most countries (except Norway and England), ever-smoking rates were higher among more educated women compared with less educated women. Relative inequalities favouring the less educated were largest in Spain (RII: 0.10), France (RII: 0.21) and Italy (RII: 0.25) (Table 3).

In 1996 among women age 25-39 years, national ever-smoking rates were positively associated with GDP (Table 4). This association was found in both the more and the less educated group (Figure 1), although the association was stronger and only statistically significant in the more educated group. Controlled for GDP, the GEM was negatively associated with national ever-smoking rates among more educated women, but positively with ever-smoking rates among less educated women. The associations with GEM did not attain statistical significance. (Table 4 and Figure 2).

Table 4. Association between national ever-smoking rates and GDP and GEM by educational level: women and men age 25-39 years

	Women			Men		
	Ratios			Ratios		
	All	Education		All	Education	
		High	Low		High	Low
β[1] GDP 1996 (no control)	0.39	0.54*	0.34	-0.78	-0.65*	-0.68*
β[1] GDP 1996 (control for GEM)	0.58	0.76*	0.08	-0.37	-0.37	-0.85*
β[1] GEM 1998 (no control)	0.02	0.13	0.22	-0.78	-0.60	-0.36
β[1] GEM 1998 (control for GDP)	-0.43	-0.45	0.16	-0.50	-0.32	0.29

[1] regression coefficient

* $p < 0.05$

Ever-smoking rates among men (aged 25-39 years) were negatively associated with GDP in 1996 (Table 4). This association was stronger and only statistically significant among less educated men. The association between ever-smoking rates and GEM was similar for men as for women, with a negative (but non-significant) association with ever-smoking rates among more educated men, but a positive (non-significant) association for less educated men.

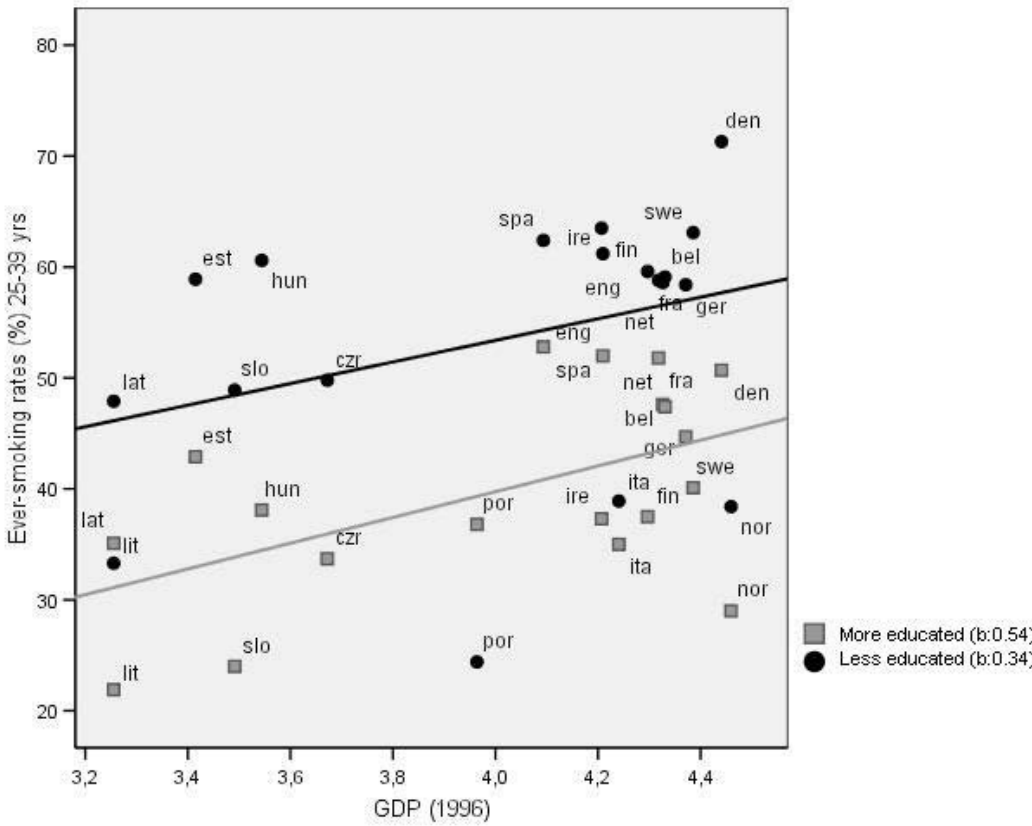

Figure 1. Correlation of GDP with ever-smoking rates among women aged 25-39 years

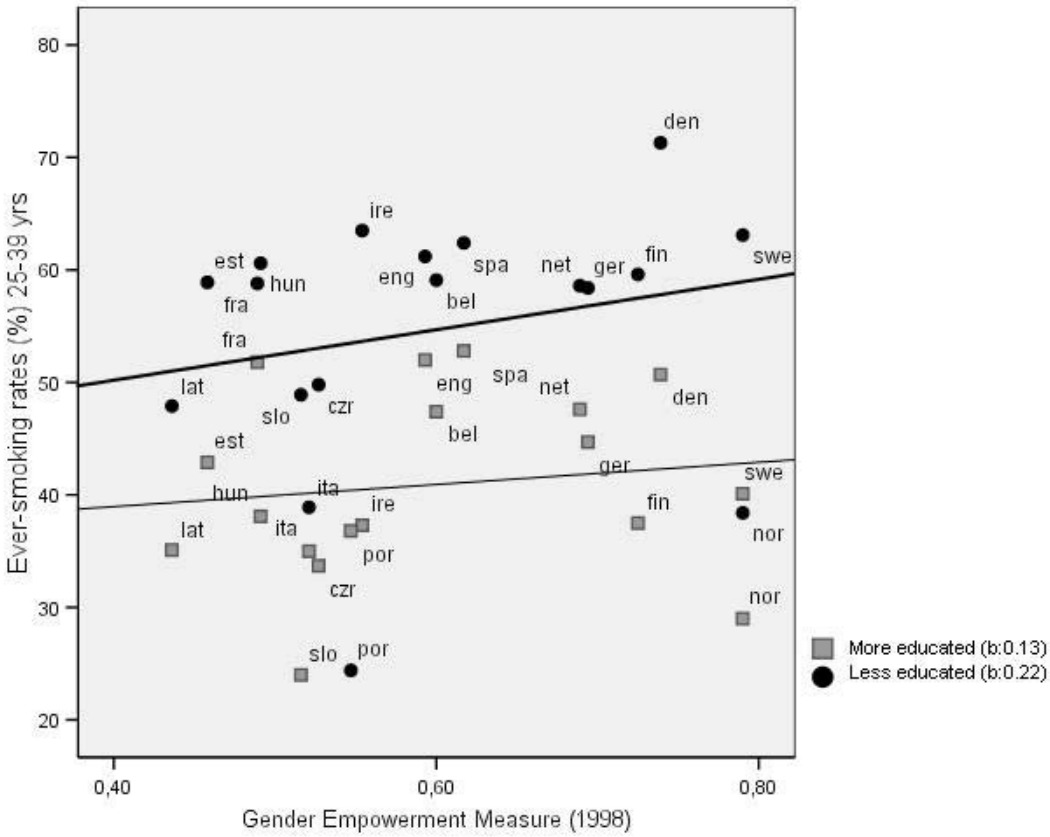

Figure 2. Correlation of GEM with ever-smoking rates among women aged 25-39 years

Discussion

Summary

Educational inequalities in ever-smoking rates differed among the three age groups. In the younger age groups, ever-smoking rates were generally higher among less educated women compared to their more educated counterparts. The ever-smoking rates of more and less educated women, respectively, strongly varied among European countries. Ever-smoking rates among women aged 25-39 years were positively associated with GDP, but especially for more

educated women. The GEM was negatively associated with ever-smoking rates among more educated women, but positively associated with ever-smoking rates among less educated women.

Evaluation of data and methods

Non-response percentages were high in some countries. Non-response could have biased our study results had educational level and smoking status been unequally distributed among respondents and non-respondents. Some studies reported that non-respondents can be characterized by lower educational level and unhealthier lifestyles [16, 17]. However, several studies observed that even though non-response is related to socioeconomic status, the association between smoking and socioeconomic status would not change greatly if non-respondents were included amongst respondents [18-20]. Nevertheless, in the present study we cannot exclude that an overrepresentation of less educated smokers in the non-response group may have led to some underestimation of the educational inequalities in ever-smoking rates. National statistical offices provided the data used for the present study. Because demographic information of the non-respondents was not available for most countries, we were not able to investigate a possible non-response bias in our study.

Another limitation relates to the time of measurement of the variables GDP and GEM. In this study we explored the association between ever-smoking rates of women aged 25-39 years and GDP and GEM. If we assume that most people start smoking between their 15th and 25th birthday, women aged 25-39 years in the year 2000 started smoking somewhere between 1975 and 2000. The variables GDP and GEM are measured in 1996 and 1998, respectively. Unfortunately, because data on GDP and GEM from earlier years were not available for all countries we chose to restrict the correlation analysis to the youngest age group. However, the time lag between the societal factors and smoking initiation may still not be appropriate for many women in this age group. Therefore, caution is required when drawing conclusions about causality. Nevertheless, countries with a low score on GEM or a low GDP in the late 1990s are likely to have relatively low scores on GEM or GDP in the two preceding decades as well, because these levels of societal factors attained in the 1990s depend to a large extent on the economic progress and gender emancipation process over a much longer historical period. Among western

European countries, the correlation between GDP in 1996 and GDP in 1980 [21] is as high as 0.84. This indicates that the relative positions of western European countries based on GDP were indeed stable over time.
Our study only included two societal factors, while other societal factors might be important in relation to the diffusion of smoking among women across Europe. An important third factor might be female labour force participation rates (FLPR). FLPR are related to women's emancipation and empowerment. It is suggested that women took up men-like habits (such as smoking) when they entered the work force, partly as a consequence of less restrictive social attitudes towards women's behaviour due to increased female labour force participation rates [6] and women's greater economic independence. High FLPR might explain our observation that ever-smoking rates among women in eastern European countries were often higher than those in southern European countries. The FLPR in eastern European countries were much higher than those in southern European countries (World bank-website, accessed in February 2007). However, a first explorative analysis of the association between female ever-smoking rates and FLPR across all countries included in our study did not show strong or significant associations.

Explanations

While less educated women aged 25-39 years were more likely to have ever smoked compared to their more educated counterparts, the opposite emerged for the age group 60+ years, where more educated women were more likely to have ever started smoking. Thus, within about one generation the educational inequalities completely reversed. This finding shows that a rapid diffusion of the smoking epidemic among women from high to lower socioeconomic groups occurred across all parts of Europe. As suggested in earlier studies covering smaller sets of countries [2, 22], this diffusion process was completed latest among southern European women. Our results confirm the unique position of Portugal, where even in the youngest age category we still find relatively low prevalence rates and a reversed pattern of inequalities.

Our results suggest that eastern European countries are, in terms of national ever-smoking rates, somewhere between northern, western and southern European countries. A similar pattern is found for educational inequalities. In

the age group 40-59 years inequalities were small in Hungary, Slovakia and Latvia, they had a 'southern' pattern in Lithuania, but a 'northern' pattern in Estonia and Czech Republic (RII = 1.30 and 1.64). Considering their poor economic development and restricted cultural influences from the west until the late 1980s, one might expect eastern European countries to be more similar to southern Europe. However, apparently other factors were more important in relation to the diffusion of the smoking epidemic among women in eastern European countries. The large variations in ever-smoking patterns among eastern European countries suggest that the shared history of Communism is less relevant to female smoking than other specific national characteristics of these countries.

The explorative analyses showed an association between two societal factors and female ever-smoking rates. National ever-smoking rates among women aged 25-39 years were positively associated with GDP, but negatively with GEM. These results suggest that societal processes have indeed affected the diffusion of the smoking epidemic in Europe, among women as well as men. It is likely that both factors represent a broader societal cultural process that has influenced the diffusion of the smoking habit across Europe.

Variations in smoking rates according to GDP are not very large, with a difference in ever-smoking rates of approximately 10% between the countries with the highest and lowest GDP, respectively. This might indicate a transition in the smoking epidemic between an older period when, women living in more economically developed regions had higher initiation rates, and more recent years in which initiation rates are highest among women living in less economically developed countries. Increasing purchasing power may have played a critical role in this changing association between GDP and ever-smoking rates among women. With economic development, the purchasing power of male and female citizens increases. Smoking used to be a luxury, especially for women from lower socioeconomic groups, but cigarettes have become accessible to these groups to the extent that GDP rises [5, 23].

Our results indicate lower ever-smoking rates among men in more economically developed countries, while female ever-smoking rates are higher in such countries. This seems to indicate a different effect of GDP on smoking rates among women and men. This difference can probably best be understood in light of the smoking epidemic, which first evolved among men, with women

lagging some decades behind [1]. Other studies reported that southern European countries were behind northern and western European countries in terms of the smoking epidemic [2, 10]. As a result, while prevalence rates among men in the North and West of Europe were already declining, rates among women had just reached their peak and started to slowly decline. At the same time, southern and eastern European countries had high prevalence rates among men but still low prevalence rates among women. This pattern is reflected in our data: female ever-smoking rates are higher in most northern and western European countries compared to southern and eastern European countries. The eastern European countries (and also Portugal and Spain) have lower GDP compared to the northern and western European countries. As a result, the association between ever-smoking rates and GDP was opposite for women as compared to men.

The emancipation of women has been important in fostering the uptake of smoking among women [6, 24, 25]. In the beginning of the 20th century, female smoking used to be socially unacceptable. Later on, female smoking became increasingly more socially accepted. While women who smoked were seen as prostitutes and fallen women in the beginning of the 20th century, later they were considered to be modern, independent women [6, 24]. Our results also suggest an inverse association between women's emancipation and female smoking (i.e. lower ever-smoking rates in countries with more gender emancipation). However, a similar pattern was also observed for men. The fact that a similar association was found for men suggests the effect of more general social-cultural processes related to gender empowerment, which influenced smoking rates among both women and men. One such process may be the individualisation of modern societies, which has been described as a generalised process affecting all European societies, but northern societies to a larger extent [26]. During this process, values, beliefs and attitudes had become increasingly based on personal choices and individual preferences. We speculate that this process might have fostered the diffusion of the tobacco epidemic in European societies.

The association between ever-smoking rates and GEM was positive for less educated women (and also men), in contrast to the negative association among more educated women (and also men). These tendencies suggest a greater sensitivity of less educated women and men to socio-cultural processes

reflected in the GEM, such as individualization. In addition, less educated women might have been more sensitive to the increasing social acceptability of female smoking in the past. Images of smoking (in part stimulated by the tobacco industry), might have played a large role in this context, particularly among women. Female smoking became more and more associated with women's emancipation. The tobacco industry may have promoted the association between female smoking and women's emancipation, by promoting cigarettes as 'torches of freedom' [24]. The tobacco industry was thus able to link positive values of independence and emancipation to the habit of smoking cigarettes [24, 25, 27]. Our results suggest that, when no longer protected by traditional norms against female smoking, less educated women might have been especially sensitive to these positive images of smoking in those years.

Conclusion

Ever-smoking rates are still high among young adult women in European countries, compared to other regions (North America, Australia). Economic development and social cultural processes related to gender empowerment are associated with the diffusion of the smoking initiation among women. Future research should focus on societal processes that are important in relation to smoking habits. Knowledge about how related social cultural processes influence the uptake of smoking is important for tobacco control. Since ever-smoking rates are today highest among less educated women, smoking prevention should focus especially on young, less educated women.

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CHAPTER 5
Effect of nation-wide tobacco control policies on smoking cessation in high and low educated groups in 18 European countries

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Abstract

Background – Recently, a scale was introduced to quantify the implementation of tobacco control policies at country level. Our study used this scale to examine the potential impact of these policies on quit ratios in European countries. Special attention was given to smoking cessation among lower educational groups.

Methods – Cross-sectional data were derived from national health surveys from 18 European countries. In the analyses we distinguished between country, sex, two age groups (25-39 and 40-59 years) and educational level. Age-standardized quit ratios were calculated as total former-smokers divided by total ever-smokers. In regression analyses we explored the correlation between national quit ratios and the national score on the Tobacco Control Scale (TCS).

Results – Quit ratios were especially high (>45%) in Sweden, England, the Netherlands, Belgium and France, and relatively low (<30%) in Lithuania and Latvia. Higher educated smokers were more likely to have quit smoking than lower educated smokers in all age-sex groups in all countries. National score on the tobacco control scale was positively associated with quit ratios in all age-sex groups. The association of quit ratios with score on the TCS did not show consistent differences between high and low educated. Of all tobacco control policies of which the TCS is constructed, price policies showed the strongest association with quit ratios, followed by an advertising ban.

Conclusion– Countries with more developed tobacco control policies have higher quit ratios than countries with less developed tobacco control policies. High and low educated smokers benefit about equally from the nation-wide tobacco control policies.

Introduction

In the last decade many countries have implemented more or less comprehensive tobacco control policies. Tobacco control policies include, amongst others; taxes on tobacco products, bans or restrictions on smoking in public places and advertising bans. Recently, Joossens and Raw (2006) developed the Tobacco Control Scale (TCS) to quantify the efforts in the field of tobacco control at country level in Europe. [1] According to the TCS large variations exist between countries.

An important question is whether these variations in tobacco control policies between countries are correlated with differences in smoking behaviour. Different types of studies (trials, time-series analyses and cross-sectional studies) showed an effect of individual tobacco control measures, mostly within countries or regions, on smoking behaviour. [2-6] The International Tobacco Control (ITC) Policy Evaluation Project studied the effect of nation-wide tobacco control policies on smoking behaviour in an international study comparing the USA, Canada, Australia and the UK. [7] The TCS created the opportunity to also compare European countries on their efforts to reduce smoking rates and the relation of these efforts with smoking prevalence in national populations.

Socioeconomic inequalities in smoking have widened and persisted in the last decades.[8] Tobacco policies need to tackle these inequalities by achieving reductions of smoking prevalence rates among lower socioeconomic groups. Nevertheless, it is generally acknowledged that mainly higher socioeconomic groups have benefited from early tobacco control policies, such as written information campaigns and health publicity. [9, 10] On the other hand, lower socioeconomic groups seem to be more responsive to price policies than smokers in a higher socioeconomic status. [9, 11, 12] It is therefore uncertain whether the impact of nation-wide tobacco control policies differs between high and low socioeconomic groups. The impact of nation-wide tobacco control policies on smoking behaviour should preferably be examined in a longitudinal study design, wherein information about smoking behaviour and its determinants before and after the implementation of a policy is measured. For the evaluation of national tobacco control programs, this longitudinal design is preferably applied to several countries in order to be able to compare "intervention" countries (where a specific intervention is implemented during the study period) to "control" countries (where the intervention is not yet widely

implemented). Unfortunately, comparative longitudinal data on smoking are available only for the ITC study referred to above. As a result, in-depth comparison between European countries with different tobacco control policies is not yet possible with the available data. Alternative approaches are needed to obtain first evidence on the potential effect of national policies on smoking in European countries. In this paper, we apply a comparative approach based on cross-sectional data.The aim of this study was to examine the extent to which tobacco control policies are correlated with smoking cessation. Special attention was given to smoking cessation among lower educational groups. The analysis consisted of two steps. First, we assessed the national levels and educational inequalities in smoking cessation ratios in 18 European countries. Second, we explored the relation of the cessation ratios by educational level with national tobacco control policies as measured by the score on the TCS. We used data from 18 countries from all European regions. For the first time, this international overview of smoking inequalities included data from eastern European and Baltic countries.

Methods

The TCS allocated a score to each country based on the level of implementation of different tobacco control policies as it was in 2004-5. The scale is based on six policies that were described by the World Bank as being most important and effective. A group of experts allocated points to each policy according to its potential impact on national smoking rates. The maximum possible score on the TCS is 100. The scale includes the following policies (maximum points): Price (30 pts), Public place bans (22 pts), Public info campaign spending (15 pts), Advertising bans (13 pts), Health warnings (10 pts) and Treatment (10 pts). [1] Table 2 shows the national scores on the TCS. Countries are ranked by their score on the TCS in 2005. Ireland has the highest score of 74 out of 100 points. Latvia has the least developed tobacco control policy with a score of 29 points.

National Health Surveys

Micro-level data from national health interview surveys of 18 European countries were obtained and analysed. Most surveys were conducted in or after the year 2000, except the German and Portuguese surveys, which were

conducted in 1998-9. Sample sizes were above 4500 for all surveys, except those from Estonia, the Czech Republic, Slovakia and Latvia. Non-response percentages ranged from about 15% in Italy and Spain up to 49% in Slovakia, while percentages in most other countries were between 20% and 35%. (See table 1) Data from 100,893 respondents who had ever smoked were included in the analyses. We limited our analyses to the adult population aged 25-59 years, in order to exclude the possibility of mortality bias among older smokers.

Table 1. Surveys included in the study

Country	Year(s)	Name of survey	Non-response rate (%)	Number of ever-smokers[1]
Finland	94/'96/'98/ '00/'02/'04	Finbalt Health Monitor	28.0-35.0	6785
Sweden	2000/1	Swedish Survey of Living Conditions	23.9/22.2	3601
Denmark	2000	Danish Health and Morbidity Survey (DHMS/ SUSY)	25.8	6060
England	2001	Health Survey for England (HSE)	33.0	5195
Ireland	1995/2001	Living in Ireland Panel Survey	18.0 / 22.0*	1634
Netherlands	2003/4	General social survey (POLS)	41.7 / 38.7	5902
Belgium	1997/2001	Health Interview Survey	41.5/38.6*	5841
Germany	1998	German National Health Examination and Interview Survey	38.6	2402
France	2004	French Health, Health Care and Insurance Survey (ESPS)	30.0*	4346
Italy	1999/2000	Health and health care utilization / Multipurpose Family Survey	13.4/18.3*	34070
Spain	2001	National Health Survey	15.0	6688
Portugal	1998/9	National Health Survey	NA	8303
Hungary	2000/2003	National Health Interview Survey Hungary	21.0/28.0	3337
Czech Rep.	2002	Health Interview Survey	29.3	745
Slovakia	2002	Health Monitor Survey	49.1	395
Lithuania	94/'96/'98/ '00/'02/'04	Finbalt Health Monitor	28.0-39.0	3306
Latvia	98/'00/'02/'04	Finbalt Health Monitor	20.0-40.0	535
Estonia	2002/2004	Health Behavior among Estonian Adult Population	33.0/38.0	1748

[1] ever-smokers (25-39 yrs) = former smokers + current daily smokers / * % non-response households

Smoking status was self-reported and respondents were initially classified as 'current daily smoker', 'occasional smoker', 'former smoker' and 'never smoker'. Quit ratios were calculated as the ratio of the number of ex-smokers divided by the number of ever-smokers (current + former smokers). Occasional smokers were not included in the analyses because it was not clear from the data from most surveys whether they have ever been daily smokers. Furthermore, occasional smokers differ from current daily smokers in terms of socioeconomic status and health consequences related to smoking. [13] Table 2 describes the percentage of ever-smokers in each country and each age-sex group.

Table 2. National score on Tobacco Control Scale (TSC) and sample characteristics (N)

	Score TCS	Men				Women			
		25-39 yrs		40-59 yrs		25-39 yrs		40-59 yrs	
		N	% ever[1]	N	% ever[1]	N	% ever[1]	N	% ever[1]
Finland	58	1283	*54.1*	2558	*63.6*	1172	*39.1*	1772	*39.5*
Sweden	60	549	*36.7*	1228	*63.5*	634	*42.4*	1190	*58.3*
Denmark	45	1011	*51.2*	2100	*70.5*	1157	*54.1*	1792	*60.9*
England	73	1012	*57.5*	1446	*61.5*	1228	*53.9*	1509	*55.6*
Ireland	74	323	*47.6*	511	*50.9*	330	*46.5*	470	*42.8*
Netherlands	52	1013	*57.6*	1952	*73.2*	1005	*50.9*	1932	*68.4*
Belgium	50	1252	*57.2*	1968	*74.9*	1179	*50.8*	1442	55,0
Germany	36	577	*57.4*	778	*61,0*	521	*49.3*	526	*39.4*
France	56	916	*60.1*	1460	*66.6*	897	*55,0*	1073	*44.3*
Italy	57	8441	*54,0*	12481	*67.6*	5992	*37.3*	7156	*37.8*
Spain	31	1870	*64.2*	2076	*73.6*	1625	*57.9*	1117	*36.9*
Portugal	39	2641	*62.4*	3619	*62.6*	1237	*27.9*	806	*12.1*
Hungary	47	672	*61.1*	929	*73.2*	712	*48.4*	1024	*48,0*
Czech Rep.	38	162	*59.8*	255	*69.5*	126	*40.3*	202	*51.1*
Slovakia	49	98	*62.4*	159	*67.8*	45	*26.9*	93	*37,0*
Lithuania	34	1115	*70.8*	1332	*76.9*	501	*24.9*	358	*13.7*
Latvia	29	146	*73.9*	191	*67.7*	102	*38.5*	96	*23.8*
Estonia	45	424	*77.3*	547	*80.6*	311	*47.7*	466	*45.2*

N = current + former smokers

[1] ever-smoking ratio (%) = total number of ever-smokers divided by sum of ever + never smokers

Educational level represents the highest level of completed education of the respondent. The level of education was initially classified according to national categories, which were subsequently reclassified into four levels of the International System of Classification of Educations (ISCED): primary or no education, lower secondary education, higher secondary education, and tertiary education.

Statistical analyses

First, age-standardized quit ratios were calculated for each country, sex and educational level. The direct method of age standardization was used with the European population of 1995 as the standard. In the next step we quantified the magnitude of educational inequalities in quit ratios, using the Relative Index of Inequality (RII) and its 95% confidence interval (CI). RII is a regression-based measure that takes into account all educational groups separately. It facilitates comparisons between countries with different educational classifications, provided that all classifications are hierarchical and sufficiently detailed. The RII assesses the association between quit ratios and the relative position of each educational group. This relative position is measured as the cumulative proportion of each educational group within the educational hierarchy with 0 and 1 as the extreme values. The resulting measure, the RII, can be interpreted as the risk of being a former smoker at the very top of the educational hierarchy as compared to the very lowest end of the educational hierarchy. [14, 15] For this paper, the RII was estimated with log linear regression controlled for 5-year age group. The regression model had a log link function and assumed a binomial distribution, using the Genmod procedure of SAS. [16, 17] Finally, we explored the correlation between national quit ratios and the national score on the TCS and the sub scores of the TCS. We applied linear regression analyses, with countries as units of observation. In univariate regression analyses the quit ratio was the dependent variable and the score on the TCS the independent variable. In further analyses we adjusted for Gross Domestic Product (GDP) per capita in the year 2000. [18] GDP is used in this study as a measure for economic development, which may be related to smoking cessation rates independently (for example, through reduced financial and environmental stress relief, increased health literacy and greater self-efficacy in relation to healthy behaviour) from the implementation of tobacco control policies. The analyses were performed separately for men and women, two age groups

(25-39 and 40-59) and two educational groups (high versus low). Sample sizes are small for some countries. This leads to imprecise estimates for these countries, which might influence the assessment of associations between quit ratios and policies. We evaluated this by also running regression analyses with country-specific quit ratios weighted according to the national sample sizes. Application of these country-weights did not change the outcomes of the regression analyses substantially or systematically, and the socioeconomic patterns remained unchanged. In this paper, we only present the results of the un-weighted regression analyses.

Results

Quit ratios among men varied from 22.4% in Lithuania up to 62.2% in Sweden among men (Table 3). Generally, the highest quit ratios were found in northern and western European countries, whereas lower quit ratios were found in southern and eastern European countries. Table 4 shows a similar geographical pattern for women.

Table 3. Educational inequalities in quit ratios - Men

	All ages	25-39 yrs				40-59 yrs			
	Quit ratio	Quit ratio		RII[o]	(95 % C.I.)	Quit ratio		RII[o]	(95 % C.I.)
		high[1]	low[2]			high[1]	low[2]		
Finland	43.1	35.0	23.6	2.45	(1.70-3.52)	53.7	45.5	1.32	(1.15-1.50)
Sweden	62.2	59.9	46.8	1.61	(1.19-2.18)	65.6	57.2	1.45	(1.23-1.71)
Denmark	34.8	31.3	16.1	3.14	(2.10-4.71)	42.6	29.9	2.08	(1.68-2.58)
England	48.3	39.1	27.6	2.64	(1.83-3.82)	64.0	43.9	1.95	(1.67-2.28)
Ireland	37.9	29.7	27.3	1.44	(0.72-2.89)	57.1	39.4	1.84	(1.37-2.47)
Netherlands	48.6	46.1	30.4	2.52	(1.86-3.41)	58.2	43.2	1.7	(1.47-1.97)
Belgium	43.5	41.1	24.5	3.03	(2.23-4.13)	54.8	41.2	1.75	(1.49-2.04)
Germany	39.2	27.7	20.7	1.86	(1.08-3.20)	52.7	48.1	1.17	(0.93-1.47)
France	48.3	45.2	32.1	2.05	(1.48-2.85)	58.6	53.9	1.21	(1.02-1.44)
Italy	37.3	29.3	23.5	1.76	(1.48-2.10)	49.5	44.4	1.2	(1.12-1.29)
Spain	30.1	25.3	17.9	2.37	(1.57-3.59)	41.5	35.5	1.39	(1.14-1.69)
Portugal	33.8	25.9	19.2	1.65	(1.23-2.21)	46.2	44.5	1.1	(0.94-1.29)
Hungary	32.9	30.8	19.7	3.45	(1.98-6.00)	46.6	37.8	1.53	(1.19-1.96)
Czech Rep.	37.4	51.2	22.0	7.63	(3.45-16.89)	48.3	37.5	2.01	(1.29-3.13)
Slovakia	42.5	41.6	25.7	1.9	(0.69-5.22)	51.9	47.3	1.39	(0.77-2.50)
Lithuania	22.4	19.7	11.1	3.28	(1.89-5.71)	33.8	22.1	2.13	(1.60-2.85)
Latvia	25.0	21.2	13.2	5.02	(1.13-22.26)	33.5	22.9	3.61	(1.39-9.38)
Estonia	28.0	25.9	21.4	3.32	(1.13-4.77)	35.3	24.9	2.13	(1.33-3.44)

[o] Relative Index of Inequality
[1] high educated (upper secondary level or higher)
[2] low educated (no education. primary or lower secondary level)

Among both men and women, higher educated ever-smokers were more likely to have quit than lower educated ever-smokers. Absolute differences in quit ratios between high and low educated men and women were generally larger in the age group of 25-39 years than in the age group 40-59 years. The absolute differences between high and low educated among men 25-39 years differed from 2.4 % in Ireland to 29.2% in Czech Republic. Large variations between countries in absolute gaps were also observed among men 40-59 years old (from 1.7% in Portugal to 20.1% in England), among women 25-39 years (from 1.4% in Portugal up to 26.4% in Sweden) and among women 40-59 years (from 0.1% in Portugal to 20% in Ireland).

Relative inequalities were also largest in the age group of 25-39 years. (Table 3) For men 25-39 years, the largest relative inequalities in quit ratios were found in Czech Republic and Latvia. RIIs were smallest in Ireland and Sweden. For men aged 40-59 years, largest RIIs were found in Latvia, Lithuania and

Estonia. Relative inequalities in this subgroup were smallest in Portugal and Germany. For women aged 25-39 years, largest inequalities in quit ratios were found in Latvia and Hungary, while Portugal had small inequalities in this subgroup. (Table 4) For women aged 40-59 years, the largest relative differences were observed in Denmark and Slovakia, while small inequalities were observed in Latvia and Portugal. (Table 4) Although the size of the relative inequalities varied across countries, confidence intervals of the RIIs for most countries overlap. Therefore, the large differences between countries in size of inequalities might to an important extent be due to chance fluctuations.

Table 4. Educational inequalities in quit ratios - Women

	All ages	25-39 yrs				40-59 yrs			
	Quit ratio	Quit ratio		RII[o]	(95 % C.I.)	Quit ratio		RII[o]	(95 % C.I.)
		high[1]	low[2]			high[1]	low[2]		
Finland	45.8	44.0	20.4	**2.32**	*(1.72-3.14)*	51.9	38.4	**1.70**	*(1.42-2.03)*
Sweden	53.9	53.7	27.3	**2.20**	*(1.57-3.08)*	56.7	42.8	**1.91**	*(1.54-2.37)*
Denmark	37.6	38.4	24.8	**2.78**	*(1.99-3.87)*	41.9	24.4	**2.61**	*(2.08-3.26)*
England	48.3	45.8	25.3	**2.74**	*(2.05-3.67)*	58.6	42.3	**1.68**	*(1.43-1.96)*
Ireland	35.3	33.8	20.1	**3.89**	*(1.85-8.19)*	54.6	34.6	**2.20**	*(1.55-3.13)*
Netherlands	55.0	55.2	33.0	**2.76**	*(2.14-3.56)*	65.2	48.8	**1.70**	*(1.49-1.93)*
Belgium	50.3	50.6	35.6	**2.51**	*(1.92-3.28)*	59.4	42.7	**1.90**	*(1.59-2.28)*
Germany	40.4	35.7	22.6	**3.10**	*(1.80-5.36)*	51.3	42.2	**1.67**	*(1.19-2.36)*
France	53.1	55.7	37.1	**2.19**	*(1.63-2.95)*	58.0	52.7	**1.35**	*(1.10-1.66)*
Italy	38.5	37.9	30.3	**1.86**	*(1.56-2.21)*	44.6	38.4	**1.31**	*(1.18-1.45)*
Spain	30.1	31.3	21.2	**3.16**	*(2.11-4.74)*	36.0	31.4	**1.51**	*(1.11-2.06)*
Portugal	36.2	31.9	30.5	0.96	*(0.69-1.33)*	40.0	39.9	1.19	*(0.84-1.67)*
Hungary	33.4	41.0	17.9	**4.60**	*(2.88-7.36)*	44.5	30.4	**2.05**	*(1.52-2.77)*
Czech Rep.	43.0	51.3	30.3	**3.75**	*(1.62-8.65)*	48.8	36.1	**2.00**	*(1.10-3.61)*
Slovakia	49.4	50.9	29.6	**3.17**	*(1.01-9.90)*	61.6	49.9	**2.45**	*(1.07-5.61)*
Lithuania	27.0	26.9	19.3	1.87	*(0.97-3.60)*	29.5	24.1	1.59	*(0.80-3.14)*
Latvia	26.9	31.6	13.0	**5.57**	*(1.29-24.14)*	31.2	17.8	1.14	*(0.35-3.70)*
Estonia	38.0	40.0	34.2	**2.30**	*(1.25-4.23)*	39.7	31.0	**1.61**	*(1.02-2.54)*

[o] Relative Index of Inequality
[1] high educated (upper secondary level or higher)
[2] low educated (no education. primary or lower secondary level)

Quit ratios were positively associated with score on the TCS. (Figure 1) The association was positive for both the high and low educated group but was somewhat stronger among the higher educated group. The regression-coefficients for high and low educated groups were 0.65 (p-value: 0.004) and 0.57 (p-value:0.014), respectively. This implies that when the score on the TCS increases with 10 points (that is when a country implements more tobacco control policies), the cessation ratio increases in absolute terms with 6.5% and 5.7% in high and low educated groups respectively. The positive association was found consistently for each age-sex group. (Table 5) After adjustment for GDP the associations slightly attenuated but remained in the same direction and were significant for low educated men aged 25-39 years and for high-educated men and women aged 40-59 years. The results do not show consistently stronger associations among one of the two educational levels. The association between score on the TCS and the RII was not significant; regression coefficients were negative for both men age 25-39 years and age 40-59 years (respectively b: -0.32 / b: -0.11) and younger women (b: -0.18), but positive for women age 40-59 years (b: 0.27).

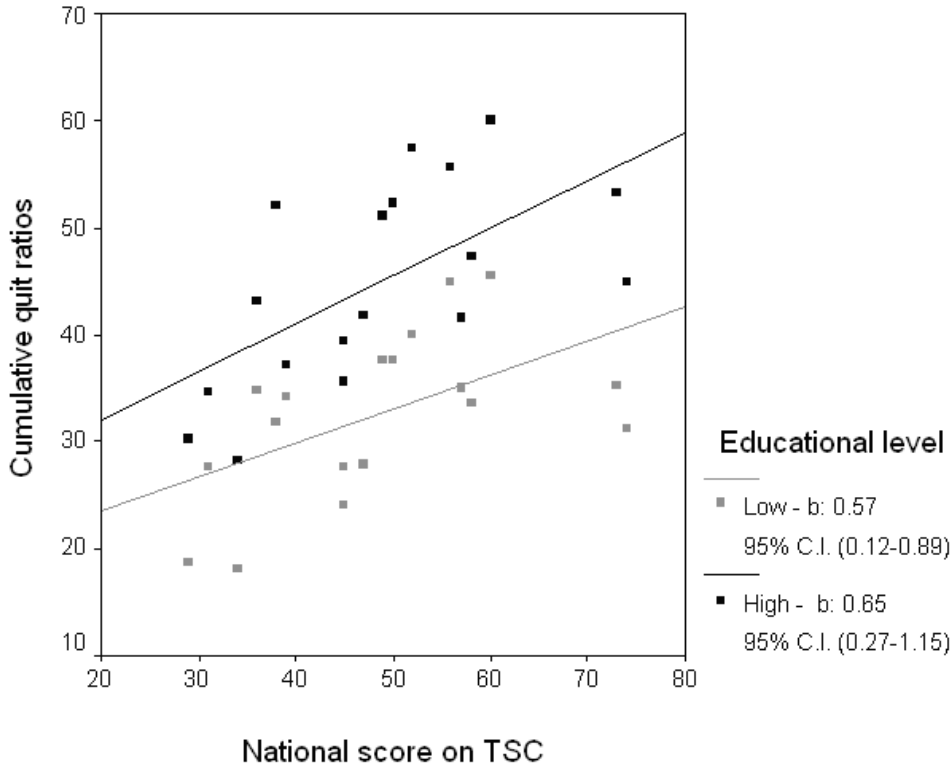

Figure 1. Scatter plot of 18 countries according to their score on the Tobacco Control Scale (TCS) and their quit ratios, for high and low educated; men and women together.

Table 5. Regression coefficients score TCS in model with quit ratios or RII – by age-sex group and educational level

	All ages	25-39 yrs		40-59 yrs	
		high	low	high	low
Men					
β[1] (no control)	0.65	0.43	0.66	0.77	0.51
95% C.I.	(0.37-0.93)	(0.20-0.66)	(0.29-1.03)	(0.54-1.00)	(0.19-0.83)
β[1] (control for GDP)	0.47	0.34	0.59	0.57	0.29
95% C.I.	(0.19-0.75)	(-0.08-0.76)	(0.33-0.85)	(0.36-0.78)	(-0.03-0.61)
Women					
β[1] (no control)	0.55	0.43	0.22	0.67	0.47
95% C.I.	(0.26-0.84)	(0.12-0.74)	(-0.03 - 0.47)	(0.36-0.98)	(0.17-0.77)
β[1] (control for GDP)	0.45	0.4	0.25	0.56	0.24
95% C.I.	(0.13-0.77)	(0.04-0.76)	(-0.04-0.54)	(0.23-0.89)	(-0.11-0.59)

[1] regression coefficient

The TCS is a combination of sub-scores on different tobacco control policies. Table 6 shows the associations with quit ratios for each sub-score. Regression coefficients were standardized to facilitate comparisons between the sub scores. Policies related to cigarette price showed the strongest association with quit ratios. Strong associations with price were found in both educational levels, although not in all age-sex groups. A comprehensive advertising ban showed the next strongest associations with quit ratios in most subgroups. In most age-sex groups, the association was stronger in the higher educated group compared to the lower educated group.

Table 6. Association between national quit ratios and sub scores on TCS adjusted for GDP – by age-sex group and educational level

Men	All		25-39 yrs		40-59 yrs	
			high	low	high	low
Sub scores	β[1]	*95% C.I.*	β[1]	β[1]	β[1]	β[1]
Price	2.08	*(-0.36 - 8.48)*	0.94	2.13	2.83*	2.01
Advertising bans	1.33	*(1.11 - 8.02)*	1.37*	1.47*	1.19*	0.72
Public place bans	0.94	*(-2.43 - 5.89)*	0.73	2.12	1.02	0.77
Treatment	0.74	*(-1.19 - 6.84)*	0.61	0.83	0.98	0.35
Campaign spending	0.54	*(-3.05 - 6.17)*	0.09	0.46	0.89	-0.01
Health warnings	-0.40	*(-7.32 - 2.31)*	-0.13	-0.65	-0.32	-0.18
Women						
Price	2.07	*(-1.09 - 8.66)*	1.48	1.18	2.66*	2.45
Advertising bans	1.59	*(1.39 - 8.67)*	1.56*	1.22	1.42*	0.99
Public place bans	0.41	*(-3.84 - 5.26)*	0.34	0.24	0.89	0.34
Treatment	0.83	*(-1.40 - 7.22)*	0.9	0.46	1.16*	0.53
Campaign spending	0.54	*(-3.52 - 6.41)*	0.31	0.36	0.57	0.40
Health warnings	-0.42	*(-9.51 - 3.43)*	-0.19	-0.77	-0.29	-0.30

* $p < 0.05$

[1]: standardized regression coefficient

Discussion

Summary of results

Higher educated smokers were more likely to have quit smoking than lower educated smokers. Educational inequalities were found for all age-sex groups and in all countries. Inequalities were generally larger in the age group 25-39 years compared to the group of 40-59 years. Quit ratios in all subgroups were positively associated with the national score on the TCS. No consistent differences were observed between higher and lower educated smokers regarding the association of quit ratios with score on the TCS. Of all tobacco control policies of which the TCS is constructed, price policies showed the strongest association with quit ratios in both educational levels, next came advertising ban.

Limitations

An important limitation of our study is the lack of an appropriate time difference in reference periods for the measurements of smoking status and of tobacco control policies. Preferably, the measurement of quit ratios should be subsequent to the measurement of the tobacco control policy. Yet, countries were ranked on the TCS based on information from 2004-5. The surveys on the other hand were conducted between the years 2000 and 2004 in most cases. As there is no appropriate time lag between the measurements of tobacco control policies and smoking behaviour, we should be cautious in drawing conclusions about causality.

Nevertheless, countries with comprehensive tobacco control policies in 2005 are likely to have implemented a more comprehensive tobacco control policy already in the years before. However, recently large changes in tobacco control policies occurred in some areas, especially public place bans, public information spending and health warnings. As a result, the ranking of countries on these three policy areas changed substantially. Comprehensive public place bans, for example, were implemented in some countries in 2003 to 2005. [19] The ranking of countries on other policies like price, advertising bans and treatment has been rather stable over the years. [19] A high correlation (0.66) was observed, for example, between tobacco prices in 1990 and 2005. [20] Therefore, we performed the regression analyses also with a stripped TCS, only including the sub scores on price, advertising bans and treatment. With the 'new' TCS none of the regression coefficients as presented in table 5 changed by more than 0.1 points and the pattern by educational level also remained unchanged; for example, the correlation of quit ratios for all ages with the 'stripped' TCS (adjusted for GDP) was 0.49 (CI: 0.11 – 0.99) for men and 0.53 (CI: 0.08 – 1.04) for women compared to the correlation with the complete TCS (adjusted for GDP) of 0.47 (CI: 0.04 – 0.66) for men and 0.45 (CI: -0.07 – 0.66) for women. This supports the idea that the countries' relative score on the TCS in 2005 is a rough proxy for the comprehensiveness of tobacco control policies over a wider span of years. Furthermore, the association between quit ratios and the sub scores on the TCS is important in this context, since it cuts down the score into different action points.

Since the study of the association with the TCS is based on an ecological design, with 18 countries, we should be aware of confounding by other contextual factors. In the analyses we controlled for the potentially important confounder GDP. GDP did not substantially affect the association between quit ratios and the score on the TCS. The association could also be a reflection of the smoking epidemic. In order to check for this type of confounding, we adjusted in the analyses also for the proportion of ever-smokers in each country. Ever-smoking ratio for men and women age 25-59 was used as a rough proxy of the stage of the smoking epidemic in countries. The association between quit ratios and the TCS did not change substantially after adjustment for ever-smoking ratios, neither did the pattern change according to educational level; for example, after adjustment for ever-smoking there was a correlation of 0.46 (CI: 0.01 – 0.69) for men and 0.30 (CI: -0.16 – 0.57) for women. Since two potentially important confounders did not significantly affect the association, it is unlikely that the association between score on the TCS and quit ratios in this study is completely due to factors unrelated to tobacco control policies.

The TCS is based on information about policies in 2005. Recently implemented policies are not incorporated, such as the ban on smoking in public places in many European countries. The impact of such policies might therefore be underestimated when using the current version of the TCS. Since we only have smoking data up to 2004, we were not able to study the impact of recently implemented policies, even if the TCS would allow for this. For similar reasons, we could not evaluate the potential impact of smoking cessation services, because these services have only recently been implemented systematically on a large scale in a number of European countries. Furthermore, our study (and the TCS) focused on nation-wide tobacco control policies, whereas the availability and accessibility of smoking cessation services may have increased mostly at local levels. Future studies, using an updated TCS, should assess whether newly applied policy instruments are as effective or perhaps more effective than price and advertising bans.

Explanations

In all countries, relative differences in quit ratios between high and low educated smokers were smaller in the age group of 40-59 years than in the group of 25-39 years. The smaller inequalities in the older age group could be an age effect. Several studies showed that smokers are, irrespective their

educational level, more likely to have quit when they become older. [26-28] If the age-related increase in quit ratios is similar in both educational groups, the relative differences between high and low educated smokers among older age groups will become smaller. On the other hand, the difference in inequalities between age groups could also represent a cohort effect. This would suggest that the inequalities in smoking cessation in the older age group have not become smaller with the cohort growing older, but have always been relative small within older generations compared to younger generations. An Italian study indeed found cohort-specific changes in smoking cessation rates. Relative inequalities in smoking cessation in this study increased from a 23% difference between high and low education in the birth cohort 1940-9 to a 30% difference in the birth cohort 1960-9 among men. Among women, inequalities increased from a 13% difference to a 61% difference. [29] In Britain, smoking cessation rates among the non-manual men and women born after about 1955 decline slightly compared to previous birth cohorts, while the rates for men and women in manual classes increased. [30]

Quit ratios were generally higher in northern and western European countries compared to southern and eastern European countries. Studies on smoking prevalence described a similar north-south gradient in the western part of Europe. (Eastern European countries were not included in previous international overviews.) [8, 31-33] The smoking epidemic model also describes this north-south gradient in the diffusion of the smoking habit: higher educated men in northern Europe take the lead in the diffusion, lower educated women in southern Europe are the last to follow.[34] We found a comparable geographical pattern for smoking cessation, with the difference that not only southern Europe, but also eastern European countries lag behind. Our results suggest that changes in smoking cessation are, in addition to changes in smoking initiation, one of the mechanisms through which the smoking epidemic evolves. Especially in later stages of the smoking epidemic, quitting smoking may contribute to differences in smoking prevalence rates among sub-populations and nations.

We observed positive correlations between quit ratios and the national score on the TCS. Countries with a more developed and comprehensive tobacco control policy have higher quit ratios in both high and low educated groups. The higher quit ratios might be a direct consequence of tobacco control policies. This would however not be an effect of the tobacco control policies that were measured with the TCS for 2005, but an effect of policies implemented in

previous years. Most of the countries with comprehensive tobacco control policies in 2005 are likely to have had more comprehensive policies already in the 1990s or perhaps even earlier. The high correlation between tobacco price in 1990 and in 2005 of 0.66 (see the section 'evaluation of data and methods') also supports this view.

The higher quit ratios in countries with comprehensive tobacco control policies could also partly be a consequence of a growing anti-tobacco environment in the society. A growing negative attitude of people towards smoking, and sympathy with anti-tobacco policies like public place bans, will have a direct impact on smoking cessation. Smokers will be discouraged to continue smoking and those who try to quit will be supported. A comparative study by Fong etal. showed that the ban on smoking in public places in Ireland led to more successful quit attempts and more favourable attitudes towards smoke-free laws. [35] Borland etal. showed that the introduction of public place bans led to more smoke-free homes which in their turn were related to more quit attempts.[36]

Of all sub-scores of the TCS, quit ratios were most strongly associated with price policies. This corresponds to the ratings of different tobacco control policies by the expert panel of the TCS and the World Bank, who both judged price policies to be the most effective and important tobacco control measures. [1, 37] Several studies suggest that an increase in tobacco price is a highly effective policy to reduce tobacco consumption, especially among lower socioeconomic groups. [37-40] Our results support the idea that price is effective, but we did not find a difference in impact between high and low education. This might be because we measured prevalence instead of consumption level. An increase in price mainly reduces the number of cigarettes smoked and not so much smoking prevalence rates. [12, 41-43]

Quit ratios were also strongly associated with the sub-score 'advertising bans'. This suggests that advertising ban is one of the most effective tobacco control measures with regard to smoking cessation included in the TCS. Yet, an advertising ban is maybe not so important on its own (the experts allocated only 13 points to this policy in the TCS), but probably particularly important in combination with other elements of tobacco control policies. Comprehensiveness of tobacco control policies determines to an important extent the effectiveness of the policies in terms of smoking cessation.[44]

Our data thus do not suggest that higher educated smokers benefited more of national tobacco control policies than did lower educated smokers. This does not correspond with the finding of earlier studies that observed a larger effect of incidental publicity campaigns among higher socioeconomic groups compared to lower socioeconomic groups. [9, 10] While it is likely that in the 1970s and 1980s higher educated smokers benefited more from the first nation-wide tobacco control policies than did lower educated smokers, our results do not indicate a difference between educational groups in the effect of the more recent tobacco control policies.

Implications

Nation-wide tobacco control policies seem to have a substantial effect on smoking cessation ratios, when comparing different countries. Tobacco control policies need to be comprehensive (including, among other options, price policies and bans on smoking advertisement) to reduce smoking prevalence in all socioeconomic groups. At the same time, since the educational inequalities in quit ratios persisted irrespective of the extent to which national tobacco control policies have been implemented in different European countries, there is a need for special effort to reduce not only absolute levels but also relative inequalities. Specific policies and interventions should aim to foster successful cessation among lower educated smokers. The literature shows that such cessation policies and interventions should be local, proactive, free-of-charge and directly targeted at low socioeconomic groups, to be effective. [39, 41, 45]

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CHAPTER 6
Affordability of cigarettes and smoking by educational level in 14 European countries

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Abstract

Objective – To explore the relation between the affordability of cigarettes, smoking prevalence and smoking consumption levels among lower and higher socioeconomic groups in 14 European countries.

Method – Cross-sectional data were derived from national health surveys from 14 European countries in the early 2000's. For the age group 16-29 years, variables on smoking status (age-standardized prevalence rates, ever-smoking ratios, and smoking continuation ratios) and smoking consumption levels (number of cigarettes smoked per capita and per smoker) were calculated. Affordability of smoking was calculated by adjusting the cigarettes price by national Gross Domestic Product per capita. Regression analyses were used to examine the association, across countries, between affordability of cigarettes and smoking variables.

Results – Large international variations were observed in all smoking variables among both men and women. A negative correlation was found between cigarette price and all smoking variables among men, with less favourable smoking outcomes in countries where cigarettes were more affordable. The association with cigarette affordability was strongest for ever-smoking (correlation -0.48). For each smoking variable, associations were stronger in the less educated group compared with the higher educated group. None of the associations were statistically significant, possibly due to the small number of countries included. Associations among women were weak and less consistent, mainly due to a positive association between affordability and ever-smoking rates among lower educated women.

Conclusions – The results for men, but not for women, suggest that the affordability of cigarettes affects several aspects of smoking, especially among lower socioeconomic groups.

Introduction

One of the first tobacco control policies implemented in most countries was taxation on cigarettes. In the 17th century, James I of England was probably the first to raise smoking-related prices when he increased tobacco tax from 2 to 82 pence per pound, thus making tobacco even more expensive than silver [1]. Increasing tobacco price is found to be effective in decreasing cigarette consumption. Supporting evidence comes from several national trend studies that observed an inverse association between price increases and tobacco consumption rates [2-4], In the construction of the Tobacco Control Scale (TCS), price policies were judged to be the most effective and important component of national tobacco control policies [5]. It has been suggested that smokers from lower socioeconomic groups would be more price sensitive than smokers from higher socioeconomic groups, and that price increases would therefore be an effective method to tackle smoking inequalities. However, the evidence for such a relationship has been challenged, due to lack of consistent evidence [6] Whereas some studies concluded that a high tobacco price could decrease smoking inequalities, others found no effect or even an opposite effect, i.e. price increases might lead to larger socioeconomic inequalities in smoking [6]. Variations in the observed effect of price on smoking suggest a large potential for confounding by other factors that vary over time or between countries. The potential effect of confounding is enhanced by the development of the smoking epidemic since the 1960s [7]. For example, if a decrease in smoking prevalence rates occurred as an "autonomous" trend inherent to the fourth stage of the smoking epidemic, and if this trend coincided with an increase in tobacco price, the observed association between price and smoking would not, or only partially, reflect a causal effect. Most studies on the effect of tobacco price have examined the relation between consumption level and tobacco price. Some studies observed that an increase in price was associated with a decrease in the number of cigarettes smoked per smoker, but not with a decrease in smoking prevalence rates [8, 9]. This suggests that the effect of price on smoking, including inequalities in smoking according to socioeconomic status (SES), is likely to vary according to the aspect of smoking studied. This variability could explain some of the inconsistencies found in various studies on the effect of price [6]. Moreover, the effect of confounders could differ for the various aspects of smoking. For example, trends related to the smoking

epidemic are most pronounced for smoking initiation and for smoking prevalence rates, and less so for smoking cessation rates or for the average cigarettes consumed per smoker. Therefore, it is important to distinguish between the different aspects of smoking in studies exploring the effect of price on smoking according to SES.

This international study explores the relation between the affordability of cigarettes and tobacco consumption across 14 European countries, with special emphasis on differences between socioeconomic groups. First, we assessed international variations in smoking status (both smoking prevalence rates, ever-smoking ratios, and smoking continuation ratios) and smoking consumption levels (per smoker and per capita) according to educational level. We then assessed the association, across the 14 countries, between these various measures of smoking and a measure of cigarette affordability, based on price information. To our knowledge, this is the first study of the effects of cigarette affordability on smoking in different socioeconomic groups that considers various aspects of smoking behaviour.

Methods

Study population

For 14 European countries, reliable and recent data on various aspects of smoking behaviour were available from nationally representative surveys. Micro-level data were extracted from the surveys of these 14 European countries. Data were provided by national statistical offices or national public health institutes (Table 1).

Table 1. Sample sizes by country and educational level, men and women (age 16-29 years)

			Men			Women		
			N (smokers + non-smokers)			N (smokers + non-smokers)		
	Price in € ('95-'00)	GDP* in € ('95-'00)	All	More educated	Less educated	All	More educated	Less educated
Finland	3.66	22100	2293	299	1994	2781	524	2257
Sweden	4.01	25750	1278	304	974	1218	300	918
Denmark	4.00	29200	1670	271	1399	1633	356	1277
England	4.58	20600	1184	332	852	1490	369	1121
Ireland	3.87	20467	884	146	738	826	197	629
Netherlands	2.29	22900	1507	265	1242	1526	329	1197
Belgium	2.56	22433	1641	574	1067	1760	806	954
Germany	2.73	23950	629	435	194	626	488	138
France	2.89	21717	1484	519	965	1482	675	807
Italy	1.85	18467	12937	437	12500	12522	700	11822
Spain	1.11	13417	2701	445	2256	2482	491	1991
Portugal	1.56	10233	4644	679	3965	4290	1012	3278
Hungary	0.45	4050	1126	95	1031	1188	163	1025
Latvia	0.32	2433	246	48	198	274	83	191
Total			34224	4849	29375	34098	6493	27605

* GDP: Gross Domestic Product

Most surveys were conducted in or after the year 2000, except for the German and Portuguese surveys which were conducted in 1998/1999. Sample sizes were above 4500 respondents for each country, except for Latvia. Non-response rates were relatively low in Italy and Spain (about 15%) and high in the Netherlands and Belgium (42%). Rates in most other countries were between 20 and 35%. In total, data from 68,322 respondents aged 16-29 years were included in the analyses. We did not include older age groups, because of the lack of internationally comparable data on the price of cigarettes by the time that these older generations started smoking (i.e. before about 1990).

Measures

We calculated various measures of smoking status (age-standardized prevalence rates, ever-smoking ratios, and smoking continuation ratios) and smoking consumption levels (number of cigarettes smoked per capita and per smoker).

Estimates for these measures were derived from self-reports about smoking in the surveys. In all surveys, respondents could be classified according to their smoking status as 'current daily smoker', 'occasional smoker', 'former smoker' or 'never smoker'. 'Occasional smokers' were not included in the analyses because it was not clear from the data of most surveys whether they had ever been daily smokers. Furthermore, occasional smokers differ from current daily smokers in terms of SES and health consequences related to smoking [10].

Using these data, smoking prevalence rates were calculated as the total number of current smokers divided by the total number of respondents. Cumulative ever-smoking ratios were calculated as the ratio of the number of ever-smokers divided by the total number of respondents (both ever and never smokers). Smoking continuation ratios were calculated as the prevalence rates divided by the cumulative ever-smoking ratios. This is equivalent to dividing the number of current smokers by the number of ever-smokers.Data on tobacco consumption levels were available for surveys from 11 countries. In each survey, the consumption levels of smokers was measured as number of cigarettes smoked per day. Based on these data, consumption levels were measured at two levels: as consumption per capita (average number of cigarettes/respondent) and as consumption per smoker (cigarettes/smoker). The average consumption per capita was calculated as the consumption per smoker times the smoking prevalence rates. Educational level was measured by the highest level of completed education of the respondent. The level of education was initially classified according to national categories, which were subsequently reclassified into four levels of education (1=none or only primary, 2=lower secondary, 3=upper secondary and post secondary non-tertiary, 4=tertiary). These levels corresponded with the International Standard Classification of Education (ISCED) as follows: 1=ISCED 0-1, 2=ISCED 2, 3=ISCED 3-4, and 4=ISCED 5-6. In the analyses we distinguished two educational levels: high educated (level 4) or less educated (levels 1, 2 and 3 combined). Because of very small numbers in level 4 in Italy, Spain, Portugal and Germany, for these countries the group of high educated smokers also included those with level 3.Data on cigarette prices were obtained for the years 1995-2000. Information on cigarette prices was obtained from sources of the Tobacco Manufacturing Association (TMA) for western European countries. Price information for Hungary and Latvia was obtained from documents of the World Bank and the National Statistical Office of Latvia [11, 12].

Price information was adjusted with information on gross domestic product per capita (GDP) in order to obtain estimates of the affordability of cigarettes. In some of the analyses, we divided price per cigarette package by the national level of GDP. In other analyses, we controlled for GDP within regression models. National figures of GDP were obtained for the years 1995-2000 on average. GDP was taken because it is the most often used measure of (international variation in) national living standards [13].

Statistical analyses

First, age-standardized prevalence rates and ratios were calculated for each of the five smoking variables, according to country, sex and educational level. The direct method of age standardization was used, with the European standard population of 1995 as the standard population. In the second step, we calculated the association, across countries, between the various smoking variables and the price of cigarettes. For this, we applied linear ordinary least-squares (OLS) regression analysis, with countries as units of observation. In the regression model we controlled for the log of GDP.

Results

Large international variations were observed in all smoking variables among both men and women. Age-standardized smoking prevalence rates among men were about 30-40% in most countries. Exceptions were Sweden with very low rates (14.9%), and Spain (43%), Hungary (44.8%) and Latvia (58.3%) with relatively high prevalence rates (Table 2a). Among women age-standardized prevalence rates were relatively low in Portugal (16.9%) and Sweden (19.5%), and high in Spain (39.6%) and England (34.5%) (Table 2b). On average, 50% of the respondents had ever smoked, with somewhat lower rates among women compared to men. The majority of people who had ever smoked still smoked by the time of the survey. Smoking continuation rates among men were especially high in Germany, Spain and Italy (rates over 80%); among women smoking continuation rates were also high in these three countries (70% or higher). In most countries women were more likely to have stopped smoking than men.

Table 2a. Smoking prevalence rates by educational level: Men

	Current smoking[1]			Ever smoking[2]			Smoking continuation[3]		
	All	More educated	Less educated	All	More educated	Less educated	All	More educated	Less educated
Finland	30.5	11.5	34.5	50.3	31.9	54.6	60.6	36.1	63.2
Sweden	14.9	6.4	17.9	30.0	14.1	36.5	49.7	45.4	49.0
Denmark	33.9	21.4	37.6	46.7	35.0	49.7	72.6	61.1	75.7
England	35.9	33.3	38.2	51.2	49.1	52.2	70.1	67.8	73.2
Ireland	28.2	16.9	31.3	41.5	30.1	44.4	68.0	56.1	70.5
Netherlands	29.9	14.2	34.6	57.4	43.7	60.9	52.1	32.5	56.8
Belgium	33.6	21.6	41.7	55.3	47.5	60.9	60.8	45.5	68.5
Germany	39.9	34.8	54.3	46.4	40.1	61.8	86.0	86.8	87.9
France	38.4	25.8	48.8	52.6	41.3	62.1	73.0	62.5	78.6
Italy	37.1	31.5	46.9	45.6	40.3	55.0	81.4	78.2	85.3
Spain	43.0	34.3	55.1	53.6	45.8	64.5	80.2	74.9	85.4
Portugal	38.7	28.3	45.8	49.0	38.4	56.3	79.0	73.7	81.3
Hungary	44.8	18.5	47.3	58.7	43.0	60.3	76.3	43.0	78.4
Latvia	58.3	39.9	67.5	73.4	57.8	80.6	79.4	69.0	83.7

[1] Current smokers/100 respondents (Age standardized)
[2] Ever-smokers/100 respondents (Age standardized)
[3] Current smokers/100 ever-smokers (Age standardized)

Table 2b. Smoking prevalence rates by educational level: Women

	Current smoking[1]			Ever smoking[2]			Smoking continuation[3]		
	All	More educated	Less educated	All	More educated	Less educated	All	More educated	Less educated
Finland	22.5	8.7	26.5	43.9	26.9	48.5	51.3	32.3	54.6
Sweden	19.5	6.4	25.4	34.4	18.7	41.2	56.7	34.2	61.7
Denmark	29.4	18.8	33.3	47.7	40.3	50.9	61.6	46.7	65.4
England	34.5	27.9	38.6	52.9	45.4	57.0	65.2	61.5	67.7
Ireland	28.3	20.4	32.3	43.6	36.3	47.3	64.9	56.2	68.3
Netherlands	26.5	13.5	31.7	54.6	42.6	59.1	48.5	31.7	53.6
Belgium	24.0	17.7	30.4	48.5	43.0	54.4	49.5	41.2	55.9
Germany	30.8	29.1	38.8	37.2	35.8	44.2	82.8	81.3	87.8
France	28.9	23.7	35.8	47.1	41.8	54.0	61.4	56.7	66.3
Italy	20.1	18.8	23.7	27.7	26.3	31.7	72.6	71.5	74.8
Spain	39.6	32.6	50.2	53.2	47.8	61.5	74.4	68.2	81.6
Portugal	16.9	15.8	18.7	26.4	25.8	28.1	64.0	61.2	66.5
Hungary	29.8	13.4	32.5	46.8	22.9	50.5	63.7	58.5	64.4
Latvia	26.4	13.7	34.8	45.5	36.6	52.5	58.0	37.4	66.3

[1] Current smokers/100 respondents (Age standardized)
[2] Ever-smokers/100 respondents (Age standardized)
[3] Current smokers/100 ever-smokers (Age standardized)

All smoking variables varied according to educational level. The magnitude of inequalities was similar among men and women. Prevalence rates among less educated groups were 1.5 to 3 times higher than among high educated groups. Ever-smoking rates and smoking continuation rates were about 1.5 and 1.3 times higher, respectively, among less educated groups (Table 2a and 2b). On average, male smokers in Europe smoked 13.5 cigarettes per day. Consumption levels per smoker were relatively high in Germany (17.8 cig/day), and low in France (10.1 cig/day) and Latvia (10.4 cig/day) (Table 3a). On average, female smokers smoked fewer cigarettes per day than male smokers (11 cig/day) (Table 3b). Relatively high levels of consumption were observed among German (14.6 cig/day) and Danish (13.6 cig/day) women, whereas relatively few cigarettes were consumed in Latvia (8.0 cig/day). Among men, number of cigarettes per capita (i.e. the number of cigarettes per smoker, multiplied with smoking prevalence rates) was high in Germany (7.1 cig/day), Spain and Latvia (both 6.1 cig/day). Low levels were observed in the Netherlands, Belgium and France (all 3.9 cig/day). Among women, number of cigarettes per capita was relatively high in Germany and Spain (both 4.5 cig/day), and low in Italy and Portugal (both 1.9 cig/day).

Table 3a. Consumption level by educational level: Men

	Cigarettes per capita			Cigarettes per smoker		
	All	More educated	Less educated	All	More educated	Less educated
Finland	16.1	4.4	1.9	14.3	16.1	13.8
Denmark	16.1	5.4	2.9	15.9	13.4	15.6
England	12.6	4.1	3.8	11.5	11.5	11.1
Ireland	15.6	3.9	2.8	13.7	16.6	13.1
Netherlands	14.2	3.9	1.9	13.1	13.3	12.5
Germany	18.2	7.1	6.0	17.8	17.3	17.6
France	11.5	3.9	2.6	10.0	9.9	9.3
Italy	4.6	3.9	5.4	12.5	12.3	11.6
Spain	6.1	4.8	7.5	14.2	14.1	13.6
Portugal	5.7	3.2	7.5	14.6	11.3	16.5
Latvia	13.2	6.1	5.0	10.4	12.5	9.4

Table 3b. Consumption level by educational level: Women

	Cigarettes per capita			Cigarettes per smoker		
	All	More educated	Less educated	All	More educated	Less educated
Finland	11.4	2.5	1.0	11.1	11.5	10.9
Denmark	14.0	4.0	2.3	13.6	12.2	13.5
England	11.3	3.5	2.0	10.1	7.2	10.4
Ireland	13.7	3.4	2.6	12.0	12.7	11.1
Netherlands	12.2	3.0	1.6	11.3	11.9	10.7
Germany	15.1	4.5	4.1	14.6	14.1	14.9
France	10.4	2.7	2.2	9.3	9.3	8.7
Italy	1.9	1.8	2.0	9.5	9.6	8.4
Spain	4.5	3.8	5.5	11.4	11.7	11.0
.0Portugal	1.9	1.4	2.4	11.2	8.9	12.8
Latvia	9.6	2.1	1.0	8.0	7.3	7.5

In men, the number of cigarettes per smoker was generally higher among high educated smokers as compared to less educated smokers. Only in Denmark, Germany and Portugal did less educated smokers smoke more cigarettes per day. Absolute inequalities varied widely across countries; in Ireland high educated men smoked 3.5 cigarettes more per day than low educated men, while in Portugal they smoked about 5 cigarettes per day less than low educated smokers. Among women, inequalities also varied substantially across countries. In one half of the countries, high educated women smoked more cigarettes a day as compared to less educated women.

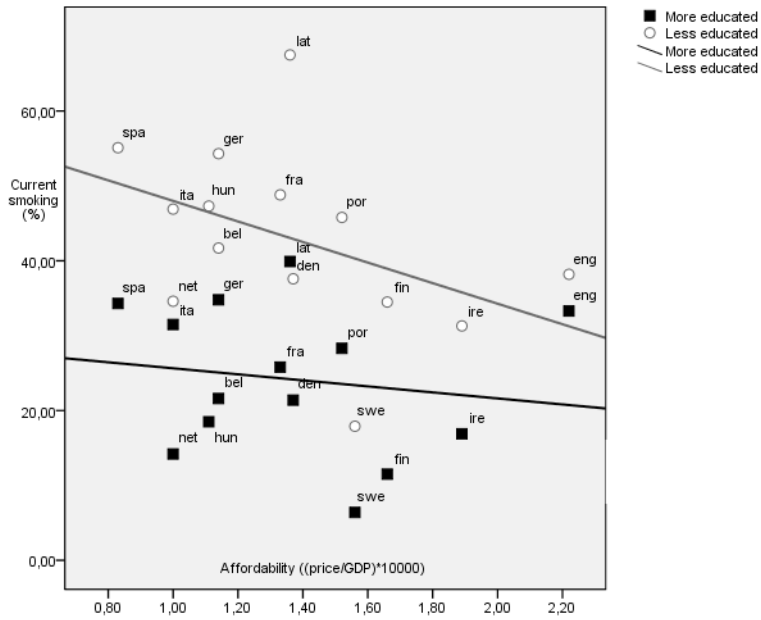

Figure 1: Current smoking rates in relation to affordability by educational level: Men

Among men, smoking prevalence rates were negatively associated with price of cigarettes (Figure 1). In countries with a relatively high cigarette price (adjusted for GDP), smoking prevalence rates, ever-smoking ratios and smoking continuation ratios were lower, and smokers consumed less cigarettes on average. The associations with affordability were relatively weak for the amount of cigarettes per smoker.

Associations with the affordability of cigarettes were strongest among less educated men (Tables 4 and 5). The strongest correlations among low educated men were observed with rates of ever smoking (correlation: -0.48) and smoking prevalence (correlation: -0.45). Regression-based estimates of effect for these two variables were -4.77 and -5.61, respectively, implying that with every one euro increase in the price of cigarettes, ever-smoking rates and smoking prevalence rates would drop by about 4.7% points and 5.6% points, respectively. The 95% confidence intervals (CI) for these two estimates just include the 0-value, implying borderline non-significance. Among high educated men, these effect estimates are considerably smaller, especially

for smoking prevalence. The 95% CI's for the high and lower educated men overlap, implying that the differences cannot be demonstrated with statistical significance.

Table 4. Association between affordability of cigarettes and smoking status (14 countries)

	More educated			Less educated		
	correlation with price*	β[1]	95% C.I.	correlation w with price*	β[1]	95% C.I.
MEN						
Current smoking	**-0.16**	**-2.37**	**-9.65 to 4.91**	**-0.45**	**-5.61**	**-12.23 to 1.01**
Ever smoking	**-0.26**	**-2.80**	**-9.66 to 4.05**	**-0.48**	**-4.77**	**-10.30 to 0.76**
Smoking continuation	**-0.08**	**-3.62**	**-16.97 to 9.74**	**-0.30**	**-4.62**	**-12.62 to 3.37**
WOMEN						
Current smoking	**-0.09**	**-2.00**	**-7.95 to 3.94**	**-0.19**	**-0.82**	**-7.03 to 5.39**
Ever smoking	**-0.07**	**-1.16**	**-8.47 to 6.15**	**-0.08**	**0.85**	**-6.98 to 8.69**
Smoking continuation	**-0.14**	**-5.78**	**-17.99 to 6.42**	**-0.22**	**-3.16**	**-10.68 to 4.36**

*** correlation with (price/gdp)*10000**

[1] regression coefficient adjusted for log GDP ('95-'00)

Table 5. Association between affordability of cigarettes and consumption level (11 countries)

	More educated			Less educated		
	correlation with price*	β[1]	*95% C.I.*	correlation with price*	β[1]	*95% C.I.*
MEN						
Cigarettes per capita	-0.27	-0.30	*-1.39 to 0.80*	-0.34	-0.91	*-2.29 to 0.47*
Cigarettes per smoker	-0.02	0.12	*-1.97 to 2.22*	-0.10	-0.59	*-2.86 to 1.69*
Current smoking	-0.19	-1.55	*-8.57 to 5.46*	-0.47	-4.42	*-10.35 to 1.51*
WOMEN						
Cigarettes per capita	-0.01	-0.36	*-1.19 to 0.47*	-0.40	-0.11	*-1.17 to 0.95*
Cigarettes per smoker	-0.33	-0.75	*-2.32 to 0.83*	0.03	-0.07	*-1.85 to 1.71*
Current smoking	-0.09	-1.18	*-7.73 to 5.37*	-0.19	-0.42	*-8.14 to 7.30*

* corellation with (price/gdp) x 10000

[1] regression coefficient adjusted for log GDP ('95-'00)

Among women, similar to men, a negative association was found between price (adjusted for GDP) and current smoking rates (Figure 2). However, the associations between the different smoking variables and price of cigarettes among women were weaker and less consistent (Tables 4 and 5). For ever smoking, the regression-based estimate of effect was small for high educated women (-1.16) and even positive for less educated women (0.85). The latter coefficient implies higher rates of ever smoking among low educated women in countries with higher prices. As a result of these small and even inverse effects for ever smoking, associations with current smoking and with smoking per capita were weak too. Also, for the same variable, the effect of price was not larger for less educated women compared to high educated women.

On the other hand, rates of smoking continuation show a similar relationship with cigarette affordability for women as for men. The regression estimates of about -4 suggest that an increase in the price of cigarettes by one euro would decrease smoking continuation rates (i.e. increase smoking cessation rates) by about 4%. No evidence was found for a greater effect on smoking cessation rates among less educated women compared to high educated women.

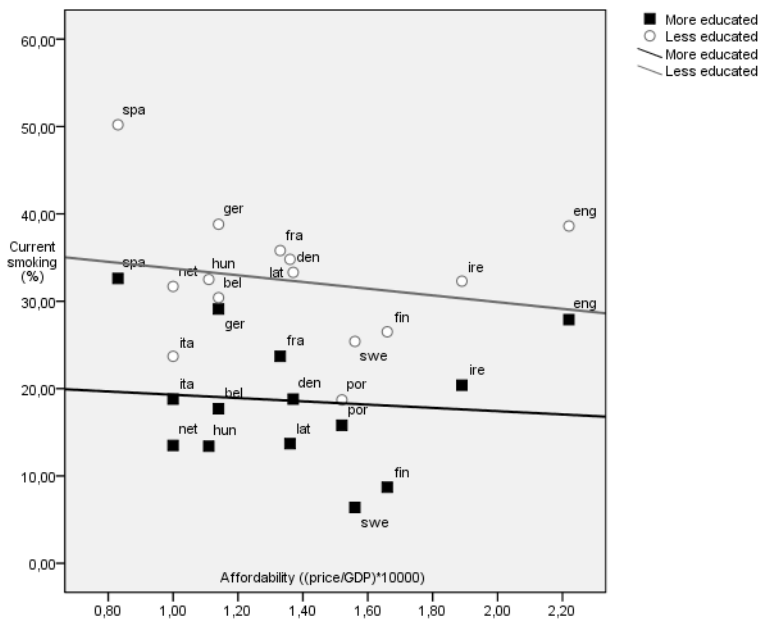

Figure 2. Current smoking rates in relation to affordability by educational level: Women

Discussion

Summary of the results

Large international variations were observed for different aspects of smoking, among both men and women in the age group of 16-29 years. For men, cigarette affordability was associated with both smoking status (current smoking prevalence, ever smoking, smoking cessation) and to a lesser extent with the number of cigarettes consumed. Especially for ever smoking and current smoking, stronger associations were observed among the less educated men. For women the association of affordability with most of the smoking variables was weak, especially for ever smoking. No evidence was found for a greater effect on smoking among less educated women as compared to high educated women.

Evaluation of data and methods

Non-response percentages were high in some countries. Non-response could have biased our study results had educational level and smoking variables been unequally distributed among respondents and non-respondents. Unfortunately, detailed information of the non-respondents was not available for most national surveys. Some studies reported that non-respondents have on average a lower educational level and unhealthier lifestyle [14, 15]. However, others concluded that even though non-response is related to SES, the association between smoking and SES would not change substantially if non-respondents had been included [16-18]. None the less, in the present study we cannot exclude the possibility of some non-response bias in our estimates of absolute levels or educational inequalities in some of the smoking variables. Another limitation relates to the data on price. For western European countries price data were derived from the TMA. However, this source did not give price data for the years 1995-2000 for eastern European countries. For Hungary and Latvia, we were able to extract that information from reports of the World Bank and the WHO. It is possible that price is not measured in exactly the same way in the different sources. If so, this could to some extent have biased our assessment of the associations with price. Unfortunately, no other historical price data were available for Hungary and Latvia to evaluate the possible bias.

Our association analysis was based on the comparison of 14 countries, or 11 countries in the study of the amount of cigarettes consumed. The acquisition of comparable data from national surveys of 14 countries involved a huge effort, and represents an important advancement in the analysis of socioeconomic inequalities in different aspects of smoking. Having said this, we must recognise that the number of 14 or 11 countries still represents a relatively small sample for a study aiming to assess associations with national characteristics such as price level. This small number, together with the great variability between countries in many other aspects, affected our ability to demonstrate associations between smoking and price with statistical significance. The correlations observed in the present study must therefore be interpreted with caution, especially when used to make inferences about generalized relationships.

Explanations

We observed large international variations in all smoking variables for men and women aged 16-29 years. Whereas earlier studies observed a strong north-south gradient in the pattern of inequalities in smoking prevalence and ever-smoking rates [19-22], we found no consistent geographic pattern for any of these smoking variables. This discrepancy in findings may be explained with reference to the smoking epidemic, which is known to have started later in southern Europe than in northern Europe. This delay in southern countries resulted in a marked north-south gradient within Europe, both for overall smoking rates and for inequalities in smoking, particularly among women. The lack of clear geographical gradients in our study suggests that, for the young generation studied here, most countries in Europe had reached the last stage of the smoking epidemic by the early 2000's. This stage is characterised by a relative stability in trends in (inequalities in) smoking rates. Vestiges of the old pattern can however still be found in lower rates of current smoking by young women in Italy and especially in Portugal.

Whereas associations with cigarette affordability were found to be in the expected direction for men, the associations for women were not as consistent. Anomalous were the positive associations between price and ever-smoking rates among less educated women. This result possibly illustrates the large potential for confounding in trend or comparative studies [6]. An earlier study

showed that economic development and socio-cultural factors were important correlates of smoking initiation rates of women in different European countries. Women's emancipation and the broader process of individualization were probably important in fostering the uptake of smoking among women, particularly among less educated women [23, 24]. International variations in these processes, which cannot be effectively taken into account by controlling for a simple measure such as GDP, may have confounded the association between tobacco price and women's ever-smoking and current smoking rates.

If confounding bias had affected the results for women, it may also have played a role in men. We should however note that, for men, the results were more consistent across the different smoking variables. The potential for confounding may be less for men compared with women, because young men in all countries had already reached the last stage of the smoking epidemic. In this stage, broader economic and socio-cultural processes may no longer be the predominant factors behind international variations. This would imply that the role of specific national factors, such as national tobacco control policies, may be more easy to detect. If so, the results provide evidence to suggest that, among men, less educated smokers would be more price-sensitive than high educated smokers. However, as the differences between the two groups were not significant, the evidence for a differential effect is weak. This is in line with the recent review that concluded that price might be effective in reducing smoking inequalities, but that strong evidence to empirically support this widely held expectation is lacking [2, 25].

Implications

This study has provided evidence that cigarette price is inversely associated with smoking of younger generations, including measures of smoking cessation and smoking initiation. The results also suggested that the effect of price is larger among lower educated persons. However, the latter evidence is weak and limited to men. This is not to deny that price policies may contribute to tackling inequalities in smoking among younger generations. However, increasing cigarette prices alone may not to be sufficient, and other tobacco control measures should be considered as well [26, 27]. Comprehensive, equity-oriented tobacco control policies should for example include measures aimed to help poor smokers who, for either health or financial reasons, want to stop smoking [28].

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CHAPTER 7

Socioeconomic inequalities in lung cancer mortality in 16 European populations

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Abstract

Background – This paper aims to describe socioeconomic inequalities in lung cancer mortality in Europe and to get further insight into socioeconomic inequalities in lung cancer mortality in different European populations by relating these to socioeconomic inequalities in overall mortality and smoking within the same or reference populations. Particular attention is paid to inequalities in eastern European and Baltic countries.

Methods – Data were obtained from mortality registers, population censuses and health interview surveys in 16 European populations. Educational inequalities in lung cancer and total mortality were assessed by direct standardization and calculation of two indices of inequality: the Relative Index of Inequality (RII) and the Slope Index of Inequality (SII). SIIs were used to calculate the contribution of inequalities in lung cancer mortality to inequalities in total mortality. Indices of inequality in lung cancer mortality in the age group 40-59 years were compared with indices of inequalities in smoking taking into account a time lag of 20 years.

Results – The pattern of inequalities in eastern European and Baltic countries is more or less similar as the one observed in the northern countries. Among men educational inequalities are largest in the eastern European and Baltic countries. Among women they are largest in northern European countries. Whereas among southern European women lung cancer mortality rates are still higher among the high educated, we observe a negative association between smoking and education among young female adults. The contribution of lung cancer mortality inequalities to total mortality inequalities is in most male populations more than 10%. Important smoking inequalities are observed among young adults in all populations. In Sweden, Hungary and the Czech Republic smoking inequalities among young adult women are larger than lung cancer mortality inequalities among women aged 20 years older.

Conclusion – Important socioeconomic inequalities exist in lung cancer mortality in Europe. They are consistent with the geographical spread of the smoking epidemic. In the next decades socioeconomic inequalities in lung cancer mortality are likely to persist and even increase among women. In southern European countries we may expect a reversal from a positive to a negative association between socioeconomic status and lung cancer mortality. Continuous efforts are necessary to tackle socioeconomic inequalities in lung cancer mortality in all European countries.

Introduction

Lung cancer in Europe is still the most common cancer related cause of death with an estimated 334,800 deaths (19,7% from total cancer mortality) in 2006 [1]. Even though lung cancer mortality in men has been declining since the late 1980s, female lung cancer mortality is still increasing in many European countries [2,3]. Trends also show important country variations [4].Some studies have assessed socioeconomic inequalities in overall mortality and cause-specific mortality in a range of European countries [5,6]. The relationship between lung cancer mortality and socioeconomic status has also been investigated in several individual countries, both in Europe [7-9] and elsewhere [10,11]. In most countries a low education was found to be an independent risk factor for lung cancer and/or lung cancer mortality. One study conducted a systematic analysis of variations between countries in the size and pattern of socioeconomic inequalities in lung cancer mortality, using data from 10 European populations, collected in the first half of the '90s [12]. This study demonstrated consistently higher lung cancer mortality rates among the "lower" educated men and women in northern and western Europe and an inverse or less pronounced socioeconomic gradient in some southern European populations.

As lung cancer continues to be an unabated pandemic, further research of inequalities in lung cancer mortality remains an important issue.

Even though previous cross-European studies have put into evidence an important north-south gradient in socioeconomic inequalities both in lung cancer mortality and smoking [12] [13], and related this to the theory of the smoking epidemic [14], there is need to focus further on regional differences in lung cancer mortality inequalities in Europe by including also eastern European and Baltic countries. One particular point of interest is to find out if the smoking epidemic in eastern European countries spreads through populations in a similar way as is the case in other European countries. As studies on socioeconomic inequalities in smoking have now been published for over two decades and recommendations to tackle inequalities in smoking have been suggested [15], there is also need to verify if there are any indications that inequalities in lung cancer mortality in Europe will in the future decrease, or on the contrary, will continue to persist.

In this paper we present new European results on socioeconomic inequalities in lung cancer mortality, based on recent and extensive datasets, collected in 16 European populations. More specifically the objectives of the paper are: (1) to describe socioeconomic inequalities in lung cancer mortality in a wide range of European population groups, including eastern and central European countries; (2) to assess the contribution of lung cancer to inequalities in total mortality (3); to get further insight into socioeconomic inequalities in lung cancer mortality in different European populations by relating these to socioeconomic inequalities in smoking practices within the same or reference populations.Cigarette smoking is indeed the major cause of lung cancer, and most lung cancers have historically occurred among current cigarette smokers or recent quitters. As population patterns in smoking prevalence will continue to be the most powerful predictor of the future occurrence of lung cancer [16], smoking data could give clues about the future evolution of socioeconomic inequalities in lung cancer mortality. In some birth cohorts also other environmental and occupational factors may have contributed to the present international patterns of socioeconomic differences in lung cancer mortality. In such case the relation between lung cancer mortality inequalities and former smoking inequalities may be less clear-cut. Knowledge of the contribution of lung cancer to inequalities in total mortality is important to identify populations in which a reduction of the inequalities in lung cancer mortality will also have a substantial impact on inequalities in total mortality. Previous research has shown that the contribution of lung cancer mortality to the difference between manual and non-manual classes in total mortality varies substantially from one country to another [17]. This study allowed us to investigate the impact of lung cancer mortality on the overall socioeconomic inequalities in mortality with another socioeconomic measure and in a larger number of countries.

The study was conducted in the framework of the EUROTHINE project1 that aimed to help policy-makers at the European and national level to develop rational strategies for tackling socioeconomic inequalities in health. Global results of this project, based on international comparisons of socioeconomic inequalities in mortality and morbidity in many European countries, have been presented elsewhere [18].

1 www.eurothine.org

Methods

Data

Data on lung cancer mortality, total mortality and socioeconomic status were available for 16 countries or regions, including four eastern European and two Baltic countries. Table 1 describes the data sources and some characteristics of the data collection. Most data sources were situated at the national level, but also regional and big urban populations (Basque Country, Barcelona, Madrid, Turin) were included. The majority of networks provided longitudinal data. In Barcelona a record linkage was done between the mortality register and the census data [19]. A similar approach was used in Madrid and the Basque country. In those populations it was not possible to achieve a 100% linkage between the population and death registries. In Madrid, this was particularly a problem: circa 30% of mortality records could not be linked. No variation in this percentage was found according to age, sex, or socioeconomic status, therefore, estimates of relative inequalities in mortality are not likely to be biased to an important extent. Absolute estimates for Madrid were corrected by using weighted numbers of death with a weighting factor equaling 1/0,7=1,428571. In the Czech Republic, Estonia, Hungary, Lithuania and Poland unlinked cross sectional data were used.

In order to compare results on mortality from longitudinal and cross sectional data sets for similar age groups we grouped the data according to the average age of death, also for countries with longitudinal data sets, even if in the latter case it would have been more logical to do this based on age cohorts. The analyses were restricted to age groups with an average age at death between 40 and 79 years.

Table 1. Data sources in the populations understudy

Population	Type of mortality data	Follow-up period	Person years at risk	Data sources used for comparison with socioeconomic inequalities on smoking	Year(s) of survey(s)	Sample size
Finland	Longitudinal	1990-00	27550171	Finbalt Health Monitor	94/98/00/02/04	20371
Sweden	Longitudinal	1991-00	48340986	Swedish Survey of Living Conditions	00/01	11484
Norway	Longitudinal	1990-00	22262277	Norwegian Survey of Living Conditions	02	6820
Denmark	Longitudinal	1996-00	15354602	Danish Health and Morbidity Survey	00	16690
Belgium	Longitudinal	1991-95	27635206	Health Interview Survey	97/01	18481
Switzerland	Longitudinal	1990-00	30728441	Not available	-	
Turin	Longitudinal	1991-01	5287281	Health and health care utilization survey Italy	99/00	118245
Basque Country	Longitudinal	1996-01	6457258	Basque Health Interview Survey	97/02	12443
Barcelona	Longitudinal	1992-01	8915780	Health Interview Survey Barcelona	00	10045
Madrid	Longitudinal	1996-97	4664793	National Health Survey	01	20748
Slovenia	Longitudinal	1991-00	10325538	Not available		
Hungary	CS unlinked	1999-02	24953908	National Health Interview Survey	00/03	10532
Czech Rep.	CS unlinked	1999-03	30308765	Sample Survey of the Health Status of the Czech Pop.	02	2476
Poland	CS unlinked	2001-03	65844117	Not available	-	
Lithuania	CS unlinked	2000-02	6189927	Finbalt Health Monitor	94/98/00/02/04	11647
Estonia	CS unlinked	1998-02	4141440	Health Behavior among Estonian Adult Population	02/04	4376

The cause specific mortality that was considered was mortality due to cancer of trachea, bronchus and lung (ICD 10 codes C33-C34; C39 – ICD 9 codes 162-163; 165). Socioeconomic status was assessed through educational level. The national categories of educational level were harmonized on the basis of the International Standard Classification of Education (ISCED) and regrouped in three categories (no, primary and lower secondary education ISCED 1+2; upper secondary and post-secondary non-tertiary education ISCED 3+4; tertiary education ISCED 5+6). Even though separate information for ISCED 1 and ISCED 2 level was available for most countries, these categories were taken together, as the distinction between these two groups is not the same for many countries and may be especially problematic in the unlinked cross-sectional studies because of the numerator/denominator bias. Information on the educational distribution in the populations, including the percentage of missing data is provided in Table 2.

For 11 populations, including four eastern European countries, survey data were available with information on smoking status. For Turin and Madrid no health interview data were available but we used national health interview surveys from Italy and Spain instead.

As indicators for smoking were used 'being a current regular or occasional smoker' and 'having ever smoked.'

Table 2. Distribution of populations by education (%)[1]

	Mortality data				Survey data			
	low	middle	high	missing	low	middle	high	missing
Finland	51.0	28.7	20.3	0.0	23.4	56.3	18.8	1.6
Sweden	36.1	37.9	16.2	9.8	26.4	46.2	27.3	0.1
Norway	34.0	45.7	18.0	2.3	17.0	54.9	25.2	2.9
Denmark	49.8	31.9	18.3	0.0	25.8	53.6	18.4	2.2
Belgium	61.3	18.7	14.1	6.0	39.5	28.9	28.0	3.6
Switzerland	32.1	52.8	14.6	0.6				
Turin/Italy	72.8	18.9	8.3	0.0	63.5	30.1	6.4	0.0
Basque C.	69.8	16.0	12.7	1.5	53.0	25,0	22.0	0.1
Madrid/Spain	64.6	16.5	15.6	3.3	66.9	19.7	13.2	0.2
Barcelona	70.1	13.9	15.3	0.7	53.0	25.0	22.0	0.1
Slovenia	47.5	40.7	10.4	1.3				
Hungary	64.3	23.3	12.4	0.0	57.4	28.9	13.4	0.3
Czech Rep.	62.8	26.7	10.5	0.0	56.6	31.1	12.4	0.0
Poland	55.8	31.2	11.0	2.0				
Lithuania	30.6	52.8	16.1	0.5	39.9	40.5	18.2	1.4
Estonia	29.4	51.6	16.6	2.3	47.6	34.3	17.5	0.6

[1] Three levels are distinguished : low = no. primary and lower secondary education (ISCED 1+2); middle = upper secondary and post-secondary non-tertiary education (ISCED 3+4); high = tertiary education (ISCED 5 +6)

Analysis

In the first step we calculated for each population age standardized lung cancer mortality rates by level of education. This was done by direct standardization using the European standard population as reference. Standardized rates were calculated stratified by sex for the complete age group under study and for 4 subgroups: 40-49 years, 50-59 years, 60-69 years and 70-79 years.

In the second step we computed the Relative Index of Inequality (RII) for lung cancer mortality, which is a regression-based measure that looks at the systematic association between mortality and relative socioeconomic status across all educational groups [20,21]. This index is calculated as the ratio of the mortality of the most disadvantaged (x=0) to the most advantaged (x=1). It should be noted that the values x = 0 and 1 do not correspond to the lowest

and highest categories but to the extremes of these categories, based on a rank measure of education, where the rank is calculated as the mean proportion of the population having a higher level of education. They represent extreme, possibly hypothetical, subgroups [22]. If the index is 2 then the mortality rate of the most disadvantaged is 2 times as high as that of the most advantaged. An RII of 1 indicates that there is no inequality. An RII below 1 indicates that a higher mortality is found among the most advantaged.

Age standardized and gender specific RIIs were computed for all ages (40-79 years) together and for the four age groups separately. RIIs for smoking calculated as prevalence rate ratios were obtained from a regression using a log-link function and assuming binominal distribution of the smoking variable. For each population we compared RIIs for lung cancer mortality in the age group 40-59 years with RIIs for smoking in the age group 20-39 years. Assuming a time lag of 20 years it was estimated that the latter would give an indication on future inequalities of lung cancer mortality. The RIIs were calculated with the GENMOD procedure of SAS v9.1 applying age adjusted Poisson models in case of lung cancer mortality and binomial models in case of smoking.

Both for total mortality and lung cancer mortality we computed the slope index of inequality (SII), which measures the absolute rate difference between the lower and the higher end of the educational hierarchy. As the SII is a measure of absolute inequalities it is sensitive to the average level of health in the population. If the mortality rate is low, the SII will be low as well, even if the RII is substantial. A negative SII corresponds with a higher mortality among the higher educated. The SII permits a decomposition of inequalities in total mortality into inequalities in cause specific mortality. The SII for total and lung cancer mortality can be estimated with the formula SII = 2*MR*(RII-1))/(RII+1) where MR is the age adjusted overall mortality rate [23]. By dividing the SII for lung cancer mortality by the SII for total mortality we obtained the contribution of inequalities in lung cancer mortality to inequalities in total mortality.

Results

In the 16 studied populations the age adjusted lung cancer mortality rates in the age group 40-79 years ranged from 65.8/100,000 person years in Sweden to 252.4/100,000 person years in Hungary among men, and from 11.9/100,000 person years in Madrid to 76.4/100,000 person years in Denmark among women.

Table 3 presents age adjusted lung cancer mortality rates by level of education for men and women in different age groups. Among men we observed a sharp increase in lung cancer mortality with a decreasing educational level. The largest socioeconomic differences were found in the younger age groups. In the southern European populations the socioeconomic gradient was smaller or even absent, e.g. in the age group between 40 and 49 years in the Basque Country.

Among women gradients in lung cancer mortality rates as a function of educational attainment varied more between the regions. In the northern European and continental populations we observed in all age groups a similar pattern as among men: the lower the educational level, the higher the lung cancer mortality rate and this for all age groups. In the southern European populations higher mortality rates were found among the highest educated. The pattern among women in the eastern European countries was remarkable: while we observed higher mortality rates among the low educated in the youngest age group, this relationship gradually inversed with increasing age. In the highest age group higher mortality rates were observed in the highest educated group. This phenomenon was most pronounced in Hungary, but also observed in Poland and Slovenia.

Table 3. European age standardized lung mortality rates per 100.000 person years at risk, by age, sex and educational level

Country	Education*	Sex and age group (in years)									
		Men					Women				
		40-49	50-59	60-69	70-79	40-79	40-49	50-59	60-69	70-79	40-79
Finland	Low	17.4	75.4	247.6	505.2	145.8	6.1	18.7	39.9	69.9	25.3
	Middle	12.3	58.4	157.8	387.0	104.6	3.7	10.4	30.3	61.5	18.7
	High	4.6	26.0	84.5	277.0	62.2	3.4	11.9	25.0	58.4	17.6
Sweden	Low	9.7	43.4	133.1	226.6	74.0	13.5	39.2	67.7	89.9	42.9
	Middle	6.2	36.5	108.4	206.7	62.7	8.2	30.7	61.7	88.5	36.9
	High	3.7	20.6	69.2	151.6	41.5	5.0	16.6	36.0	64.7	22.7
Norway	Low	23.3	89.4	231.2	359.6	130.9	22.4	57.4	97.3	99.4	59.3
	Middle	14.1	53.9	162.8	283.1	92.2	10.0	29.7	64.9	81.2	37.0
	High	5.3	31.8	106.3	217.7	61.8	5.7	13.0	46.2	63.2	23.9
Denmark	Low	14.1	69.9	221.0	453.5	130.8	13.8	62.3	159.9	242.0	89.1
	Middle	10.3	50.2	189.6	471.6	118.6	9.6	41.7	115.3	207.9	67.2
	High	4.9	26.6	114.9	286.3	70.2	4.6	22.4	83.8	154.6	45.9
Belgium	Low	24.2	115.5	335.9	661.3	199.3	8.2	20.8	42.0	57.5	25.6
	Middle	14.6	69.8	216.5	464.1	131.3	5.4	16.1	31.8	66.9	22.1
	High	8.8	45.4	157.4	322.0	91.2	5.1	13.4	28.2	50.6	18.4
Switzerland	Low	37.3	130.0	302.8	456.2	176.0	15.9	31.8	49.6	61.8	33.9
	Middle	20.2	78.5	196.4	355.4	118.2	8.9	23.7	45.8	65.9	28.7
	High	9.8	43.1	119.8	222.2	70.4	6.7	17.1	36.5	73.7	24.7
Turin	Low	28.7	120.1	317.3	569.8	187	4.9	20.8	46.3	93.9	29.9
	Middle	15.8	85.8	204.8	406.3	127.1	6.7	18.0	65.9	94.9	34.0
	High	16.1	57.2	146.5	385.0	102.8	5.8	24.5	44.7	130.7	35.5
Basque C.	Low	13.4	64.4	138.6	338.5	96.7	5.5	8.6	11.1	24.7	10.0
	Middle	10.8	71.9	150.4	269.1	92.3	6.5	19.2	15.8	35.6	16.1
	High	13.9	60.1	102.6	257.8	77.8	14.2	28.4	42.5	24.7	26.2
Madrid	Low	41.7	119.1	322.7	533.3	187.9	4.1	10.3	22.7	36.3	14.1
	Middle	34.4	123.1	251.1	627.1	182.4	6.3	27.4	41.3	74.4	29.0
	High	30.6	90.7	220.3	425.9	139.4	10.4	20.7	27.9	29.6	19.9
Barcelona	Low	51.9	128.4	279.1	474.0	177.5	6.5	10.8	18.3	38.1	14.3

Country	Education*	Sex and age group (in years)									
		Men					Women				
		40-49	50-59	60-69	70-79	40-79	40-49	50-59	60-69	70-79	40-79
	Middle	31.2	105.3	334.6	456.9	173.2	9.0	24.1	56.6	111.9	36.8
	High	12.9	53.1	178.0	295.4	96.3	7.4	20.7	88.9	116.3	42.8
Hungary	Low	89.8	280.2	507.4	602.9	304.4	41.5	73.2	89.8	115.7	71.2
	Middle	49.9	144.8	260.7	362.1	164.3	24.5	49.3	95.0	160.1	64.4
	High	16.9	81.6	186.5	337.1	113.7	9.7	45.0	102.2	222.8	67.2
Czech Rep.	Low	35.8	190.8	459.9	616.6	248.9	9.9	39.6	71.0	98.6	43.5
	Middle	15.9	76.4	199.0	308.9	111.0	6.1	27.2	65.9	128.0	40.8
	High	4.2	31.5	101.2	200.1	58.0	3.0	15.6	44.9	82.7	25.9
Poland	Low	46.7	208.2	502.3	695.2	277.0	18.3	47.4	64.4	87.7	46.1
	Middle	17.7	94.1	256.6	416.3	143.0	9.3	40.2	69.2	119.3	45.7
	High	7.0	47.4	151.1	257.0	81.9	4.3	24.8	53.9	103.9	33.8
Lithuania	Low	72.5	191.9	395.1	521.3	235.9	6.7	15.1	22.4	48.0	17.9
	Middle	26.4	117.0	257.3	378.2	148.7	4.8	7.9	20.5	51.5	14.9
	High	15.8	39.4	131.0	212.2	72.5	2.1	10.4	14.0	19.7	9.5
Estonia	Low	55.4	192.8	452.7	631.6	256.4	18.1	22.2	31.9	74.1	29.3
	Middle	24.8	140.9	361.3	582.5	203.5	3.2	18.8	35.7	110.9	28.4
	High	7.2	46.7	141.3	319.9	87.3	2.5	9.7	22.3	50.6	15.0

* Low: no, primary and lower secondary education (ISCED 1+2); Middle: upper secondary and post-secondary non-tertiary education (ISCED 3+4); High: Tertiary education (ISCED 5 +6)

Table 4. Relative indices of inequality (and 95% CI) for lung cancer mortality in 16 European populations, by gender and age group

Men	**40-49 yrs**		**50-59 yrs**		**60-69 yrs**		**70-79 yrs**	
Finland	4.75	(3.38- 6.69)	3.74	(3.05-4.58)	4.54	(3.88-5.32)	2.48	(2.15-2.86)
Sweden	3.39	(2.33- 4.94)	2.23	(1.88-2.65)	2.07	(1.84-2.33)	1.46	(1.33-1.61)
Norway	5.90	(4.02- 8.68)	3.96	(3.18-4.92)	2.60	(2.27-2.98)	1.86	(1.66-2.09)
Denmark	3.49	(2.01- 6.05)	3.25	(2.55-4.14)	1.97	(1.68-2.30)	1.34	(1.18-1.52)
Belgium	4.37	(3.10-6.17)	4.11	(3.40-4.98)	3.13	(2.77-3.54)	2.79	(2.48-3.13)
Switzerland	5.36	(3.95-7.27)	4.08	(3.47-4.80)	3.18	(2.86-3.54)	2.27	(2.07-2.49)
Turin	3.05	(1.45-6.42)	2.59	(1.79-3.76)	2.99	(2.24-3.98)	2.05	(1.56-2.68)
Basque C.	1.10	(0.51-2.37)	0.98	(0.66-1.47)	1.19	(0.82-1.74)	1.70	(1.26-2.30)
Madrid	1.63	(0.82-3.25)	1.35	(0.84-2.18)	1.93	(1.31-2.84)	1.15	(0.77-1.70)
Barcelona	1.74	(1.19-2.52)	1.98	(1.49-2.61)	1.68	(1.38-2.05)	1.72	(1.40-2.10)
Slovenia	3.31	(2.34-4.67)	3.29	(2.66-4.09)	1.80	(1.56-2.07)	1.56	(1.29-1.89)
Hungary	6.74	(5.40-8.41)	6.03	(5.27-6.88)	5.10	(4.50-5.78)	2.95	(2.59-3.36)
Czech Rep.	12.09	(8.45-17.30)	10.93	(9.33-12.80)	8.27	(7.28-9.38)	5.46	(4.82-6.18)
Poland	10.86	(8.97-13.15)	7.46	(6.73-8.26)	5.41	(5.01-5.85)	3.95	(3.64-4.29)
Lithuania	7.64	(4.16-14.04)	4.88	(3.58-6.65)	3.83	(3.00-4.88)	2.73	(2.04-3.65)
Estonia	9.02	(4.37-18.65)	3.74	(2.64-5.30)	3.04	(2.38-3.88)	1.86	(1.41-2.45)
Women	40-49 yrs		50-59 yrs		60-69 yrs		70-79 yrs	
Finland	2.51	(1.45-4.33)	2.57	(1.74-3.78)	2.02	(1.48-2.76)	1.34	(1.01-1.76)
Sweden	3.83	(2.73-5.37)	2.75	(2.28-3.32)	1.73	(1.48-2.03)	1.18	(1.02-1.37)
Norway	6.69	(4.36-10.25)	5.83	(4.37-7.77)	2.60	(2.11-3.20)	1.62	(1.33-1.97)
Denmark	4.56	(2.52-8.27)	3.69	(2.82-4.83)	2.38	(1.95-2.91)	1.64	(1.36-1.97)
Belgium	2.36	(1.37-4.08)	1.96	(1.30-2.96)	1.88	(1.35-2.62)	0.95	(0.69-1.30)
Switzerland	3.33	(2.28-4.86)	1.97	(1.52-2.54)	1.25	(1.02-1.53)	0.85	(0.70-1.04)
Turin	0.63	(0.17-2.36)	1.03	(0.45-2.38)	0.59	(0.32-1.08)	0.79	(0.44-1.41)
Basque C.	0.26	(0.10-0.73)	0.14	(0.05-0.34)	0.16	(0.05-0.54)	0.60	(0.20-1.77)
Madrid	0.24	(0.05-1.28)	0.18	(0.05-0.65)	0.42	(0.12-1.48)	0.43	(0.11-1.65)
Barcelona	0.50	(0.21-1.18)	0.25	(0.12-0.51)	0.35	(0.19-0.67)	0.62	(0.33-1.15)
Slovenia	1.42	(0.74-2.73)	0.81	(0.49-1.33)	0.43	(0.31-0.61)	0.26	(0.18-0.38)
Hungary	4.99	(3.80-6.56)	2.28	(1.87-2.78)	0.87	(0.71-1.06)	0.43	(0.35-0.53)
Czech Rep.	3.70	(2.22-6.15)	2.69	(2.10-3.43)	1.36	(1.08-1.71)	0.70	(0.55-0.88)
Poland	5.47	(4.28-6.98)	1.90	(1.64-2.20)	0.99	(0.87-1.14)	0.57	(0.50-0.66)
Lithuania	3.62	(0.71-18.55)	1.72	(0.63-4.65)	1.52	(0.75-3.09)	1.27	(0.68-2.37)
Estonia	25.31	(4.02-159.56)	2.35	(0.97-5.67)	1.15	(0.61-2.17)	0.68	(0.42-1.09)

The observed patterns are confirmed in Table 4 in which RIIs and 95% confidence intervals are presented by country, sex and age group. In all populations, except in the southern European populations RIIs among men were all significantly higher than 1 and decreased with increasing age. Large inequalities were observed among men aged 40-59 years in eastern European and Baltic countries. Among the male population in southern European populations inequalities were small or non-existent in all age groups. Inequalities among women were generally smaller than among men in all age groups. In the southern European populations most RIIs were significantly lower than 1.

The contribution of lung cancer mortality to the total mortality in the population 40-79 years is presented in Figure 1. Among men the contribution of inequalities in lung cancer mortality to inequalities in total mortality was largest in Belgium and Turin. Among women this percentage was largest in Denmark and Norway. Only in the latter populations lung cancer mortality contributed substantially to the inequalities in total mortality. In the other female populations the contribution of lung cancer mortality was marginal, or even negative, indicating that lung cancer mortality rates were higher among the high educated, while an inverse relationship was found for total mortality.

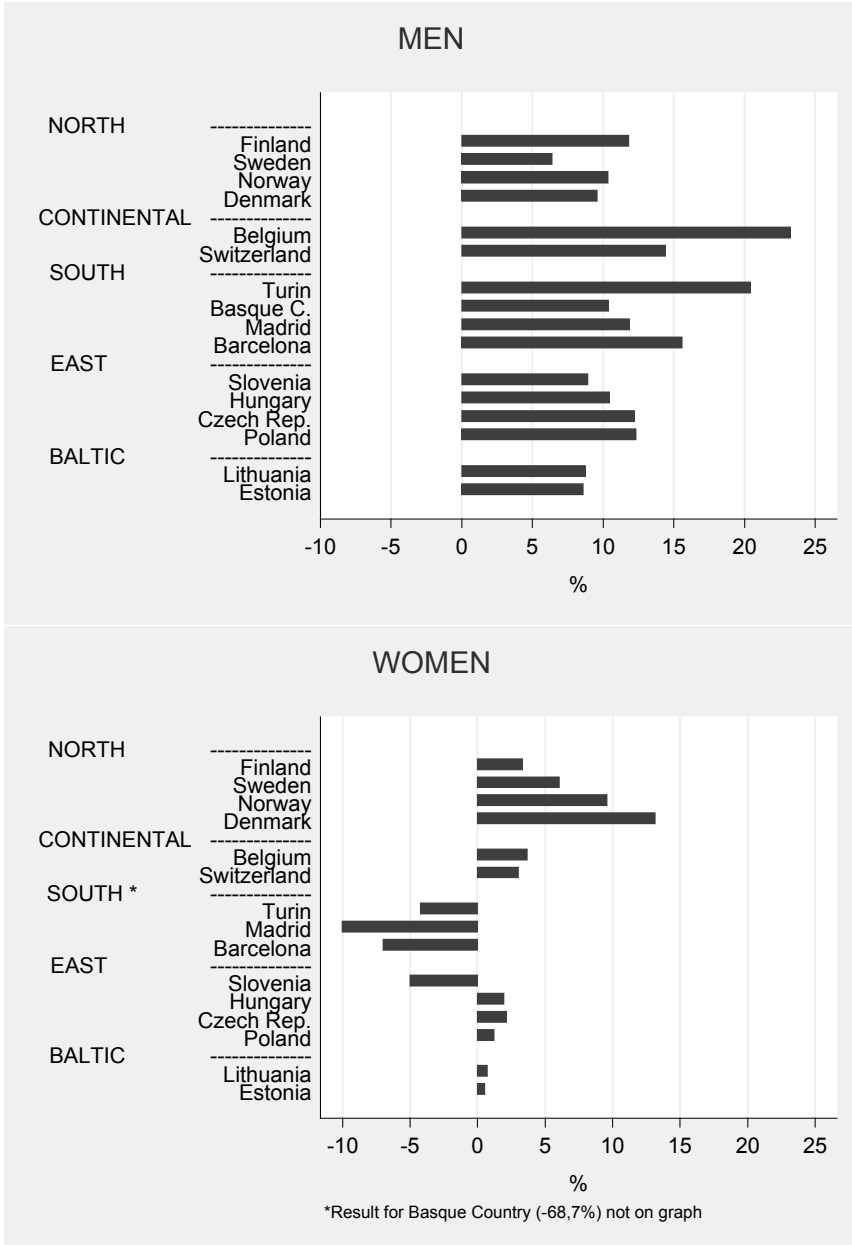
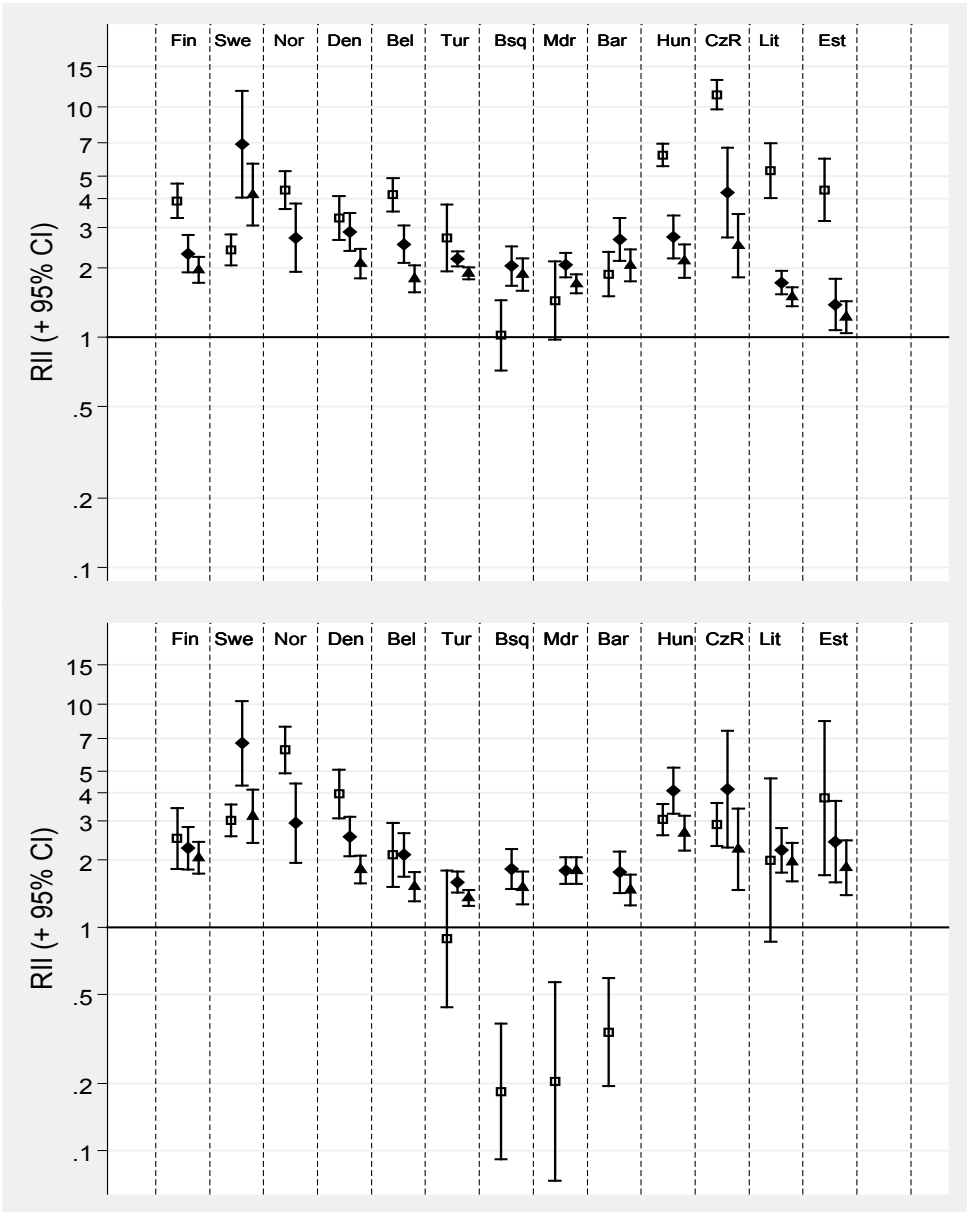


Figure 1. Contribution of inequalities in lung cancer mortality to inequalities in total mortality in 16 European populations, age group 40-79 years



RII lung cancer mortality (age group 40-59 yrs) RII current smoking (age group 20-39 yrs) RII ever-smoking (age groups 20-39 yrs)

Figure 2. Relative indices of inequalities (and 95% CI) for lung cancer mortality and smoking in 13 European populations – Men (above) and women (under)

In Figure 2 we present for each population RIIs for lung cancer mortality for persons between 40 and 59 years in relation to RIIs for current smoking and ever-smoking for persons between 20 and 39 years. The assumption is made that the latter gives us an indication of possible lung cancer mortality inequalities among persons aged 40 to 59 years within 20 years.

It is striking that in some countries, like Sweden, Hungary and the Czech Republic smoking inequalities among young adult women were larger than lung cancer mortality inequalities among women aged 20 years older.

In the southern European populations the positive association between education and lung cancer mortality among women between 40 to 59 years contrasts strongly with the negative association between education and smoking among women between 20 to 39 years. RIIs for ever-smokers were usually smaller than the ones for current smokers, but the geographical pattern was quite similar (Figure 2).

Discussion

Summary of findings

Our study indicates that there are still important socioeconomic inequalities in lung cancer mortality in Europe. Some regional patterns can be distinguished. Large socioeconomic inequalities, with much higher lung cancer mortality rates among the low educated, are observed in the male populations of some eastern European countries, like the Czech Republic and Hungary. Among women the largest inequalities in lung cancer mortality are observed in the northern populations. In most populations there are still important educational inequalities in smoking, both among men and women. In the southern populations inequalities in lung cancer mortality and smoking are much smaller or (among women) even inverse.

Methodological considerations

In our data, education was available in a comparable form for a large number of countries. Advantages of this measure are that it allows for classification of individuals regardless of whether they are inside or outside of the labour force market and it largely averts reverse causation since most people acquire their education early in life. We observed large differences between countries in the distribution of population by educational level. These differences mainly

reflect true variations between countries of Europe in educational systems and attained levels of education. To cope with these differences, we used RII, a measure that takes educational distributions into account. RII estimates can be compared between countries, provided that a detailed and hierarchical classification of educational levels is used in each country.

Data from eastern European (except Slovenia) and the Baltic countries had cross-sectional unlinked design, while all other European countries and Slovenia were census-linked mortality follow-up studies. Results based on unlinked cross sectional data may be biased due to differences, e.g. a differential non-response, between the data obtained from the mortality registry (numerator) and the data available from the population census or other surveys (denominator) [24]. Although this bias may affect inequalities in both directions [25] a recent study in Lithuania [26] indicated that unlinked estimates tend to overstate mortality in disadvantaged groups and understate mortality in advantaged groups, at least at older ages. The educational inequalities among men in the countries with unlinked study design may thus be overestimated, but they are so large that we believe that, even taking into account the bias, socioeconomic inequalities in these countries are indeed larger than in the other populations.

In our study death rates and RIIs were calculated by age groups based on the age of death, rather than on the age cohort. This means that the death rates of several birth cohorts were grouped together, while we know that in many western European countries inequalities in the rates of smoking changed drastically across the past decades. Unfortunately, we could not use age cohorts as longitudinal data were not available for all populations. For the 11 populations for which such data were available we repeated the analyses making use of age cohorts. Age specific inequalities in lung cancer mortality appeared to be very similar to the ones obtained by using the first approach.

Also in previous work [27] a north-south gradient in smoking inequalities was found for women, showing larger educational inequalities in the northern countries. Such a gradient was not observed for men. Even though differences in the questionnaires, survey methodology, response rates and missing values across European countries may have affected the comparability of survey data on smoking, the fact that our results are in line with previous research is an indication of the validity of the findings.

The comparison of inequalities in lung cancer mortality with inequalities of current smoking should be done with caution, due to the time lag between exposure and established disease. This time lag varies and depends on smoking duration and intensity [28,29], but in overall terms a 20- to 50-year delay is assumed between the uptake of regular smoking and the occurrence of lung cancer [30]. We tried to take this time lag into account by using information on inequalities in smoking as proxy for information on inequalities in lung cancer mortality 20 years later. It is clear that this assumption has serious limitations. Educational inequalities in trends in smoking behaviour and in smoking cessation rates have indeed been observed in several European countries [13,31] and may result in changing inequalities in smoking and lung cancer mortality by socioeconomic group. Even though it is unfortunate that lung cancer mortality data from two southern urban areas (Madrid and Turin) had to be compared with smoking data from two national health interviews, the conclusion based on this comparison was very similar to the one in the other southern urban area (Barcelona) for which we were able to compare with a corresponding health survey.

The use of mortality data at a European level has unavoidably some limitations. Discrepancies may exist in models of death certificates, nature and amount of information entered, way to establish the diagnosis, degree of consistency of the certification process, autopsy practices, certifiers practices, implementation of the ICD-10 and implementation of automated coding systems [32]. The results of our study would be biased only to the extent that coding practices are associated with educational level within populations. Although there are no specific indications for variations in coding according to the educational level of the deceased, we can not completely rule out such bias. However, such bias is unlikely to explain the results for broader groups as analysed here.

Comparison with other studies and interpretation of results

Generally speaking our findings are in line with the Mackenbach et al paper [12] that explored inequalities in lung cancer mortality by educational level in 10 European populations. This is not surprising. Our study population includes 8 populations that were also included in this study, although we have been working with more recent data. The typical southern European pattern with higher lung cancer mortality rates among the low educated men and the high

educated women, which is also reported in other studies [33], is confirmed by our data from the Basque Country, and is also observed in Slovenia, that suggests that the north-south gradient is also prevalent among eastern European countries.

If we would apply our findings on lung cancer mortality in the eastern European countries to the concept of the spread of the smoking epidemic, as described in several papers [34,14,13], we would stage lung cancer mortality among men in Eastern European countries (relative high mortality rates, higher mortality in low educated groups) as more advanced than the southern European populations but not yet having reached the situation of the northern European countries (relative low mortality rates, higher mortality in low educated groups).

It is striking that among females (40-49 years) educational inequalities in the eastern European countries are very similar to what we find in the northern European countries, while inequalities in the oldest age group (70-79 years) are quite in line with the observations in southern European countries. This could confirm the hypothesis that the lung cancer mortality inequalities in eastern Europe are shifting from a southern to a northern European pattern. This will lead to increasing socioeconomic inequalities among women in the coming years. The findings that in some eastern European countries lung cancer mortality rates are decreasing in male populations and increasing in women [35,36], support this hypothesis.

Up to now, few other studies have explored socioeconomic differences in lung cancer mortality rates in central and eastern European countries. One study in Estonia reported an important increase in lung cancer mortality differences by education between 1989 and 2000, both in men and women [37]. The magnitude of the inequalities that are reported in this study are in line with our findings.

As has also been observed in previous research [17], the contribution of inequalities in lung cancer mortality to inequalities in total mortality is quite heterogeneous across different European countries. In our study it is more than 10% in most male populations. This confirms that among men inequalities in lung cancer mortality remain an important factor to explain inequalities in overall mortality. Among women the relative contribution of inequalities in lung cancer mortality is less important, although quite substantial in two northern countries (Denmark and Norway).

From Figure 2 it appears that all over Europe there are still large socioeconomic inequalities in lung cancer mortality, but also in smoking among young adults. There is no doubt that smoking is the main factor that explains the socioeconomic differences that are observed in lung cancer mortality. From this perspective inequalities in smoking could be a good indicator of inequalities in lung cancer mortality in the future. The large inequalities in smoking found in younger age groups do not give much hope towards reduction of inequalities in lung cancer mortality in the future.

Inequalities in lung cancer mortality are usually larger among men than among women. Smoking inequalities, on the contrary, are more or less of the same magnitude in women and in men. It is therefore plausible that the inequalities in lung cancer mortality among men and women may in the future converge towards the present pattern among men. northern European countries already reached this stage, especially the younger age groups.

Whereas in previous research the hope was expressed that in southern European countries large inequalities in lung cancer mortality among women could be avoided [12], our results suggest that the reverse of a positive to a negative association between socioeconomic status and lung cancer mortality is ongoing.

It cannot be excluded that other factors than smoking have contributed to the observed inequalities in lung cancer mortality. Some studies have suggested a possible role of other environmental and occupational exposures [38], poor lung health, deprivation and poor socioeconomic conditions throughout life [8], differences in access to treatment [39,40] and differences in survival [41]. Some of these factors are more plausible than others. More specific research is needed to explore further the relation between socioeconomic inequalities in lung cancer mortality and other factors than smoking, especially in eastern European and Baltic countries.

Conclusions and recommendations

Our study confirms that regional patterns of socioeconomic inequalities in lung cancer mortality persist and are consistent with the geographical spread of the smoking epidemic. The pattern of inequalities in eastern European and Baltic countries is more or less similar as the one observed in the northern countries although the absolute rates are higher. During the coming decades,

we may expect in southern European countries a reverse of a positive to a negative association between socioeconomic status and lung cancer mortality. Among men inequalities in lung cancer mortality account for a substantial fraction of inequalities in total mortality. Among women the inequalities are still smaller, but there are some indications of an increasing trend, and especially in some northern European countries the contribution of lung cancer mortality inequalities to inequalities in total mortality is substantial. Further efforts to tackle socioeconomic inequalities in lung cancer mortality in Europe are necessary in all countries. This can be done by increasing specific tobacco control measures in lower socioeconomic groups, including strict enforcement of laws and agreements, increase of financial and other barriers to smoking, geographic or social targeting of smoking cessation services, and tailoring of communication approaches [15].

Although the efforts should primarily target smoking prevention, there is also need for further research to establish the role of other factors than smoking, such as other environmental and occupational factors, and differences in access to treatment and survival.

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CHAPTER 8
Discussion

This thesis presents studies that focus on socioeconomic inequalities in smoking in Europe. The objectives were threefold: 1) to describe the association between different socioeconomic indicators and smoking behaviour in different parts of Europe around the year 2000, 2) to explore whether the international variations in smoking behaviour and smoking inequalities can be explained by specific characteristics of countries, and 3) to examine whether these international differences in smoking inequalities are reflected in the international differences in inequalities in lung cancer.

In this chapter we discuss the main findings of this thesis, address the methodological issues related to our studies, and interpret the main results. Finally, we consider the implications of this thesis for future research and policy developments.

Main findings

Socioeconomic inequalities in various aspects of smoking in Europe

The first aim of this thesis was to describe the inequalities in smoking in Europe around the year 2000. In the various chapters we have mapped smoking behaviour and smoking inequalities in Europe. We observed socioeconomic inequalities in different aspects of smoking behaviour in all European regions, but the size of the inequalities varied across countries. The largest inequalities in most aspects of smoking were still found in northern and western European countries. In all regions the inequalities in smoking were largest in the younger age groups. The international variations in smoking inequalities between northern and southern Europe observed in our studies have also been described previously [1-4], but our results for eastern Europe are new. Information on smoking behaviour, and especially inequalities in smoking in eastern Europe, was seldom available. Our studies showed that the pattern of smoking inequalities in eastern Europe differs significantly from the pattern observed in southern European countries. Our results indicate that, in terms of smoking prevalence rates and inequalities in smoking, most eastern European countries are somewhere between north-west Europe and southern Europe, with large differences between the eastern European countries. These results are in line with recent national studies also showing that eastern European countries are more comparable to northern than southern Europe. [5-7]

We have studied information from both younger and older age groups. It appeared that, in all regions, the inequalities in smoking (ever smoking and smoking cessation) are largest in the youngest age group (25-39 years), among both men and women. In the older age groups (40-59 and 60+ years) the inequalities in smoking among women are in many countries still reversed, in favour of less educated women. Similar to an earlier study [2], the largest inequalities in smoking in the younger age groups also suggest an increase in inequalities rather than a decrease in the near future. From a life course perspective, smoking is a process rather than a static behaviour. Current smoking prevalence rates are determined by two transition stages: initiation (uptake of smoking) and cessation. Inequalities in current smoking are explained by the inequalities in both initiation rates and cessation rates.

In chapter 4 we focused on ever smoking (a proxy for uptake of smoking). For this smoking aspect a clear geographic pattern emerged, with large inequalities in northern and eastern Europe and smaller inequalities in the south of Europe, especially in the age group 25-39 years. Our results demonstrated that the inequalities in ever smoking among women reversed within three generations. In the older generation (age 60+ years) the more educated women were still more likely to have ever smoked, while in the younger generation (25-39 years) especially less educated women have ever smoked.

In the next chapter the focus was on smoking cessation (measured as number of ex-smokers divided by number of ever-smokers). In the case of men the inequalities in this age group were largest in eastern European countries. Among women there were no large variations in the size of inequalities between European countries. The largest inequalities in cessation rates were found in countries from different regions such as Ireland, Hungary and Latvia. Also for this aspect of smoking, inequalities were largest in the younger age group (25-39 years).

Our research group, and many others, have described inequalities in smoking mainly by educational level. However, in line with a previous study [8], chapter 3 showed that smoking is not only related to educational level but also to occupational class and measures of wealth. Strikingly, it was not related to income or employment status. In some cases, the use of different socioeconomic indicators resulted in different geographical patterns. In southern Europe, among women age 40-60 years educational inequalities were still in favour of

less educated women (they smoked less often), but if we used housing tenure (a measure of wealth) as the socioeconomic indicator we see that women who were worse off (i.e. renting their accommodation) were more likely to smoke. Similarly, while educational level showed the largest inequalities in the younger generation in northern Europe, in the older generation occupational class and measures of wealth were more important.

Role of national context on smoking behaviour and inequalities in smoking

In the second part of this thesis we explored the extent to which context variables could explain (a part of) the international variation in smoking behaviour and inequalities in smoking. In three chapters we examined the following context variables in relation to smoking among the younger age groups: economic development (or current level of national wealth), emancipation, nation-wide tobacco control policies, and cigarette price.

The current level of economic development, measured by Gross Domestic Product (GDP), is associated with smoking behaviour in Europe (Table 1). In economically more developed countries smoking rates (current and ever) are lower and cessation rates are higher among men, compared to economically less developed countries. In the case of women the association is opposite: in economically more developed countries current and ever-smoking rates are higher than in countries with less economic development. Cessation rates among women, however, are highest in countries with higher levels of national wealth.

In chapter 4 we studied two context variables: GDP and Gender Empowerment Measure (GEM) in relation to ever-smoking rates among women. With our focus on ever- smoking rates we tried to verify the hypothesis that these two context variables are important in relation to smoking uptake (ever smoking) and the spread of large-scale smoking across societies.

The current level of economic development, measured as GDP, is associated with smoking behaviour among women in Europe. In chapter 4 we observed a positive association between GDP and ever-smoking rates among higher educated women. The association with ever smoking among lower educated women was also positive, but weak. No significant association was found between GDP and inequalities in ever smoking among women.

GDP is also associated with other aspects of smoking behaviour. Current smoking rates among young males were lower in countries with more economic prosperity. Cessation rates among both men and women were higher in economically more developed countries. Inequalities in current smoking were not correlated with GDP, but smaller inequalities in cessation rates were seen in economically more developed countries (Table 1).

It is suggested that social cultural processes, such as emancipation, were important at the start of the diffusion of smoking in societies. However, no clear association was found between the GEM, used as a proxy for emancipation, and ever smoking and inequalities in ever smoking among women. The associations were weak and not statistically significant. Nevertheless, we observed different associations by educational level. The GEM was negatively associated with ever-smoking rates among more educated women, but positively associated with ever-smoking rates among less educated women.

In chapter 5 we investigated the effect of nation-wide tobacco control policies on smoking cessation. The results showed a clear association between tobacco control policies and smoking cessation. In countries with a more comprehensive tobacco control policy, ex-smoking rates are higher compared to countries with less comprehensive policies. The effect of policies on smoking behaviour did not differ by educational level, and no significant association was found between nation-wide tobacco control policies and inequalities in ex- smoking rates. Thus, the current tobacco control policies in European countries do not seem to reduce the inequalities in cessation and smoking rates, neither do they increase the inequalities. This concurs with other reports, which also show inconsistencies regarding whether or not tobacco control policies have different effects on lower and higher educated groups. [9-12]

In chapter 6 we further explored the association between one tobacco control measure, i.e. cigarette price, and different aspects of smoking behaviour. We did not find the strong association that we had expected. The price of cigarettes was negatively correlated with smoking behaviour among men, but the results were not statistically significant. Among women the pattern was not consistent. Price increases seem to have a stronger effect among lower socioeconomic groups. However, we found no statistical evidence for an

association between cigarette price and inequalities in smoking behaviour in this study population. This lack of evidence for an association between price and smoking behaviour has also been reported by others. [13, 14]

To conclude, some contextual variables have been important in relation to smoking behaviour in Europe. The current level of economic development was associated with ever smoking among women, and comprehensive tobacco control policies were associated with higher cessation rates. However, except in the case of economic development, no significant associations were found between the context variables and smoking inequalities. Thus, the international variations in smoking inequalities remain largely unexplained.

Inequalities in lung cancer and relation with smoking inequalities

In the final part of this thesis we focused on one of the most important smoking-related diseases: lung cancer. We observed important socioeconomic inequalities in lung cancer mortality. The international differences in smoking inequalities are reflected in the international differences in inequalities in lung cancer. In line with earlier studies [15, 16], our results also showed the typical north-south pattern in lung cancer mortality. Smoking appeared to be one of the main predictors of inequalities in lung cancer. Among men the inequalities in lung cancer mortality contributed for an important part to the inequalities in total mortality. Among women the inequalities in lung cancer contributed substantially to the total mortality only in Denmark and Norway. In the other countries the contribution was marginal or sometimes even negative.

Methodological issues

Evaluation of descriptive studies

Comparability of data can be a problem in (descriptive) international studies. In this thesis smoking data from the ECHP dataset and the Eurothine project were used. In both cases the data on smoking used in our studies were highly comparable across countries. With regards to this important variable no comparability problems were encountered.

Another important variable in this thesis was educational level. Educational level was somewhat less comparable across countries since there are many different educational systems and categories in Europe. We used the ISCED classification

to categorize the different educational levels into four international comparable categories. [17] The results for educational level emerging from our data, were compared with data from Eurostat. [18] The frequencies for the different educational levels were highly comparable between the two data sources for the different countries. We concluded that educational level could be used to compare countries with respect to the general association with smoking behaviour. By using the relative index of inequalities (RII) we further limited the problem of comparability of educational level. The RII is a regression-based measure that takes into account all educational groups separately. It facilitates comparisons between countries with different educational classifications, provided that all classifications are hierarchical and sufficiently detailed. [19]
Comparability of smoking was not a problem, but the smoking data did impose some limitations on our studies because the data sources did not include information on age-at-initiation or age-at-cessation. The latter could be particularly important in relation to chapter 5 in which we studied the effect of tobacco control policies on cessation rates. The lack of this information prevented us from making a distinction between recent quitters and those who gave up smoking some years ago. This could have avoided the problem of an inappropriate time lag, which will be discussed below.

Evaluation of explanatory studies

International studies that compare several countries can never provide evidence that is as strong as the evidence provided by randomized control trials (RCTs). However, because international comparisons cannot be made using RCTs, other research designs are needed, for example to evaluate the potential effects of tobacco control policies. Possible alternatives are time-series analyses within single countries, or a comparison of in-depth studies conducted in different countries. International studies, such as ours, provide the unique possibility to study the association between context variables (country characteristics) and international patterns in outcome variables (e.g. smoking inequalities). However, in this type of study some methodological issues may arise; below we discuss some problems related to 1) information bias and 2) confounding, which may have affected the strength of our evidence.

Information bias arises when research variables are measured inaccurately, without appropriate time lags, or not in a comparable way for all countries. If variables are not measured precisely or are not available for the required time period, the outcome(s) of the study should be interpreted with caution.

An important problem related to information bias has to do with time lags. In all three explanatory studies (chapters 4, 5 and 6) we were not able to collect the independent variables for the preferred time period. In chapter 4 (exploring the association between economic development, emancipation and female smoking behaviour) only women aged 25-39 years were included in the association analyses to limit the effects of the inappropriate time lag. However, the problem still remained to some extent since these women had probably started smoking somewhere between 1975 and 2000, while the independent variables GDP and GEM were measured in 1996 and 1998, respectively. However, countries with a low score on GEM or a low GDP in the late 1990s are likely to have relatively low scores on GEM or GDP in the two preceding decades as well, because these levels of societal factors attained in the 1990s largely depend on the economic progress and gender emancipation process over a much longer historical period.

We encountered the same problem of inappropriate time lag in chapter 5. In this study (focusing on the effect of tobacco control policies on cessation rates) the data on smoking behaviour were from the years 2000-2004, and information on tobacco control policies was from 2004-2005. Also in this case, it is highly likely that countries with a comprehensive tobacco control policy in 2005 had already implemented a more comprehensive tobacco control policy in the previous years. This assumption was supported by the sensitivity analyses that we conducted.

In chapter 6 (examining the price of tobacco products) the same problem occurred again since we only had access to price data for the years 1995-2000. In this study we tried to avoid the problem of inappropriate time lags by focusing on the youngest age group (16-29 years). Individuals in this latter group are likely to have started smoking in the years 1990-2004 (i.e. in the last 5-10 years). Older age groups would have started smoking long before the date that we measured the price. For older age groups we could not have studied the association between price and other aspects of smoking, including smoking initiation.

Besides the inappropriate time lag, inaccurate measurement was a problem in chapter 4. The GEM from 1998 might not have given an accurate representation of the phenomenon 'emancipation', at least in terms of what we considered it to be when we formulated the hypothesis that emancipation of women might have affected smoking initiation. We hypothesized that the social unacceptability of female smoking inhibited women from smoking in the early 20th century. Amos et al. [20] showed that when women joined the work force on a large scale and became more emancipated, female smoking became more socially accepted. We were particularly interested in emancipation in terms of individual freedom (of women) and lifestyle. The GEM was the only measure focusing on emancipation-related issues which were available for all countries; however, it measures gender inequality in economic and political spheres of activity and does not correspond exactly with our idea about emancipation. If a more valid measure of emancipation in terms of individual freedom had been available and used in our analyses, we might have observed a stronger association between female smoking behaviour and emancipation.
We also experienced problems related to inaccurate measurement and comparability with respect to the price of cigarettes and GDP, for which we used information from different sources. Especially data from eastern European countries were difficult to collect. Therefore, in this case, in the interpretation of international patterns some caution is warranted.

Confounding occurs when a third factor, that is both related to the outcome measure and the independent variable, explains (part of) the observed association between the outcome measure and the independent variable. Confounding is a potentially serious problem in observational studies, perhaps even more so when variations between countries are examined. In our studies it is possible that other factors (confounders) underlie the international patterns in smoking inequalities in Europe.
In most of our studies we controlled for possible confounder(s) such as economic development, female labour force participation and the smoking epidemic. Nevertheless, we cannot rule out that we may have missed some possible confounders. In several of our studies scatter plots showed outliers which could not be explained by the included confounders. This indicates the role played by factors that we could not measure and control for.

In chapter 6 we discussed the possibility of the smoking epidemic being a confounder in the association between cigarette price and female smoking behaviour. The results for women were not consistent and were especially deviant for ever-smoking rates and smoking behaviour in the less educated group. The fact that European women were still in two different stages of the smoking epidemic is probably the cause of the inconsistent results. In the case of men the results were more consistent, and confounding by the smoking epidemic seemed less of a problem.
In chapter 4 (focusing on female ever smoking in Europe), we suspected the smoking epidemic to be a confounder. After performing parallel analyses for men we observed a different effect of GDP on smoking rates among men and women. This could be explained by the fact that the smoking epidemic first evolved among men, with women lagging some decades behind. This might indicate confounding by the smoking epidemic.
Controlling for confounding was difficult, e.g. in chapter 4 where the independent variables, GDP and GEM, were strongly associated. The fact that we only included 14 to 18 cases of observations (number of countries) in the association analyses in chapters 4, 5 and 6 limited the possibilities to control for confounders. The small number of observations also resulted in a limited power to detect statistically significant associations.

Summary of strength of evidence

In all chapters we were confronted with possible threats to the validity of our results, especially in chapters 4, 5 and 6. The methodological limitations have consequences for the interpretation of the results. For example, we must use caution when drawing conclusions about causality in chapters 4, 5 and 6 when there was no appropriate time lag between measurement of the independent variables and smoking behaviour, or when control for confounding was partial. Nevertheless, despite these limitations, we think our studies provide some evidence for an effect of tobacco control policies, although less so for the effect price. Similarly, the association between economic development and (female) smoking behaviour cannot be denied, but there is no convincing evidence for an association with emancipation.

Explanation of international variation in smoking and inequalities in smoking

This thesis aimed to further study the international variations in socioeconomic inequalities in smoking in Europe. Based on different studies focusing on the association between smoking behaviour and societal characteristics we aimed to better understand the typical geographical pattern in smoking behaviour and smoking inequalities in Europe.
This section explains the international variation in smoking and smoking inequalities, based on our results.

International patterns are usually explained by referring to the smoking epidemic model. This model describes the diffusion of the smoking habit in societies in four stages. Smoking used to be an innovative behaviour and was first adopted by the higher socioeconomic groups, followed soon after by the lower socioeconomic groups. Later, when smoking was common in all groups of the society, stopping with smoking became a new innovative behaviour. Again, the higher socioeconomic groups were the first to give up smoking. These differences between socioeconomic groups resulted in a generalized pattern of trends in inequalities in smoking. In the early days smoking was more common among higher socioeconomic groups, but nowadays smoking is more prevalent in lower socioeconomic groups in all European countries.
The process of the diffusion of smoking in societies is often thought of as an 'epidemic', i.e. as a more or less autonomic process that evolves in a specific way, which is similar in different countries, and is driven by intrinsic factors. However, we think that this smoking epidemic is mainly driven by external factors. Some external factors do not specifically aim to affect smoking behaviour (e.g. economic development), whereas others do. For example, tobacco control policies aim to reduce smoking prevalence rates, whereas tobacco industries try to increase their profit and thus increase smoking consumption levels. These various external factors influenced the spread of the smoking habit in different countries. Differences in both the start and development of the spread of smoking in European countries explain the international variations in smoking prevalence and in socioeconomic inequalities in smoking. The key question is: which factors explain these differences in start and development.

One of the factors that influences the course and the outcome of the smoking epidemic is nation-wide tobacco control policy. One of our studies showed a strong association between tobacco control policies and cessation rates. Countries with more comprehensive tobacco control policies also had higher cessation rates. Tobacco control policy is a contextual factor that specifically aims to act on smoking behaviour. National tobacco control policy might explain (part of) the variation in overall cessation rates between European countries. However, it cannot explain the international variation in inequalities in these cessation rates. According to our results, tobacco control policies do not seem to affect the smoking inequalities, as both high and low educated groups appeared to benefit equally from the policies.

Another factor potentially important in relation to the international variation in smoking behaviour, and possibly also smoking inequalities, is the current level of economic development. GDP appeared to be associated with all smoking aspects (Table 1).

Tabel 1. Correlation between economic development (GDP 1996) and smoking behaviour, by sex, age and educational level (high/low)

	25-39 years			40-59 years			60+ years		
	High	Low	RII	High	Low	RII	High	Low	RII
Men									
Current smoking	-0.57	-0.55	-0.21	-0.56	-0.51	0.06	0.46	0.44	0.33
Ever smoking	-0.65	-0.68	0.39	-0.35	-0.43	0.21	0.61	0.55	0.02
Smoking cessation	0.41	0.53	-0.49	0.71	0.65	-0.53	n.a.	n.a.	n.a.
Women									
Current smoking	0.40	0.34	0.05	0.41	0.43	0.35	0.41	0.43	0.42
Ever smoking	0.54	0.34	0.05	0.56	0.50	0.27	0.64	0.59	0.35
Smoking cessation	0.35	0.31	-0.37	0.56	0.51	0.12	n.a.	n.a.	n.a.

Note: Correlation is calculated with the log of GDP (1996)

RII: relative index of inequalities / n.a.: data not available

Table 1 shows that the association between GDP and current smoking prevalence varies considerably by sex and age, consistent with the smoking epidemic model. [21] Current level of economic development is negatively associated with smoking prevalence among young adult men (rates are lower in countries with higher GDP). The opposite is (still) true for women in this age group; for women we observed a positive association between current smoking and GDP. We see a similar pattern for the inequalities in smoking (measured by the RII): a negative association among men and a very weak but still positive association among women. The pattern in the association with GDP for ever smoking is similar to that of current smoking. Among both men and women, cessation rates were positively associated with current level of economic development. Inequalities in cessation are negatively associated with GDP. For the age group 60+ years we observed positive associations between GDP and current smoking and smoking inequalities among both men and women. The fact that the associations show a pattern that is consistent with the smoking epidemic suggests that economic development have been important with respect to the diffusion of smoking in societies in Europe.

In chapter 4 we explicitly focused on ever smoking and possibly important contextual factors, such as economic development. In this study no association was found between current level of economic development and inequalities in ever smoking in the age group 25-39 years, but we did find an association between current level of economic development and female ever-smoking rates in this age group. The observed association was particularly strong for more educated women. This suggests that economic development mainly affected ever smoking among the more progressive group, i.e. the more educated women. It is likely that economic developments determined the start of smoking on a large scale in several ways. For example: 1) increased purchasing power, 2) campaigns by the tobacco industry, and 3) general social development following the USA pattern.

First of all, purchasing power: more economic development in a country normally leads to growing purchasing power for citizens. People get more money to spend and at a given moment can also buy luxury articles, such as cigarettes. The fact that smokers are price sensitive, and thus smoke less when prices increase, also supports the idea that smoking is related to purchasing power. However, in chapter 4 and Table 1 we see only a weak

association between GDP and ever-smoking rates among lower educated women. This suggests that purchasing power cannot be the only explanation for the observed association between smoking and economic development. If purchasing power alone would have led to this association, we would expect to find the same association among lower educated women.

Second, a society where people have larger personal budgets (in countries with higher GDP) becomes an interesting market for the tobacco industry. The aggressive campaigns from the tobacco industry and the associated promotion strategies were effective and definitely increased smoking prevalence rates and accelerated the uptake of smoking among the general public. [20, 22-26] Television advertisements appeared to be most effective. Via television foreign tobacco companies became well known to the public television attracted younger people who were most vulnerable in terms of uptake of smoking, and television advertisements often linked a certain cigarette brand with famous role models, such as Hollywood actors. [23] Recent examples of eastern European countries showed that the entry of the tobacco companies at a time of major political and economic change left these countries particularly vulnerable to industry influence. This influence was enhanced by the industry's significant investments in these countries, their ability to take over existing state monopolies in most east European countries, and the lack of democratic opposition. [22] The tobacco industry has probably played an important role in relation to the spread of smoking among all groups of society in those societies with a potential market for these industries.

Third, the extent to which a nation was (and felt) connected, in a cultural way, to the USA has probably been important in this context. The USA was ahead of Europe in terms of the spread of smoking through the society. Countries that were close with the USA (through trade, immigrants and Marshall Aid after World War II) and identified themselves with America, probably took over the habit of smoking first. In those years the USA was the 'modern model' for many western European countries. Through trade, marketing by American companies, and also films, many products from the USA (including cigarettes) became popular in those (western) European countries that were also interesting for American companies and products (i.e. economically more developed countries).

Among men, compared to women we observed an opposite association between current level of economic development and ever-smoking rates. For men we see higher-ever smoking rates in countries that are economically less developed. (Table 1) The opposite association among men is probably best explained by the fact that men started smoking on large scale a few decades earlier than women. The diffusion of the smoking habit in societies evolved with the economic development, among both men and women. However, we saw opposite associations between smoking and economic development because we measured the level of economic development at a particular time (e.g. 1996) and associated this with smoking at time 'x' among both men and women, while women are behind men in terms of the smoking epidemic.

In addition, in the same time period an attitude change took place with regards to smoking in northern and western European countries. In those countries large health promotion campaigns on smoking were launched. As a result, knowledge about smoking, and especially the health consequences, increased among the northern European population and resulted in a first decrease in ever-smoking rates among men. These campaigns were first implemented by governments from economically more developed countries. Despite the health promotion campaigns in northern Europe, ever-smoking rates were still higher among women in these countries compared to the rates among southern European women. This is probably because women still had to catch up with the trends that had already evolved among men. The ever-smoking rates among women are therefore probably still low in economically less developed countries for factors other than knowledge about the health risks of smoking. It is suggested in the literature that particularly traditional role patterns in the early and mid-20th century have been important in relation to female smoking. Smoking used to be socially unaccepted in those years. For a woman smoking was 'not done' and women who did were often portrayed as prostitutes. When the traditional role patterns were slowly replaced by more emancipated values, smoking became more popular among women. The typical geographical north-south pattern in smoking behaviour (also observed in our studies) supports this hypothesis. The traditional role patterns between men and women in southern European countries were maintained longer than in northern and western European countries. [27] Important factors in this context are probably emancipation and individualization.

Chapter 4 studied the relationship between female ever smoking and emancipation. We did not find a significant association and cannot conclude that emancipation has been important in relation to smoking in the age group 25-39 years. We already mentioned that the lack of evidence might be due to methodological limitations. Thus, it is still possible that emancipation has been important in relation to ever smoking among women. However, the lack of observed associations may also be interpreted as evidence to suggest that it is not so much emancipation, but rather another cultural factor, that stimulates societal changes in norms and role patterns.

One such factor is individualisation: this is a process in which traditional role patterns and conservative values, valued by the group above those of the individual, were slowly replaced by values and expectations that emphasized the interest of the individual, male or female. This process probably made a large contribution to the increased individual freedom of choice for women. This probably enabled women to smoke a cigarette without being portrayed as a 'fallen woman'. The scatter plots also show a clear association between individualization in European countries [28] and female ever-smoking rates in those aged 40 years and older (Figure 1a and 1b). The scatter plots show a clear difference between more and less educated women, suggesting that less educated women were more susceptible to the process of individualization in their country as far as smoking is concerned.

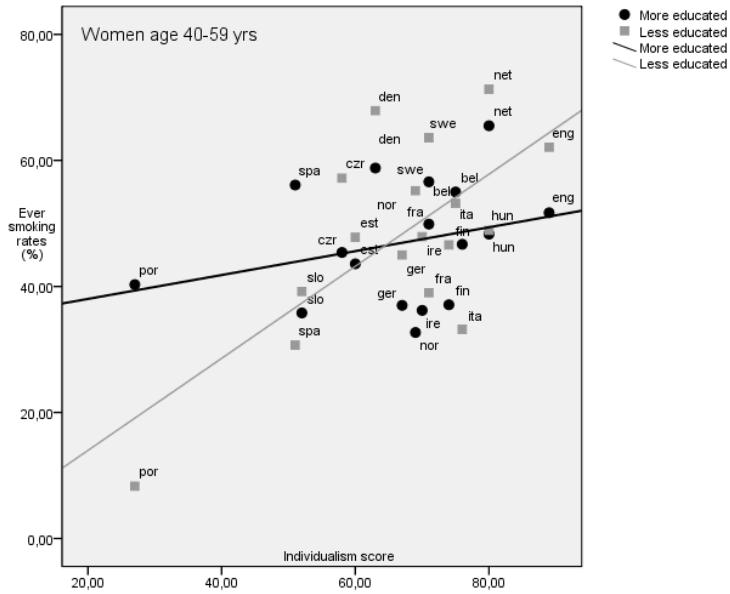

Figure 1a. Scatter plots: Individualization and ever-smoking rates by educational level for females aged 40-59 years

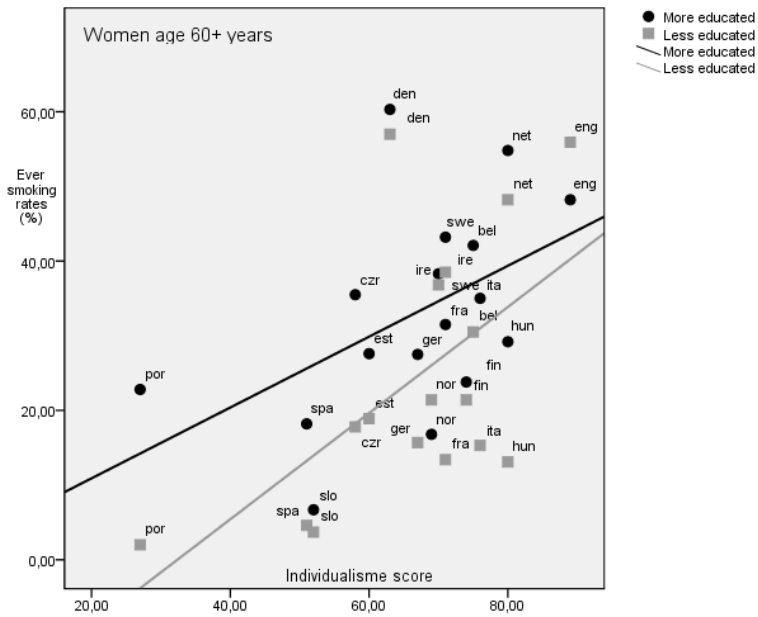

Figure 1b. Scatter plots: Individualization and ever-smoking rates by educational level for females aged 60+ years

In this context, the position of eastern European countries in terms of smoking prevalence and inequalities in smoking is interesting, i.e. eastern European countries are somewhere between north and south Europe. The large differences in political history have probably played an important role in this context. In much of the 20th century, although the communist system had little room for individualization, it also aimed for a community spirit that was different from the conservative regimen in southern Europe. In southern Europe life was mainly determined by the church and the traditional role patterns promoted by it. During the communist period there was no room for religion, and the traditional role patterns (women at home, men at work) were set aside: everybody, including women, joined the workforce. The differences in smoking behaviour and smoking inequalities between southern and eastern Europe might be explained by the fact that the traditional roles were replaced in an earlier period in the eastern region compared to southern Europe.

Thus, cultural processes such as individualization and the wider societal processes that maintain or change value systems, may have been important with regard to the initiation and maintenance of international variations in smoking behaviour and smoking inequalities. In the same way, socio-cultural factors may be important in relation to development and implementation of tobacco control policies. Tobacco control policies can be defined as a comprehensive package of regulations, information and interventions to reduce smoking in the general population. Important for the development and implementation of such a package is support from society. This depends, amongst other things, on the extent to which smoking is 'denormalised' and the extent to which citizens accept the state's intervention. This is illustrated by an example of the implementation of a smoking ban in bars and restaurants in Ireland and the Netherlands. In Ireland, implementation of the smoking ban was presented and seen as a protection of Irish citizens against the health risk of (passive) smoking, and the Irish population generally accepted this interference of the government. In the Netherlands however, the smoking ban was first presented as a way to protect the workers in bars and restaurants. A part of the Dutch society experienced the ban as an infringement by the government on their individual freedom to behave as they liked. This strong opposition was based on a culture of strong individual freedom and non-interference in an individual's sphere of life, also labelled 'tolerance'.

In summary, of the four country characteristics that were studied only current level of economic development showed some association with inequalities in smoking. Tobacco control policies were related to overall levels of smoking cessation, but not to inequalities therein. International variations in inequalities in smoking remain largely unexplained. Other country characteristics that might have been important in relation to smoking behaviour and smoking inequalities include the degree of individualization and other social-cultural processes related to smoking and tobacco control.

Implications

Implications for tobacco control policies

This thesis shows that smoking is becoming even more concentrated in lower socioeconomic groups. Consequently, the health burden of smoking is also largest in these groups. Inequalities in smoking-related mortality are large in most European countries. Inequalities in smoking and the health burden of smoking are expected to increase rather than decrease in the near future. Continuous efforts are therefore needed to tackle socioeconomic inequalities in smoking. In this section we formulate recommendations for policies in this field. Nation-wide tobacco control policies are important in relation to smoking cessation (chapter 5). However, these policies are unlikely to decrease smoking inequalities to an important extent. If the effect of tobacco control policies is similar among the different groups, then inequalities would remain about the same. Therefore, it is important to increase the effectiveness of tobacco control policies among lower socioeconomic groups. First of all, it is important to recognize that there is no 'one size fits all'. Instead, tobacco control measures need to target disadvantaged social groups and be tailored to their needs.

Targeting of socioeconomic groups at high risk requires accurate identification of these groups. For this, it is important to use different socioeconomic indicators for different age groups of interest. Chapter 3 shows that educational level is the best socioeconomic indicator for use among younger age groups, especially in relation to smoking initiation. To identify groups at risk at higher ages, especially in relation to smoking cessation, measure of wealth or occupational class may be preferable.

Our studies show that in most European countries the inequalities in smoking are largest in the youngest generations. Therefore, the less educated groups of these generations deserve special attention, particularly because these groups have a potentially long smoking career ahead of them. In addition, also for smoking, prevention is better than cure. Interventions should therefore ideally focus on the first step in the smoking career: smoking initiation and the transition from incidental smoking to structural, daily smoking.

Tailoring of specific tobacco control measures towards lower socioeconomic groups may be important to increase the effectiveness of these measures. Several approaches may be followed. First, strict enforcement of laws and agreements is required. Restrictions on smoking at the workplace should, for example, be applied consistently across all workplaces to ensure that workers at all levels benefit from their protection. Secondly, financial and other barriers to the use of cessation therapies should be removed. Removal of financial barriers is essential for the delivery of nicotine replacement therapy (NRT) and other cessation services to smokers with a low income [29]. A third approach is to offer services and interventions to deprived neighbourhoods - where most of the uneducated, unemployed or poor people tend to live [30]. Finally, mass media and public education approaches may achieve greater effects among lower socioeconomic groups by tailoring their messages, materials and channels according to the needs and preferences of these groups [31, 32].

Earlier literature suggested that price policies are an effective tool to tackle smoking inequalities. However, in chapter 6 (and consistent with more recent evidence), we found only weak evidence for an effect of cigarette price on smoking inequalities. Simply increasing prices does not appear to be sufficient; price increases can best be included as part of a comprehensive tobacco control policy aimed at lower socioeconomic groups in particular. Consistent with other studies [33], the results in chapter 5 suggest that the comprehensiveness of the national tobacco control policies is important in determining the effectiveness of the policies.

Finally, we would like to illustrate what could be achieved in terms of reduced smoking prevalence rates if all European countries implemented all tobacco control policies in the same comprehensive manner. Tables 2 and 3 present calculations based on the results of chapter 5. In these calculations we estimated what would happen if all European countries were to implement

tobacco control policies in a comprehensive way, i.e. if they scored the maximum of 100 on the Tobacco Control Scale. The tables show that, for Europe at large, the probability to still smoke at age 40 years among men and women would be reduced by 62.5% and 44.3%, respectively, under full implementation of a comprehensive tobacco control policy as compared to the situation in 2005. The international variation in the probability to smoke at age 40 years between countries would become smaller under comprehensive policies, especially among men. Both absolute and relative differences in smoking between higher and lower educated men would decrease, although among women these differences would not change to an important extent. If all European countries would have had comprehensive tobacco control policies in place in 2005, there could be 3.4 million fewer smokers at age 40-44 years in the year 2035. Although these scenarios are only estimates based on assumptions, they illustrate that implementation of comprehensive tobacco control policies has the potential to contribute to a substantial reduction in smoking prevalence in all socioeconomic groups across Europe.

Table 2. Smoking prevalence rates in European countries with comprehensive tobacco control policies: Males

	Population (age 10-14 years in 2005)	Probability of still smoking at 40th birthday		Absolute number of smokers at 40th birthday		Potential smokers saved	Decrease (%)
		status quo[1]	TCS= 100 points[2]	status quo[1]	TCS= 100 points[2]		
Finland	168881	0.28	0.12	46988	20126	26862	57.2
Sweden	316854	0.09	0.02	29292	7421	21871	74.7
Denmark	177531	0.30	0.10	53502	17378	36124	67.5
England	1975500	0.27	0.16	541125	321592	219533	40.6
Ireland	141413	0.28	0.17	39235	24096	15139	38.6
Netherlands	516830	0.24	0.08	125515	42193	83322	66.4
Belgium	322751	0.28	0.10	90237	31433	58804	65.2
Germany	2203007	0.35	0.10	769860	215795	554065	72.0
France	1977854	0.28	0.11	544520	217033	327487	60.1
Italy	1456921	0.33	0.15	480848	215947	264901	55.1
Spain	1073956	0.44	0.12	470660	133544	337116	71.6
Portugal	284236	0.43	0.15	121853	41178	80675	66.2
Hungary	306066	0.40	0.15	121799	47240	74559	61.2
Czech Rep.	311703	0.33	0.09	101199	27999	73200	72.3
Slovakia	188165	0.33	0.12	61457	22242	39215	63.8
Lithuania	125081	0.54	0.18	67197	22832	44365	66.0
Latvia	73795	0.53	0.16	39404	11863	27541	69.9
Estonia	41840	0.50	0.20	20741	8266	12475	60.1
EU: all	11662384	0.32	0.12	3725432	1428178	2297254	61.7

Note: [1] status quo refers to situation of implementation of tobacco control policies in 2005, scored by the Tobacco Control Scale (TCS) [34]
[2] TCS = 100 points: situation if all countries would have implemented all policies that are mentioned in the Tobacco Control Scale. 100 points is the maximum score on this scale.

Table 3. Smoking prevalence rates in European countries with comprehensive tobacco control policies: Females

	Population (age 10-14 years in 2005)	Probability of still smoking at 40th birthday		Absolute number of smokers at 40th birthday		Potential smokers saved	Decrease (%)
		status quo[1]	TCS= 100 points[2]	status quo[1]	TCS= 100 points[2]		
Finland	162,552	0.17	0.99	26,941	16,078	10,863	40.3
Sweden	301,250	0.14	0.08	41,079	22,612	18,467	45.0
Denmark	168,497	0.26	0.14	44,539	23,546	20,993	47.1
England	1,871,400	0.23	0.17	427,318	312,650	114,668	26.8
Ireland	134,002	0.28	0.22	37,588	29,785	7,803	20.8
Netherlands	493,202	0.17	0.84	84,714	41,184	43,530	51.4
Belgium	308,134	0.19	0.09	57,824	28,541	29,283	50.6
Germany	2,090,343	0.26	0.13	549,874	269,958	279,916	50.9
France	1,885,222	0.19	0.10	357,297	189,179	168,118	47.1
Italy	1,379,026	0.19	0.12	259,503	163,629	95,874	36.9
Spain	1,016,351	0.36	0.18	363,102	179,718	183,384	50.5
Portugal	272,228	0.15	0.08	41,994	21,676	20,318	48.4
Hungary	292,659	0.29	0.17	83,658	49,314	34,344	41.1
Czech Rep.	295,771	0.17	0.07	50,128	21,559	28,569	57.0
Slovakia	179,826	0.12	0.06	21,969	11,435	10,534	47.9
Lithuania	125,081	0.16	0.08	20,151	10,543	9,608	47.7
Latvia	71,260	0.25	0.12	17,567	8,587	8,980	51.1
Estonia	39,751	0.22	0.12	9,018	4,672	4,346	48.2
EU: all	11,086,555	0.12	0.13	2,494,264	1,404,666	1,089,598	43.7

Note: [1] status quo refers to situation of implementation of tobacco control policies in 2005, scored by the Tobacco Control Scale (TCS) [34]
[2] TCS = 100 points: situation if all countries would have implemented all policies that are mentioned in the Tobacco Control Scale. 100 points is the maximum score on this scale.

Implications for monitoring of smoking inequalities

Monitoring of tobacco consumption is important for tobacco control policies in terms of identifying specific groups at risk, and of assessing factors associated with smoking among lower socioeconomic groups. Until recently, monitoring of trends in tobacco consumption was usually carried out for national populations, without a specific focus on socioeconomic inequalities. Chapter 2 demonstrated that nowadays data sources and indicators are available to monitor socioeconomic inequalities in smoking at the national or regional level.

Educational level is a key socioeconomic indicator and should therefore be included in all equity-oriented monitoring systems. However, socioeconomic status is not determined by educational level alone. Studies should preferably use more than one indicator. The choice of additional socioeconomic indicators can best be made from an explicit life course perspective. The relative importance of different socioeconomic indicators is likely to change over a person's life course, if only because each socioeconomic indicator is formed during different phases of life. Especially among the older age group, occupational class, accumulated wealth and housing tenure need to be included in addition to educational level.

Current smoking status (classified as current smoker, ex-smoker, or never-smoker) is a core smoking indicator used to describe socioeconomic inequalities in the prevalence of smoking. Nevertheless, the use of complementary smoking indicators would have significant additional value. From a life course perspective smoking is a process, not a static behaviour. In order to understand smoking status at any particular age, it is important to focus on changes in smoking status during the preceding life course. Indicators of smoking initiation and smoking cessation can be used to understand changes over time and to evaluate effects of policies. Estimates of inequalities in initiation and cessation rates are needed to identify the most important age groups at risk and to suggest entry points for policies to tackle inequalities in smoking. In addition to indicators, measures of cumulative smoking exposure (e.g. years of smoking and consumption level) are needed, for example to predict the extent to which current inequalities in smoking will contribute to inequalities in smoking and health in the future.

Cross-sectional surveys are the preferred data source for monitoring of smoking inequalities because they usually cover large and nationally representative samples. When retrospective questions regarding age at initiation and age at cessation are included, these surveys also enable a descriptive study of inequalities in smoking initiation and cessation over the life course. Important in this context is information on age at cessation or time since cessation.

Implications for future research

In this thesis we studied possibly important contextual factors in relation to the international variation in smoking inequalities. The factors that we assessed explained only a modest part of the international variation in smoking prevalence and in smoking inequalities across Europe. This indicates a need for more research to further elucidate key processes and factors. Particular attention should be paid to factors that were important in determining the start and diffusion of the smoking epidemic in different countries. Potentially important country characteristics include cultural processes such as individualization, and prevailing attitudes towards preventive policies, socioeconomic conditions, tobacco control policies and history of the influence of the tobacco industry.

This thesis has shown that large smoking inequalities still exist in all parts of Europe and are expected to increase in the near future. Future studies should assess the factors that have affected the current magnitude of smoking inequalities and should explore factors that might be addressed in order to tackle inequalities in smoking. Country characteristics possibly amenable to change smoking habits include tobacco control policies, as well as national values and norms towards health and smoking. Some countries are currently implementing tobacco control policies. Time-series studies covering several countries would allow to evaluate the impact of these policies on smoking at national levels and on smoking inequalities. Future studies in this field should preferably include a time dimension, and assess trends at the individual (or at least at the national) level, in order to obtain stronger evidence about the effect of new tobacco control policies on smoking in different population groups, and among disadvantaged groups in particular.

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Summary

Part I: Introduction

Smoking of cigarettes is unequally distributed among the various socioeconomic groups. In Europe the highest prevalence rates are currently found among lower socioeconomic groups. Inequalities are observed for all aspects of smoking, i.e. lower socioeconomic groups are more likely to ever start smoking, experience more difficulties to stop smoking, and smoke on average more cigarettes per day during their smoking years. Consequently, also the burden of disease and death related to smoking is disproportionately experienced in lower socioeconomic groups.

Although socioeconomic inequalities in smoking are observed in all European countries, large variations exist between countries with regard to the size, direction and trends of these inequalities. In the 1990s several studies observed an interesting geographic pattern, with large educational inequalities in smoking in northern European countries and smaller or even reversed inequalities in southern European countries.

Even though several studies have described this geographical pattern in smoking inequalities, 'white spots' still exist in the European map of inequalities in smoking. In this thesis we examined the international variations in socioeconomic inequalities in smoking in Europe, with the aim to further elucidate these variations. We also aimed to study relationships with health inequalities and, more specifically, inequalities with regard to lung cancer.

The following research aims guided most of the empirical analyses: 1) to describe associations between different socioeconomic indicators and smoking behaviour in different parts of Europe around the year 2000, 2) to explore whether international variations in smoking behaviour and smoking inequalities can be explained by specific characteristics of the countries, and 3) to examine whether these international differences in smoking inequalities are reflected in international differences in inequalities in the incidence of lung cancer.

Most of the results in this thesis are based on the Eurothine project, a large international project with the goal to improve the description of health inequalities in Europe and to enhance the evidence base for policies to reduce inequalities in health. Within the Eurothine project morbidity and mortality data were collected for 19 European countries from all regions of Europe.

Thanks to this wide range of countries, we are the first to include eastern European countries in an international overview on smoking inequalities. In the Eurothine project, smoking data were obtained from national interview surveys around the year 2000, and lung cancer mortality data were derived from longitudinal studies conducted between 1990 and 2003. In most analyses we used educational level as the key indicator of socioeconomic status.

Part II: Methodological issues related to the study of smoking inequalities

Our work started with two studies that aimed to evaluate the methods to be applied when investigating inequalities in smoking. First, we conducted a literature review focusing on the study designs, socioeconomic indicators and smoking outcomes applied in recent studies on inequalities in smoking (Chapter 2). The review showed that most studies in this field had a cross-sectional design and measured smoking prevalence rates among adults in relation to educational level. However, in addition to educational level, measures of household wealth and occupational class also showed a strong association with smoking measures. It is therefore recommended to use other socioeconomic indicators, in addition to educational level, to identify socioeconomic groups where smoking rates are highest. From the review it was concluded that estimates of inequalities in initiation and cessation rates are needed to identify the most important age groups and entry points for policies aimed at addressing inequalities in smoking.

Next, we examined the extent to which smoking behaviour is related to other socioeconomic indicators in addition to educational level (Chapter 3). Data were derived from the European Household Panel. Consistent with the review, Chapter 3 showed that smoking is not only related to educational level but also to occupational class and measures of wealth. Surprisingly, Chapter 3 showed that smoking is not related to income or employment status. In some cases, the use of different socioeconomic indicators resulted in different geographical patterns. In southern Europe, although educational inequalities existed among women aged 40-60 years they seemed to be in favour of the less educated women (i.e. they smoked less often); however, if we used housing tenure (a measure of wealth) as the socioeconomic indicator it appeared that women who were worse off (i.e. renting their accommodation) were more likely to smoke. In

addition, the size of the inequalities differed per indicator, and which indicator is most important in relation to smoking differed according to the population. For example, whereas educational level showed the largest inequalities in the younger generation in northern Europe, in the older generation occupational class and measures of wealth proved to be more important.

Part III: International patterns of smoking inequalities

In the second part of this thesis we carried out a series of studies to assess the extent to which national characteristics are related to international variations in smoking and to inequalities in smoking. In all studies, we started with a description of international patterns of the inequalities in smoking in Europe around the year 2000. Different aspects of smoking were described. Next, in each chapter, we examined relationships with contextual variables such as current level of economic development, emancipation, nation-wide tobacco control policies and cigarette price.

In Chapter 4 we examined the socioeconomic inequalities in female ever-smoking rates in 19 European countries, and explored the association of cross-national differences in these inequalities with the current level of economic development (measured by GDP) and women's emancipation as measured by the Gender Empowerment Measure (GEM). Ever- smoking rates were used to measure the extent of smoking initiation in different generations. The size of educational inequalities in ever-smoking rates varied considerably between countries and reversed within three age groups (often, in younger age groups less educated women were more likely to have ever smoked, while in older age groups the opposite was found). For women aged 25-39 years the association of ever-smoking rates with GDP was positive, especially for higher educated women. The associations of ever-smoking rates with the GEM were weak and varied by educational level. The GEM was negatively associated with ever-smoking rates among higher educated women, but positively associated with ever- smoking rates among lower educated women. Our results suggest that economic development and socio-cultural processes related to emancipation have affected ever smoking in different ways for higher and lower educated women.

In Chapter 5 we focused on smoking cessation in relationship to tobacco control policies. We used the Tobacco Control Scale (TCS) to quantify the implementation of tobacco control policies at country level. Cumulative smoking cessation ratios were especially high (45%) in Sweden, England, the Netherlands, Belgium and France, and relatively low (30%) in Lithuania and Latvia. Higher educated smokers were more likely to have quit smoking than lower educated smokers in all age/sex groups in all countries. National scores on the TCS were positively associated with cessation ratios in all age/sex groups. These associations were not consistently stronger or weaker among lower educated smokers compared with higher educated groups. Thus, smokers from both educational levels seem to benefit about equally from the nation-wide tobacco control policies. Of all components of the TCS, the one measuring price policies showed the strongest association with quit ratios, followed by the component measuring the existence of advertisement bans.

Given the positive results for price policies, in Chapter 6 we further explored the association between cigarette price and different aspects of smoking behaviour. For the age group 16-29 years we calculated variables on smoking status (age-standardized prevalence rates, ever-smoking ratios, and smoking continuation ratios) and smoking consumption levels (number of cigarettes smoked per capita and per smoker). We observed large international variations in all aspects of smoking behaviour among both men and women. The price of cigarettes was negatively correlated with smoking among men, and the associations were somewhat stronger for less educated smokers compared to more educated smokers. However, possibly due to the small number of countries included, our results were not statistically significant. Associations among women were weak and less consistent, especially for ever-smoking rates, possibly due to confounding by cultural factors. From the results for men we concluded that price policies are likely to be an effective tool to reduce smoking inequalities, but probably only in combination with other tobacco control measures.

In conclusion, the following two national characteristics were found to be related to the prevalence of smoking in Europe. Economic development was associated with ever smoking among women, and comprehensive tobacco control policies were associated with higher cessation rates. However, with the exception of economic development, we did not observe any clear associations

between the country characteristics and the magnitude of inequalities in smoking. Regarding tobacco control policies, the evidence indicates that higher and lower educational groups benefit about equally from more comprehensive policies.

Part IV: Smoking and inequalities in lung cancer mortality

In the final analysis in this thesis (Chapter 7) we focused on one of the most important smoking-related diseases: lung cancer. We observed large socioeconomic inequalities in lung cancer mortality in most European countries. Among men educational inequalities were largest in the eastern European and the Baltic countries, whereas among women they were largest in northern European countries. The international pattern of these inequalities was consistent with the international variations in smoking inequalities, although the correlation was not perfect. In most countries the contribution of lung cancer mortality inequalities to inequalities in all-cause mortality in male populations was over 10%. For women, the contribution ranged from 1%-14% in northern and eastern European countries, but was negative (between -5% and -10%) in southern European populations. Based on the evidence from this and other analyses, we expect that socioeconomic inequalities in lung cancer are likely to persist and may even increase in the coming decades.

Part V: Discussion, conclusions and implications

Chapter 8, the General Discussion, starts with a summary of the main findings of this thesis. In the introduction we formulated three research aims. The first aim was to describe the association between different socioeconomic indicators in Europe around the year 2000. We observed socioeconomic inequalities in different aspects of smoking in all European regions, and the size of the inequalities varied across countries. The largest inequalities in most aspects of smoking were still found in northern and western European countries. In all regions, inequalities in smoking were largest in the younger age groups.

The second objective was to explore whether the international variations in smoking and smoking inequalities could be explained by country characteristics. We found that some contextual variables, such as tobacco control policies, have been important in relation to smoking behaviour in Europe. However, except in the case of economic development, we did not find significant

associations between the contextual variables and smoking inequalities. Thus, the international variations in smoking inequalities remained largely unexplained.

The third aim was to study whether the international differences in smoking inequalities are reflected in similar differences in inequalities in lung cancer mortality. Chapter 7 showed that this is indeed the case; we found important socioeconomic inequalities in lung cancer mortality, with the largest inequalities among men in eastern European countries and among women in northern European countries.

Next, we discussed the methodological limitations that should be acknowledged when interpreting the results. The main threats to the validity of our results were information bias and confounding bias. For example, in all three explanatory studies (Chapters 4, 5 and 6) we were not able to collect data on the independent variables for the preferred time period. Further, in most of our studies we controlled for possible confounders such as current level of economic development, female labour force participation, and also the smoking epidemic. These methodological issues have consequences for the interpretation of our results, therefore we need to apply caution when drawing conclusions about causality (Chapters 4, 5 and 6), when there was no appropriate time lag, or when control for confounding is only partial.

We then presented an overview of the possible explanations for the international variations in smoking behaviour and in smoking inequalities. Three types of factors were discussed: 1) tobacco control policies, 2) economic development, and 3) socio-cultural processes. First, countries with a more comprehensive tobacco control policy appeared to have higher cessation rates. Recent tobacco control policies, however, do not seem to affect the smoking inequalities, as both higher and lower educated groups appeared to benefit equally from these policies. Second, the current level of economic development (as measured with GDP) appeared to be associated with all aspects of smoking and also with smoking inequalities. The pattern in the associations between GDP and smoking behaviour is consistent with the smoking epidemic, suggesting that economic development has been important with respect to the diffusion of smoking in societies in Europe. Several mechanisms could have been important in this process, including increased purchasing power, intensive marketing by the tobacco industry on new markets, and increased

exposure to developments originating in the USA, especially among countries with close trade relations with the USA. Third, we considered the role of socio-cultural processes. We found that, contrary to frequent suggestions in the literature, women's emancipation is not strongly related to the diffusion of smoking among women. We suggest that broader socio-cultural factors are more important, such as individualization and the wider societal processes that maintain or change value systems.

The results of our thesis have implications for 1) policy development, 2) monitoring activities, and 3) future research. First, with regard to policies, the most important implication is that it is necessary to increase the effectiveness of tobacco control policies among lower socioeconomic groups. Nation-wide tobacco control policies are important in relation to smoking cessation, but these policies are unlikely to decrease smoking inequalities if they lack a specific focus on lower socioeconomic groups. Tobacco control measures need to target disadvantaged social groups and be tailored to their needs. For example, smoking cessation services need to be pro-active and free of charge. Second, in terms of monitoring smoking inequalities, this should be done on a routine basis to provide entry points for equity-oriented policies. Educational level should be included in all monitoring systems, but studies should preferably also use other indicators (e.g. occupational class, measure of wealth), especially among the older age groups.

Furthermore, monitoring studies should use indicators of smoking initiation and smoking cessation in order to understand changes over time and to evaluate the effects of policies. Finally, with regard to future research, we suggest to further explore the national factors that have been important in relation to the start and diffusion of the smoking epidemic within and across countries. Moreover, future studies should assess factors that have affected the current magnitude of smoking inequalities, paying particular attention to factors that might help tackle inequalities in smoking. Items that may be used to improve the smoking situation include tobacco control policies, and national values and norms towards good health and against smoking.

SAMENVATTING

Deel I: Introductie

Het roken van sigaretten is ongelijk verdeeld over de verschillende sociaal economische groepen in de bevolking. In Europa komt roken op dit moment het meest voor in de lagere sociaal economische groepen. De ongelijkheden zien we terug bij alle aspecten van roken; mensen uit de lagere sociaal economische groepen starten over het algemeen vaker met roken, zij hebben vervolgens meer moeite om te stoppen met roken en zij roken gemiddeld meer sigaretten per dag tijdens hun ' rookjaren'. Als gevolg hiervan komen in de lagere sociaal economische groep ook meer ziektes en sterfgevallen voor die samenhangen met roken.

Hoewel sociaal economische ongelijkheden in roken in alle Europese landen bestaan, zijn er belangrijke verschillen tussen landen wat betreft de grootte, de richting en de trends van deze ongelijkheden. In de jaren ' 90 beschreven verschillende studies een interessant geografisch patroon, met grote verschillen in roken in Noord Europa en kleinere of zelfs omgekeerde verschillen (m.a.w. meer rokers in hoger sociaal economische groepen) in Zuid Europa.

Meerdere studies hebben dit opvallende noord-zuid patroon in ongelijkheden in roken beschreven. Toch zijn er nog altijd een aantal witte vlekken op de kaart van Europa als het gaat om ongelijkheden in roken. In dit proefschrift hebben wij deze internationale verschillen in ongelijkheden in roken in meer detail beschreven, bestudeerd, en vervolgens ook pogingen gedaan de internationale verschillen te verklaren. Daarnaast wilden we ook de relatie met ongelijkheden in gezondheid, in het bijzonder de ongelijkheden in longkanker, nader bestuderen.

De volgende onderzoeksdoelen vormden de basis voor de empirische analyses waarvan in dit proefschrift verslag is gedaan: 1) het beschrijven van de associaties tussen verschillende sociaal economische indicatoren en rookgedrag in verschillende delen van Europa rond het jaar 2000, 2) onderzoeken of de internationale verschillen in rookgedrag en ongelijkheden in roken kunnen worden verklaard aan de hand van specifieke kenmerken van landen, en 3) onderzoeken of deze internationale verschillen in ongelijkheden in roken hun weerslag hebben op internationale verschillen in ongelijkheden in sterfte aan longkanker.

Het grootste deel van de analyses in dit proefschrift is gebaseerd op data uit het Eurothine project. Dit is een groot internationaal project dat als doel had het verbeteren van de beschrijving van de ongelijkheden in gezondheid in Europa en het vergroten van de wetenschappelijke basis voor beleid om de ongelijkheden te verkleinen. Binnen het Eurothine project zijn gegevens over mortaliteit, morbiditeit en risicofactoren voor ziekte verzameld voor 19 Europese landen uit alle regio's in Europa. Wij zijn de eerste die Oost-Europese landen hebben kunnen opnemen in een internationaal overzicht van ongelijkheden in roken. In het Eurothine project zijn de rookgegevens afkomstig uit nationale persoonsenquêtes die rond het jaar 2000 zijn afgenomen. De gegevens over sterfte aan longkanker zijn afkomstig uit verschillende nationale sterftestudies die uitgevoerd zijn tussen 1990 en 2003. In de meeste analyses hebben we opleidingsniveau gebruikt als de centrale indicator van sociaal economische status.

Deel II: Methodologische aspecten van onderzoek naar rookongelijkheden

Ons werk begon met twee studies die als doel hadden om de methoden die worden gebruikt in het bestuderen van rookongelijkheden te evalueren en te verfijnen. Allereerst hebben we een literatuur onderzoek uitgevoerd met als doel de studieopzet, de gebruikte sociaal economische indicatoren en de gebruikte rookmaten in 70 recente studies op het gebied van rookongelijkheden te inventariseren (Hoofdstuk 2). Het onderzoek liet zien dat de meeste studies in dit veld cross-sectioneel van aard zijn en rookprevalenties onder volwassen hebben beschreven aan de hand van opleidingsniveau. Toch werden ook met andere maten van sociaal economische status een sterke samenhang gevonden met rookmaten. Het is daarom aan te bevelen om naast opleidingsniveau ook andere sociaal economische indicatoren te gebruiken bij het identificeren van de groepen waar het meest gerookt wordt. Uit het literatuuronderzoek bleek daarnaast dat het belangrijk is om afzonderlijke analyses te verrichten van de kansen beginnen met roken en op stoppen met roken. Door naar deze twee overgangskansen in het rookgedrag te kijken, kunnen de belangrijkste leeftijdsgroepen en determinanten worden geïdentificeerd waar verder onderzoek en beleid zich op zouden moeten richten.

Vervolgens hebben we de mate bestudeerd waarin rookgedrag is gerelateerd aan andere sociaal economische indicatoren dan opleidingsniveau (Hoofdstuk 3). De data die we gebruikt hebben voor deze studie kwamen uit ' the European Household Panel'. In overeenstemming met het literatuur onderzoek, laat ook hoofdstuk 3 zien dat roken niet alleen gerelateerd is aan opleidingsniveau maar ook aan beroepsklasse en maten van welvaart. Opmerkelijk genoeg bleek dat roken niet gerelateerd was aan inkomensniveau of werkeloosheid, indien voor andere sociaal economische variabelen werd gecontroleerd. In sommige gevallen hingen de resultaten af van het land of regio dat werd onderzocht. In Zuid Europa vonden we bijvoorbeeld voor vrouwen in de leeftijd van 40-60 jaar meer rokers in de hoger opgeleide groep, terwijl wanneer we 'huizenbezit' gebruikten om sociaal economische status te bepalen vonden we dat de vrouwen die huurden (lagere sociaal economische status) vaker rookten. Daarnaast vonden we dat de resultaten afhingen van de onderzochte leeftijden. Bijvoorbeeld, daar waar opleidingsniveau de grootste ongelijkheden laat zien in de jongere generatie in noord Europa, blijken in de oudere generatie beroepsklasse en maten van welvaart het sterkst met roken samen te hangen.

Deel III: Internationale patronen in rookongelijkheden

In het tweede deel van dit proefschrift hebben we een aantal studies uitgevoerd waarin we onderzochten in welke mate nationale kenmerken gerelateerd zijn aan de internationale verschillen in roken en ongelijkheden in roken. We begonnen alle studies met een beschrijving van het internationale patroon in de ongelijkheden in roken in Europa rond het jaar 2000. Verschillende aspecten van het rookgedrag zijn beschreven. Vervolgens hebben we in deze studies de relatie onderzocht tussen het internationale patroon in roken en contextuele variabelen zoals het huidige economische ontwikkelingsniveau (BNP), de mate van emancipatie, de ontwikkeling van anti-tabaksbeleid en de hoogte van de tabaksprijs.

In Hoofdstuk 4 hebben we gekeken naar de sociaal economische ongelijkheden in het aantal vrouwen dat ooit heeft gerookt ('ever-smoking') in 19 Europese landen. Wij onderzochten de relatie tussen de internationale verschillen in ever smoking en het huidige niveau van economische ontwikkeling (gemeten aan de hand van het BNP) en de mate van vrouwenemancipatie (gemeten met de Gender Empowerment Measure (GEM)). De prevalentie van aantal mensen dat

ooit heeft gerookt werd gemeten voor verschillende generaties. De grootte van de opleidingsverschillen in het aantal vrouwen dat ooit gerookt heeft varieerde aanzienlijk tussen landen. De richting van die ongelijkheden is omgedraaid met drie generaties: in de meeste landen werd er in de jongere leeftijdsgroep het meest gerookt door laag opgeleiden, terwijl dat in de oudste leeftijdsgroep andersom was. In het geval van vrouwen in de leeftijd van 25-39 jaar vonden we een positieve relatie tussen BNP en het aandeel vrouwen dat ooit gerookt had, vooral in het geval van hoog opgeleide vrouwen. De relatie met de mate van emancipatie was zwak en verschilde per opleidingsgroep; emancipatie was negatief gerelateerd aan de kans op ooit roken onder hoog opgeleide vrouwen, maar positief in het geval van laag opgeleide vrouwen. Onze resultaten suggereren dat economische ontwikkeling en sociaal-culturele processen die samenhangen met emancipatie het rookgedrag op verschillende manieren heeft beïnvloed bij hoger en lager opgeleide vrouwen.

In Hoofdstuk 5 hebben we ons gericht op het stoppen met roken in relatie tot anti-tabaksbeleid. We hebben gebruik gemaakt van de Tobacco Control Scale (TCS) om de mate waarin anti-tabaksbeleid is ontwikkeld te kwantificeren voor de verschillende Europese landen. Ook dit hoofdstuk begon met een beschrijving van het internationale patroon in (ongelijkheden in) de kans op stoppen met roken. Het percentage ooit rokers dat nu gestopt is was hoog (ongeveer 45%) in Zweden, Engeland, Nederland, België en Frankrijk en relatief laag (ongeveer 30%) in Litouwen en Letland. Het bleek dat in alle landen en voor alle leeftijdsgroepen, het waarschijnlijker was dat een hoger opgeleide roker gestopt was met roken dan een lager opgeleide roker. De nationale score op de TCS was positief gerelateerd aan de kans op stoppen met roken in alle subgroepen. Deze associaties waren niet consistent sterker of zwakker voor lager opgeleide groepen dan voor hoog opgeleiden. Dit duidt erop dat rokers uit zowel de laag opgeleide als de hoog opgeleide groep profiteren van de nationale anti-tabaks maatregelen. Van alle componenten waaruit de TCS is opgebouwd, bleek prijs van sigaretten de sterkste associatie te vertonen met het stoppen met roken, gevolgd door een verbod op tabaksadvertenties.

Gezien de relatief sterke relatie tussen de prijs van sigaretten en het stoppen met roken die in hoofdstuk 5 werd gevonden, hebben we in Hoofdstuk 6 de associatie tussen prijs en verschillende aspecten van het rookgedrag verder onderzocht. Voor de leeftijdsgroep 16-29 jaar hebben we verschillende aspecten

van roken bekeken: het % respondenten dat nu rookt, het % dat ooit heeft gerookt, het % ooit rokers dan inmiddels is gestopt, en het aantal sigaretten dat per roker resp. per respondent wordt geconsumeerd. Wederom vonden we grote internationale verschillen in alle aspecten van het rookgedrag bij zowel mannen als vrouwen. De prijs van sigaretten bleek negatief gecorreleerd met roken onder mannen, de associatie was iets sterker in het geval van lager opgeleide rokers in vergelijking met hoger opgeleide rokers. Onze resultaten waren echter niet statistisch significant, mogelijk als gevolg van het kleine aantal landen dat opgenomen kon worden in de analyses. De associaties tussen prijs en rookgedrag onder vrouwen waren zwak en minder eenduidig. Dit was vooral het geval bij het % vrouwen dat ooit rookte, waarbij mogelijk sprake is van verstoring van de onderzochte associatie door culturele factoren. Uit de resultaten voor mannen concludeerden wij dat beleid gericht op de prijs van sigaretten mogelijk een effectief middel is om de ongelijkheden in roken te verkleinen, maar waarschijnlijk alleen in combinatie met andere anti-tabaks maatregelen.

Concluderend kunnen we stellen dat sommige nationale kenmerken gerelateerd zijn aan rookgedrag in Europa. Economische ontwikkeling bleek samen te hangen met de kans op ooit roken onder vrouwen, en een goed ontwikkeld anti-tabaks beleid was geassocieerd met de kans dat ooit rokers al waren gestopt ten tijde van de persoonsenquêtes. Desalniettemin hebben we, economische ontwikkeling daar gelaten, geen duidelijke associaties gevonden tussen landenkenmerken en de grootte van ongelijkheden in roken. Wat betreft het anti-tabaks beleid duiden onze resultaten erop dat hoog en laag opgeleide rokers hier ongeveer evenveel van profiteren.

Deel IV: Roken en ongelijkheden in longkanker sterfte

In het laatste deel van dit proefschrift (Hoofdstuk 7) hebben we ons gericht op één van de belangrijkste rook-gerelateerde ziektes: longkanker. We vonden grote sociaal economische ongelijkheden in longkankersterfte in de meeste Europese landen. In het geval van mannen waren de ongelijkheden het grootst in Oost-Europese landen en de Baltische staten, terwijl de ongelijkheden onder vrouwen het grootst waren in Noord-Europese landen. Het internationale patroon van de ongelijkheden in longkanker sterfte komt grotendeels overeen met het geografische patroon dat wordt waargenomen bij ongelijkheden

in roken. In de meeste landen was de bijdrage van de ongelijkheden in longkankersterfte bij mannen aan de ongelijkheden in de totale sterfte meer dan 10%. In het geval van vrouwen varieerde deze bijdrage van 1 tot 14% in Noord- en Oost-Europese landen, en was zelfs negatief (tussen -5 en -10%) in Zuid-Europese populaties. Wij verwachten, gezien onze resultaten en resultaten uit eerdere analyses, dat de sociaal economische ongelijkheden in longkanker zullen blijven bestaan en mogelijk zelfs zullen toenemen in de komende decennia.

Part V: Discussie, conclusies en implicaties

Hoofdstuk 8, de algemene discussie, begint met een samenvatting van de belangrijkste bevindingen van dit proefschrift. In de introductie hebben we drie onderzoeksdoelen geformuleerd. Het eerste doel was om de associatie te beschrijven tussen verschillende sociaal economische indicatoren en roken in Europa rond het jaar 2000. We vonden sociaal economische ongelijkheden in verschillende aspecten van het rookgedrag in alle Europese regio's, waarbij de grootte van de ongelijkheden varieerde tussen landen. De grootste ongelijkheden vinden we voor de meeste aspecten van roken in Noord- en West-Europese landen. In alle regio's waren de ongelijkheden het grootst in de jongere leeftijdsgroepen. Het tweede onderzoeksdoel was vast te stellen in hoeverre de internationale verschillen in roken en ongelijkheden in roken samenhingen met specifieke kenmerken van landen. Uit ons onderzoek blijkt dat sommige van deze kenmerken, zoals de ontwikkeling van anti-tabaks beleid, inderdaad samenhangen met rookgedrag in Europa. Echter, met uitzondering van economische ontwikkeling, hebben we geen overtuigende associaties kunnen vinden tussen landenkenmerken en de omvang van sociaal economische ongelijkheden in roken. Anti-tabaksbeleid hing bijvoorbeeld ongeveer even sterk samen met de kans op stoppen met roken onder hoge en lage opleidingsgroepen. Het derde onderzoeksdoel van dit proefschrift was te onderzoeken of de international verschillen in rookongelijkheden hun weerslag hebben in soortgelijke internationale verschillen in ongelijkheden in longkanker. Hoofdstuk 7 liet zien dat dit inderdaad het geval is; we vonden omvangrijke sociaal economische ongelijkheden in longkanker sterfte, met de grootste ongelijkheden onder mannen in Oost-Europa en onder vrouwen in Noord-Europa en de kleinste ongelijkheden in zuidelijke landen.

Vervolgens hebben we in hoofdstuk 8 de methodologische beperkingen en problemen besproken die van belang zijn voor de interpretatie van onze resultaten. De belangrijkste problemen waren informatie bias en een confounding bias. In de drie verklarende studies (hoofdstuk 4, 5 en 6) waren we bijvoorbeeld niet in staat gegevens over relevante landenkenmerken (economische ontwikkeling, emancipatie en tabaksprijs) te verzamelen voor de meest geschikte tijdsperiode in het recente verleden. En hoewel we in de meeste studies in dit proefschrift hebben gecontroleerd voor mogelijke 'derde' factoren die de relatie tussen de landenkenmerken en het rookgedrag zouden kunnen beïnvloeden ('confounders', zoals vrouwenarbeidsparticipatie en de rookepidemie), kunnen we niet uitsluiten dat we de waargenomen associaties zijn beïnvloed door confounders die wij niet konden meten. Deze methodologische problemen hebben consequenties voor de interpretatie van de resultaten., en nopen tot voorzichtigheid bij het trekken van conclusies over de causaliteit van de waargenomen relaties (hoofdstuk 4, 5 en 6) Toch zijn sommige van de waargenomen associaties aannemelijk in het licht van eerdere literatuur en dragen onze studies bij een de "evidence base" voor bijvoorbeeld de rol van nationaal anti-tabaksbeleid.

Na de bespreking van de methodologische problemen, hebben we in hoofdstuk 8 een aantal mogelijke verklaringen voor de internationale verschillen in rookgedrag en rookongelijkheden besproken. In dit verband hebben we drie type factoren de revue laten passeren: 1) anti-tabaksbeleid, 2) economische ontwikkeling en 3) sociaal-culturele processen. Allereerst het anti-tabaksbeleid. Het bleek dat in landen met een goed samenhangend anti-tabaks beleid meer rokers gestopt waren. Recente anti-tabaks maatregelen lijken echter de omvang van de sociaal economische ongelijkheden in roken niet sterk te beïnvloeden, aangezien zowel hoog als laag opgeleide rokers ongeveer evenveel lijken te profiteren van deze maatregelen. Als tweede factor bespraken we economische ontwikkeling. Het huidige niveau van economische ontwikkeling (gemeten als BNP) bleek geassocieerd te zijn met alle aspecten van het rookgedrag en ook met de omvang van sociaal economische ongelijkheden in roken. Het patroon van associaties tussen BNP en roken toont parallellen met de ontwikkeling van ongelijkheden gedurende de rookepidemie. Dit suggereert dat economische ontwikkeling belangrijk is geweest in relatie tot de verspreiding van roken

in Europa in gedurende de 20ste eeuw. Verschillende mechanismen kunnen hierbij van belang geweest zijn, zoals bijvoorbeeld een toename in koopkracht, intensieve marketing van de tabaksindustrie, en een grotere blootstelling aan marktinvloeden uit Amerika. Als derde en laatste factor bekeken we sociaal-culturele processen. We vonden, in tegenstelling tot de vaak gedane suggesties in de literatuur, geen aanwijzingen voor een sterke invloed van emancipatie op de verspreiding van roken onder vrouwen in Europa. Voor vrouwen en mannen werden vergelijkbare associaties gevonden met maten van emancipatie. Onze indruk is dat bredere sociaal-culturele factoren hier een rol spelen, zoals individualisering en de brede maatschappelijke processen die de bestaande waarden en normen ten aanzien van roken beïnvloeden

De resultaten die gepresenteerd zijn in dit proefschrift hebben implicaties voor beleidsontwikkeling, voor het monitoren van ontwikkelingen in roken en voor toekomstig onderzoek. Wat betreft het anti-tabaksbeleid, onderstrepen de resultaten hoe belangrijk het is om de effectiviteit van de anti-tabaksmaatregelen onder de lagere sociaal economische groepen te verhogen. Nationaal anti-tabaksbeleid is belangrijk gebleken in relatie tot het stoppen met roken, maar het is onwaarschijnlijk dat het beleid tot nog toe de ongelijkheden in roken zullen verkleinen. Belangrijk is de inhoud van het anti-tabaksbeleid af te stemmen op de rokers uit lagere sociaal economische groepen. Anti-tabaks maatregelen gericht op lagere groepen moeten toegesneden zijn op hun leefsituatie en behoeftes. Zo blijkt bijvoorbeeld uit ander onderzoek dat de maatregelen die gericht zijn op stoppen met roken onder lagere sociaal economische groepen een groter bereik en hogere effectiviteit hebben indien zij pro-actief en gratis zijn.
Op het gebied van monitoring is het belangrijk dat de ongelijkheden in roken regelmatig in kaart worden gebracht, mede gelet op de grote dynamiek in het vóórkomen van roken en de mogelijk grote effecten van nieuw anti-tabaksbeleid. Opleidingsniveau moet worden opgenomen in monitoring systemen, maar waar mogelijk moeten ook andere indicatoren (bijv. beroepsklasse en maten van welvaart) worden gebruikt, vooral bij de oudere leeftijdsgroepen. Daarnaast moeten ook maten van het beginnen en het

stoppen met roken opgenomen worden, om op die manier inzicht te krijgen in de veranderingen in ongelijkheden door de jaren heen en ook om de effecten van beleid nauwkeuriger te kunnen evalueren.

Als laatste hebben we aanbevelingen gedaan voor toekomstig onderzoek. Er moet verder onderzoek worden verricht naar nationale kenmerken die belangrijk zijn geweest in relatie tot de opkomt en de ontwikkeling van de rookepidemie in verschillende landen. Bovendien zou toekomstig onderzoek zich moeten richten op factoren die de grootte van de rookongelijkheden hebben beïnvloed, zoals sociaal-culturele factoren. Speciale aandacht moet worden gegeven aan de rol van nationaal anti-tabaksbeleid en specifieke maatregelen in het kader van dat beleid.

DANKWOORD

Wie had gedacht dat ik nog zou promoveren? Ik niet, drie jaar geleden. Toen kwam ik tot de conclusie dat de wetenschap het niet was voor mij en besloot ik mij om te laten scholen tot juf. In twee jaar zou ik mijn lesbevoegdheid kunnen halen, naast de opleiding kon ik nog twee dagen werken. Anton wilde mij graag helpen om in die tijd alsnog mijn proefschrift af te maken. Dit was voor hem denk ik geen gemakkelijke klus, maar het is ons gelukt. Het boekje is af!

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ABOUT THE AUTHOR
Curriculum Vitae

Maartje Schaap werd geboren op 5 december 1978 in Mijdrecht. In 1997 behaalde ze haar vwo-diploma aan het Alkwin College in Uithoorn. Daarna vertrok ze voor 3 maanden naar Ghana in het kader van een uitwisselingsproject. In september 1998 begon ze aan haar studie Gezondheidswetenschappen aan de Universiteit Maastricht. Zij specialiseerde zich in GezondheidsVoorlichting en deed schreef haar scriptie over de relatie tussen binnenhuisluchtvervuiling en luchtwegaandoeningen in Lima, Peru. Na haar studie werkte ze een jaar als onderzoeker aan de Universiteit Maastricht, onder andere op een project van Cystic Fibrose WorldWide in Georgië en een SOA/HIV project in Zuid Afrika. In juli 2005 begon ze als junior onderzoeker aan de afdeling Maatschappelijke Gezondheidszorg (MGZ) van het ErasmusMC en voerde onderzoek uit wat resulteerde in dit proefschrift. In september 2007 begon Maartje aan de Pabo-opleiding om zich te laten omscholen tot leerkracht basisonderwijs. Tot juli 2009 werkte ze nog twee dagen per week als onderzoeker op MGZ.
Sinds augustus 2009 staat ze als juf voor de klas op een Montessori school in Hoofddorp.
Maartje is getrouwd met Remi Nout en de trotse moeder van dochter Anouk.

List of publications

Schaap MM, Van Agt HME and Kunst AE (2008) Identification of socioeconomic groups at increased risk of smoking in European countries: looking beyond educational level. Nicotine & Tobacco Research 10 (2): 359-369

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PHD PORTFOLIO SUMMARY

Summary of PhD training and teaching activities

Name PhD student: Maartje M. Schaap
Erasmus MC Department: Public Health (MGZ)
Section: Medical Societal Determinants of Public Health (MMDV)
PhD period: 1 July 2005 – 30 June 2009
Promotor: Prof. dr. Johan P. Mackenbach
Supervisor: Dr. Anton E. Kunst

1. PhD training		
	Year	Workload (Hrs/ECTS)
Research skills		
· Writing scientific papers (Dept. of Public Health)	2005	8 hours / 0,3 ECTS
Erasmus Summer Programme, Erasmus MC, Rotterdam		
· Principles of Research in Medicine and Epidemiology	2006	40 hours / 1,4 ECTS
· Regression Analysis		
Presentations		
· Identification of socioeconomic groups at risk of smoking, European Congress of Epidemiology, Utrecht	2006	10 hours / 0,4 ECTS
· Presentation about identification of socioeconomic groups at risk for smoking, Symposium on Health Inequalities, Brussels	2006	10 hours / 0,4 ECTS
· Smoking inequalities in Europe, Eurothine Steering committee meeting in Barcelona	2006	20 hours / 0,8 ECTS
· Inequalities in smoking initiation among women in 19 European countries, Eurothine Consortium meeting in Rotterdam	2007	20 hours / 0,8 ECTS
· Effect of nation-wide tobacco control policies on smoking cessation in 18 European countries, Eurothine Consortium meeting in Rotterdam	2007	20 hours / 0,8 ECTS

International conferences		
· European Congress of Epidemiology, Utrecht	2006	24 hours / 0,9 ECTS
· Symposium on Health Inequalities,Brussels, Belgium	2006	8 hours / 0,3 ECTS
Seminars and workshops		
· Eurothine Steering Committee Meeting, Edinburgh	2005	24 hours / 0,9 ECTS
· Eurothine Steering Committee Meeting, Barcelona	2006	24 hours / 0,9 ECTS
· Eurothine Consortium Meeting, Rotterdam (Organization)	2006 2007	40 hours / 1,6 ECTS 24 hours / 0,9 ECTS
· Eurothine Steering Committee Meeting, Barcelona	2009	40 hours / 1,6 ECTS
· Dynamo-HIA Consortium Meeting, Rotterdam (Organization)	2005-09	100 hours / 3,5 ECTS
· Attending seminars of the Department of Public Health	2005-07	360 hours / 12,9 ECTS
· Other		
· Database management of Eurothine survey data		
2. Teaching activities		
Supervising practicals and excursions		
Curriculum medical students, 4th year, ErasmusMC Rotterdam		
· Theme 4.2 'The population as patient'	2006	40 hours / 1,6 ECTS