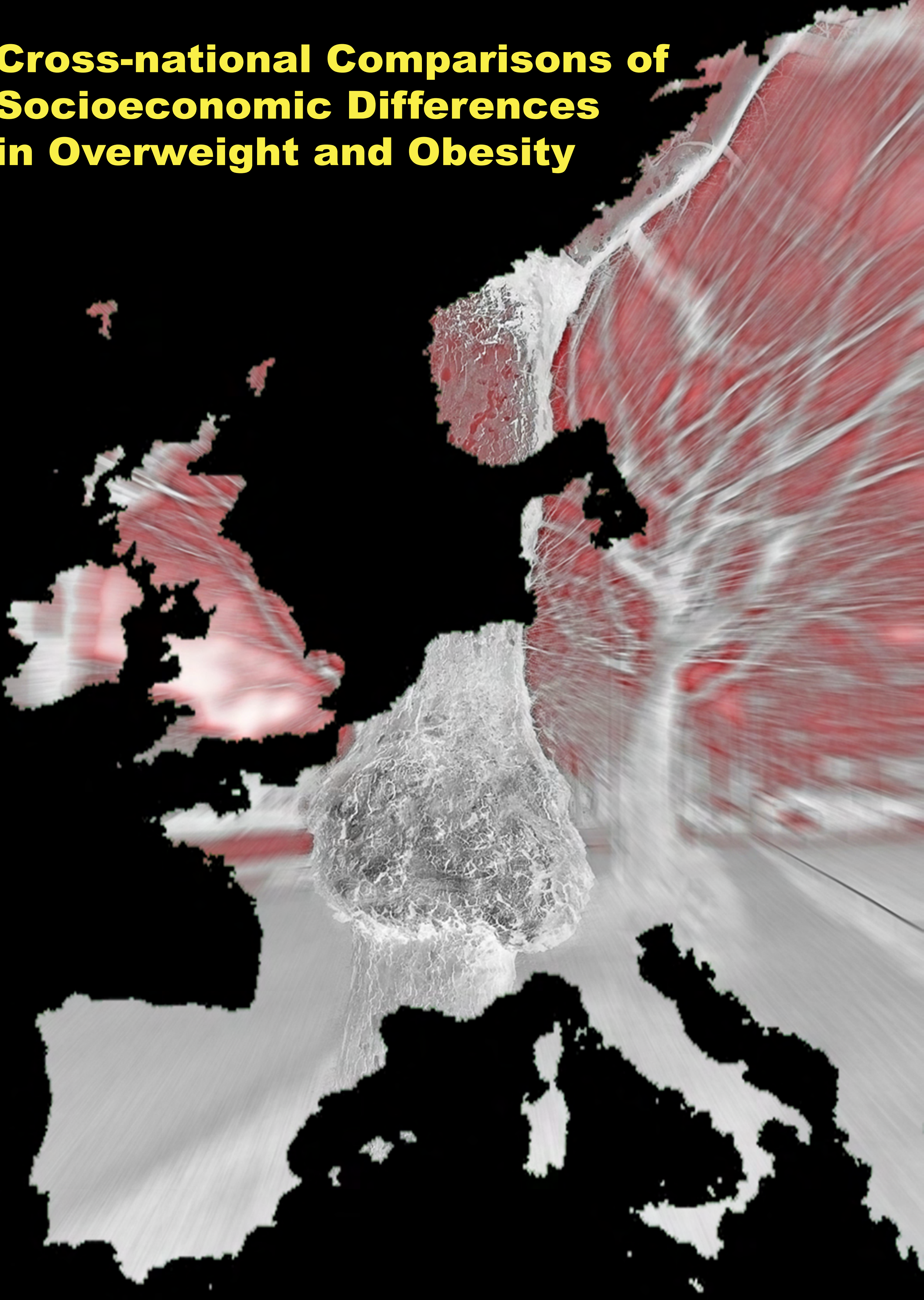
Cross-national Comparisons of Socioeconomic Differences in Overweight and Obesity



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Cross-national Comparisons of Socioeconomic Differences in Overweight and Obesity

Internationale vergelijkingen van sociaal-economische verschillen in overgewicht en obesitas

PROEFSCHRIFT

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Een vuile koffiemok
Een papiertje vol
        onleesbare krabbels
Een plant, verworden tot
                fletse treurwilg
Ze keken me aan als een
        vanitasstilleven
Dat mij toeschreeuwde
                        Klaar is Kees!

Cross-national Comparisons of Socioeconomic Differences in Overweight and Obesity

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ABBREVIATIONS

BMI	Body Mass Index, weight in kilograms divided by squared height in meters. Because of its ease of use, this is the most commonly used measure for body composition. A BMI between 25 and 30 is referred to as ‘overweight’. A BMI greater than or equal to 30 is referred to as ‘obesity’. These categories are based on their positive correlation with adverse health outcomes.
ECHP	European Community Household Panel, an international survey.
ESEC	European SocioEconomic 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.
PRR	Prevalence Rate Ratio, a measure where (after adjustment for confounders such as age) a health outcome is offset to a reference group. People of higher socioeconomic position are used as a reference group throughout this dissertation.
RII	Relative Index of Inequality, where RII = 1 indicates perfect equality. Throughout this dissertation, RII > 1 indicates an unfavorable health outcome for those of a lower socioeconomic position.
SEP	Socioeconomic Position, formerly known as Socioeconomic Status (SES). Educational, occupational and income level are the aspects of SEP that are most commonly used in research.

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Part I

Introduction

INTRODUCTION

Introduction

Overweight and obesity have become increasingly common in the past decades. Overweight affects 30–80% of adults in Europe. The World Health Organization estimates that 150 million adults in Europe will be obese by 2010. [1] The associated costs with overweight, obesity and related diseases are gargantuan, both from a societal and a financial point of view. One 2002 estimate indicated that the total direct and indirect annual costs of obesity in 15 EU countries may have been as high as € 32.8 billion. [2] Obesity and its associated risks may kill 320 000 men and women annually in Western Europe. [3] The effects on quality of life are more difficult to quantify but are manifold. This raises the question what can be done about it, and how this can be done most effectively.

The immediate cause of obesity and overweight is an energy imbalance between calories consumed on one hand, and calories expended on the other hand. But it is overly simplistic to regard overweight and obesity as the result of an imbalance between energy intake and expenditure. Biological susceptibility interacts with a changing environment that includes more sedentary lifestyles and increased dietary abundance. [4 5] The heritability of obesity is estimated at 40-70 %. [6] However, genetic factors alone can not explain the rapid increase in the prevalence of overweight and obesity in the recent few decades. A twin study showed that identical twins living apart had greater discordance in relative body weight gain, compared with identical twins living together. Household or physical environment accounted for about 50 % of the variation in adolescent overweight. [7]

Two environmental patterns are important in this context. There is a shift in diet towards increased intake of energy-dense foods that are high in fat and sugars but low in vitamins, minerals and other micronutrients. Meanwhile, there is a trend towards decreased physical activity due to the increasingly sedentary nature of many forms of work, changing modes of transportation, and increasing urbanization. [8] However, important as they are, these direct factors are just one element of the explanation.

The prevalence of virtually all diseases and their risk factors is not equally divided over the general population. [9 10] Overweight and obesity are much more common among people of lower socioeconomic position (SEP), especially women. [11 12] SEP is a construct that comprises various facets, such as income level, occupational status and educational attainment. But what these different facets have in common is that they comprise ‘upstream’ factors in the origination of overweight and obesity. Upstream factors are defined as features of the social environment, such as SEP. For instance, in the year 2000 obesity was more than four times as common among low-educated Dutch women, compared to their high-educated counterparts. [13] This offers an important entry-point for preventative measures, as upstream factors may affect the downstream prevalence of diseases such as diabetes and cardiovascular disease.

One might be inclined to think that inequalities in overweight and obesity are caused by similar inequalities in their immediate cause: passive overconsumption. This occurs when energy intake exceeds energy use. Theoretically, this could happen with any unbalanced combination of diet and physical activity, but unfavorable behavioral factors (e.g. fast-food intake, sedentary behavior) tend to be correlated. But, as stated above, there is much more to it. There are several additional explanations for socioeconomic differences in overweight and obesity, which include material circumstances (e.g. housing and working conditions), psychosocial stress (e.g. work-related stress) and childhood living conditions. [14] Another explanation is that BMI itself affects (at least in part) SEP, for example because of discrimination and stigmatization of overweight and obese people. [11 12] Thus, the interrelation between SEP and overweight and obesity may act as a double-edged knife: on the one the hand SEP may lead to overweight and obesity (causation mechanism). On the other hand overweight and obesity may affect SEP (selection mechanism). Although both mechanisms play a role, the causation mechanism may be more important. [15]

In this dissertation, international comparisons of inequalities in overweight and obesity and related factors will be made. The rationale for making international comparisons is that another level of explanation of inequalities in overweight and obesity is added.

If comparisons are made between countries, important differences in the magnitude of health inequalities emerge. [9 16] First, international variations in inequality may reflect cultural differences in e.g. nutritional and exercise behavior. For example, the adherence to the Mediterranean diet may be greater among people of lower SEP. [17] A second reason for making cross-national comparisons is to gain greater understanding on the possible effects of national characteristics on inequalities in overweight and obesity. For instance, people of lower SEP may carry an increasing proportion of the burden of overweight and obesity with an increasing general level of socioeconomic development.[18] That is, not all societal strata may benefit equally from an increase in wealth. Third, as the term suggests, an international perspective enables the researcher to put the results from individual countries into perspective. Thus, the results provide a provide a benchmark on inequalities in overweight and obesity. This information could also help to focus policies and interventions and provide a yardstick for success. [19]

Therefore, in this dissertation, we aim to describe international variations in inequalities in overweight and obesity and related health indicators in order to enhance our understanding about the mechanisms that may cause them. This may be illustrated using the Flatland metaphor of dimensionality: [20]

> "I looked and saw the circle [and] I began to fathom this whole new world. Or, Universe! The circle was no mere circle, but perfect circular beauty like I had only before inferred, conjectured, and dreamt of. […] [Mr. Sphere has] shown me the intestines of all my countrymen in the Land of Two Dimensions by taking me with him into the Land of Three. What therefore more easy than now to take his servant on a second journey into the blessed region of the Fourth Dimension, where I shall look down with him once more upon this land of Three Dimensions." [20]

In this classic novel, Mr. Square, who lives in a two-dimensional world called Flatland, meets three-dimensional Mr. Sphere. Mr. Square could not understand the meaning of a sphere, until Mr. Sphere grabs Mr. Square by the hand and literally drags him into the third dimension. Mr. Square now realizes that there is one more dimension than his own, the third dimension. Now being able to see three dimensions, Mr. Square's perception of Flatland also changes; he can suddenly look 'inside' his flat countrymen, and he even wonders what the world would look like when seen from another, fourth dimension.

This quote illustrates how our perception of the world can change when we add another dimension. The 'international' aspect of this dissertation comprises this other dimension – a dimension that remains invisible in 'Mr Square'-type, single-country studies. Zooming in and out of a phenomenon's context can yield new clues on the causal mechanisms that underlie that phenomenon.

Objective

The objective of this dissertation is threefold. First, we aim to give descriptive overviews of the state of affairs of socioeconomic inequalities in overweight and obesity and associated health indicators throughout Europe. Second, we will try to explain the international patterns in those inequalities by studying the inequality patterns of nutrition and physical activity, the immediate causes of overweight and obesity . Third, we will try to explain the inequalities in diabetes and hypertension (measures of objective health) and subjectively experienced health by studying cross-national inequality patterns of overweight and obesity.

As such, overweight and obesity play a dual role: one of health outcome, and one of risk factor for related diseases. The first role means that overweight and obesity in themselves comprise negative health outcomes, causing e.g. psychosocial problems and absenteeism. [21] The second role means that inequalities in overweight and obesity fuel subsequent adverse health corollaries: inequalities in e.g. type 2 diabetes may be a 'carbon copy' of inequalities in overweight and obesity.

More specifically, the research questions addressed in this dissertation are:

- How large are the socioeconomic differences in overweight and obesity in Europe? Is there international variation in the magnitude of these inequalities? To what extent can general level of socioeconomic development of countries explain these differences?
- Which socioeconomic indicator best predicts overweight in different European countries: educational attainment, occupational class and household income?
- How large are the socioeconomic differences in the prevalence of risk factors for overweight and obesity (low vegetable consumption, physical inactivity)? Is there international variation in the magnitude of these inequalities?
- How large are the socioeconomic differences in the prevalence of diabetes, hypertension and subjectively experienced ill health? Is there international variation in the magnitude of these inequalities? To what extent can obesity explain inequalities in diabetes, hypertension and subjectively experienced ill health?

How large are the socioeconomic differences in overweight and obesity in Europe? Is there international variation in the magnitude of these inequalities? To what extent can general level of socioeconomic development of countries explain these differences?
The topic of inequalities in overweight and obesity has been described many times. [11 12] However, European overviews are scarce and those available do not give a complete overview [22] or are somewhat outdated. [23] The former finding means that the new EU member states are not represented. The latter is important given the rapid rise of the prevalence of overweight and obesity, which underscores the need for up-to-date data. From the existing literature on inequalities in overweight and related variables, inconsistent geographical patterns emerge. We will give a more complete description of these patterns, because our data includes up to nineteen different countries, including the Baltic and eastern European countries. Also, the role of general welfare level in explaining the inequalities is largely unknown. Other studies of indicated that a country's level of socioeconomic development predicts the size of its obesity gap. [12] This phenomenon has been studied in a world-wide study [24] and also in one that only covered developing countries, [18] but a European study was lacking.

Which socioeconomic indicator best predicts overweight: educational attainment, occupational class and household income?
In existing literature, the various measures of SEP (e.g. educational attainment, occupational level, income level) are sometimes used interchangeably, as a pragmatic compromise to create broader overviews. However, these measures are in fact different facets of SEP, and hence need to be investigated accordingly. No large international studies exist that compare the relative predictive value of these three facets of SEP for inequalities in overweight and obesity. Reasons for this include the poor international comparability and the limited availability of these measures. In our study, we utilized measures with good international comparability, by using data from the European Community Household Panel (ECHP). [25] Our analyses will demonstrate which SEP facet is most closely associated with overweight and obesity, which may yield clues about the underlying causes. Studying international patterns will demonstrate whether this 'inequality triad' (education-occupation-income) is similar in all European countries of the study, or that one facet of SEP is much more important in one country than in another.

How large are the socioeconomic differences in the prevalence of risk factors for overweight and obesity (low vegetable consumption, physical inactivity)? Is there international variation in the magnitude of these inequalities?
Nutritional behavior and physical activity are notoriously difficult to measure and as a consequence few large international overviews on inequalities exist. With these risk factors being the immediate cause of overweight and obesity, the lack of knowledge highlights the need for investigations in this area.

People with a higher SEP generally eat vegetables more often than those in lower socio-economic groups. A low proportion of vegetables in the diet is associated with high energy and fat intake, which are well-known risk factors for overweight and obesity, cardiovascular diseases and other common public health problems. [26 27] Only a few European studies exist in this area. They show that in Europe, consumption of vegetables and fruits is generally more common among those with higher education. Exceptions to this are southern and eastern Europe, where vegetable consumption is more common among the lower classes. These results suggest that in regions where consumption of vegetables and fruits is more common, the lower social classes tend to consume more of these than the higher social classes. [28 29]

Although some knowledge exists on the international patterning of inequalities in vegetable consumption, several blank spots remain in this context. This could perhaps be summarized as a demand-and-offer question. It is not clear whether international patterns can be explained by differences in availability and price (“offer”), or rather by differences in demand, for instance because of differences in the extent to which vegetable use is part of the local, society-wide cuisine, and the associated cultural habits.

Inequalities in physical activity may also be approached from two directions. On the one hand, differences in attitudes towards physical activity and differences in the level of social participation [30] may vary from country to country, from culture to culture. On the other hand, environmental characteristics may also determine the magnitude of the differences in physical activity. For instance, if leisure time physical activity is affordable, all layers of society may benefit from it. Or perhaps a country’s level of socioeconomic development is a determinant for the quality of the built environment, which in turn underlies inequalities in physical activity? [31] Moreover, an integrative description of international patterns in inequalities in physical activity is absent.

How large are the socioeconomic differences in the prevalence of overweight-related diseases (diabetes, hypertension)? Is there international variation in the magnitude of these inequalities? To what extent can obesity explain inequalities in diabetes and hypertension?
Cardiovascular disease (CVD) accounts for more than 1.9 million deaths each year in the European Union. [32] The term ‘metabolic syndrome’ refers to a clustering of CVD risk factors whose underlying pathophysiology is thought to be related to insuline resistance. Insuline resistance is a key feature of type 2 diabetes, hypertension, and obesity. [33] In Europe, about 14 % of the prevalence of hypertension may be attributed to overweight. [34] We estimate that 8.7 % (men) and 16.0 % (women) of the prevalence of hypertension is attributable to diabetes. [35 36] Although the information is more fragmentary, SEP inequalities in type 2 diabetes and hypertension are also known to be closely related to overweight and obesity prevalence. However, cross-European comparisons on the this topic are scarce. [10 14 37]

Moreover, the role of overweight and obesity in the origination of SEP inequalities in diabetes and hypertension has never been quantified in cross-European overviews of this scale. From a health intervention and prevention perspective, this is surprising, to say the least. Knowing which factor contributes most to these inequalities could importantly guide intervention activities. And depending on the particular country, reducing one inequality (obesity) may also tackle other inequalities (hypertension, diabetes) at the same time. If only this dissertation was not about health and health promotion, the saying "killing two (or three!) birds with one stone" would be appropriate here.

How large are the socioeconomic differences in subjectively experienced level of health? To what extent can obesity explain inequalities in the prevalence of subjectively experienced ill health?
In the previous section we argued that inequalities in overweight and obesity contribute to inequalities in 'objective' measures of disease outcome: diabetes and hypertension. In the current section we aim to evaluate to what extent inequalities in relative weight and smoking contribute to inequalities in general health as perceived by the people themselves. Large inequalities in self-assessed health (SAH) have been observed in many European studies, [38 39] sometimes with varying results. [40] Researchers liked to believe that more egalitarian countries also have smaller inequalities in SAH. The use of various methods of measuring SAH may have contributed to this controversy. However, support for this belief seems to be diminishing. The survey item that measures SAH – "How do you rate your own health in general"- usually has five Likert-type response categories, ranging from 'very good' to 'very bad'. Most studies discard the majority of the information that is collected: only one or two of these categories are evaluated, typically 'bad' and 'very bad'. We devised a novel method that deploys all available information.

Using this more complete measure we gained greater understanding into international differences in inequalities in SAH. Obesity and smoking prevalence have both taken epidemic proportions, making them two phenomena that are likely to affect subjectively experienced health. The question is: are inequalities in subjectively experienced health a reflection of similar inequalities in obesity, in smoking, or both? And are there international differences in these associations?

The international patterns in the relative contribution of overweight and obesity or smoking to inequalities in SAH may be explained in terms of the timing and speed with which 'modern' behaviors are adopted by the various strata of society. Both the 'Western diet' (high-fat, high-sugar, low-fiber) and smoking encountered more enthusiasm in one country than another. For groups of higher SEP, it generally became a short-lived lifestyle to use a western diet or to smoke. Once the adverse health effects became apparent, people of higher SEP increasingly adopt healthier lifestyles, while their lower SEP counterparts still maintain the same habits. Differences in the speed and the timing of the adoption and the subsequent abandonment of these lifestyles creates international differences in inequalities in overweight and obesity, smoking, and self-assessed health. Using a novel method and data of eighteen European countries, we answered important questions about the relative contribution of overweight/obesity and smoking to subjectively experienced health in various European countries.

Data sources

Most studies of this dissertation were conducted as a part of the Eurothine project. Eurothine stands for 'European project for Tackling Health Inequalities'. The Eurothine overall objective that is relevant for this dissertation is "*to develop and collect health inequalities indicators, and to provide bench-marking data on inequalities in health and health determinants to participating countries*". [41] Although both mortality and morbidity data were collected as a part of this project, only the latter will be analyzed and discussed in this dissertation.

Individual-level morbidity data, based on self reports, were acquired from pre-existing, large national surveys from the adult population from a total of 19 European countries.

The countries may (somewhat arbitrarily) be divided into five geographical regions:

- Nordic: Finland, Sweden, Norway, Denmark
- Baltic: Lithuania, Latvia, Estonia
- Eastern: Slovak Republic, Hungary, Czech Republic
- Southern/Mediterranean: France, Italy, Spain, Portugal
- Western: Ireland, England, Netherlands, Belgium, Germany

This categorization just serves to illustrate the diversity, the dimensions, and hence the uniqueness of the Eurothine data base. With the inclusion of Eastern and Baltic countries, the Eurothine project is the first of its kind.

The fact that pre-existing data were utilized implied that efforts were needed to make the data internationally comparable. We dubbed this process ‘harmonization’. Harmonization basically refers to the process of item recoding (and sometimes the combination of several related items) and subsequent evaluation of the frequency distributions in order to make the survey items as comparable as possible. Thus, the harmonization process started with a knowledge-driven (top-down) conversion and was, if needed, refined by an auxiliary, data-driven (bottom-up) step. The first step always comprised the most important step. In addition, external validity was evaluated against existing publications (e.g., Eurostat reports). We discarded those variables that we deemed to be of insufficient quality. More information on the harmonization process can be found in the Appendix of this dissertation and on www.eurothine.org (under “Technical documents / Data specifications documents”).

For some variables, such as height, harmonization was easy enough. A simple conversion from inches to centimeters or from meters to centimeters was all that was needed, if anything. For other variables, however, it was more difficult. Notorious in this respect is the measurement of educational attainment. In fact, it is for this reason that UNESCO devised the ISCED classification. [42] Other harmonization challenges include differences in item phrasing (e.g. disease definition, recall period) or response categories (number of categories, contents of categories). We succeeded with varying levels of success in the process of harmonization. Only variables of which values were judged to be directly comparable, or of which the socioeconomic inequalities in those values were comparable, were utilized in this dissertation.

The only study for which a different dataset was utilized was ‘The predictive value of various socioeconomic indicators for overweight in European countries’ (Chapter 4). Here, Eurostat data from the European Household Panel (ECHP) were used. [43] The ECHP is a standardized, internationally comparable survey that has been conducted on large samples. Importantly, occupational class was measured using the European Socioeconomic Classification (ESEC), a new and finely-graded measure designed to enable better international comparability of this variable. [44] We previously concluded that the ESEC scheme is highly useful for describing socioeconomic inequalities in health. [45]

Structure of this dissertation

In Chapter 2, existing literature on socioeconomic inequalities in overweight and obesity is reviewed. The review first puts inequalities in overweight and obesity in different perspectives, ranging from proximal, or ‘micro’ factors to more distal, or ‘macro’ factors. Thus, the explanations for inequalities in overweight and obesity are viewed from a hierarchical perspective. Additionally, these factors are put in a historical perspective.

In Part II we give European overviews of the current situation regarding inequalities in overweight and obesity. In Chapter 3-4, country overviews are given on slightly different sets of countries. Although both chapters have an explanatory element, this feature is much stronger in Chapter 4. An important question of Chapter 3 is whether the negative associations between socioeconomic position and overweight are a generalized phenomenon by now. We will answer this question by giving extensive descriptions of the socioeconomic inequalities that are currently visible throughout Europe. In addition, we explore to which extent general level of socioeconomic development (Gross Domestic Product) can explain international patterns in socioeconomic inequalities in overweight and obesity.

In Chapter 4, we used the unique opportunity to make an international comparison of inequalities in overweight and obesity using three different facets of socioeconomic status. For practical reasons, educational level is usually used to measure socioeconomic inequalities in health. However, other aspects of socioeconomic position may also increase understanding of these inequalities. In this study, international comparisons are made between the relative contribution of educational, occupational and income level - three 'classic' indicators of socioeconomic position.

Part III investigates socioeconomic inequalities by zooming in to the *direct causes* of overweight and obesity: nutritional and exercise behavior. In Chapter 5, an international overview of socioeconomic inequalities in fruit consumption is given. Our choice for fruit consumption was mainly data driven: our data did not contain a direct measure for energy intake. However, people may consume similar food volumes, independent of the energy density of the diet consumed. [46] We reasoned that the consumption of energy-poor/high-volume foodstuffs (like fruit) are inversely related to consumption of energy-dense/low-volume foodstuffs (like fats and sugars). Hence fruit consumption may be a measure for energy intake. Alternatively, fruit consumption might be an expression of health consciousness, correlated with other health-conscious nutritional behaviors such as low-fat, low-sugar diets.

In Chapter 6, an international overview of socioeconomic inequalities in leisure time physical activity is given. Here the 'output' side of the IO-relationship between diet and exercise is studied. This chapter paints a partial picture as only leisure time, and not work-related physical activity is evaluated. However, Chapter 5-6 together might give us an idea about which element (input or output) is most important in explaining inequalities in overweight and obesity. It is also conceivable that there are international differences in the relative importance of these two factors for the size of the inequalities in overweight and obesity.

In Part IV, after having explored some of the possible causes of inequalities in overweight and obesity, in Chapter 7-9 we turn to three important specific *health consequences* of overweight and obesity: type 2 diabetes, hypertension, and subjectively experienced ill health, respectively. We start by giving descriptive overviews of the socioeconomic inequalities in diabetes and hypertension (Chapter 7 and 8, respectively). The role of overweight and obesity in the origination of inequalities in diabetes and hypertension is studied in two distinct ways. First, using multivariate analyses on individual countries, we assess the relative contribution of body weight to inequalities in diabetes and hypertension prevalence. The second approach is one that makes between-country comparisons in the magnitude of inequalities in relative body weight (the risk factor) on the one hand, and diabetes or hypertension prevalence (the disease outcome) on the other. In short, the question pertaining to the second approach is: is there a positive correlation between level of inequalities in risk factor and level of inequalities in disease outcome? In our attempt to answer this question, we felt we needed to zoom out to social and cultural factors.

In Chapter 9, the effect of overweight and obesity, relative to other factors, on self-reported health is explored. Although self-reported health (a subjective measure) is used, this measure is 'anchored' to the presence of a range of chronic diseases. This novel approach has the advantage that, contrary to the standard 'less-than-good health' approach, all the response categories of the self-assessed health variable are taken into account, not just one. We quantify the consequences of overweight and obesity, possibly mediated through related health complaints, on subjectively experienced health. Overweight and obesity, and smoking are compared with respect to their relative contribution to self-assessed health.

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Chapter 2

Weighty differences: social stratification and overweight *

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A MYSTERIOUS PHENOMENON

From famine to feast, from undernutrition to overweight: this is how the ‘nutrition transition’ of the Dutch population during the past century and a half may be summarized. If we do not include the winter of starvation of 1944-1945, the last episode of extensive mortality by food shortage took place in the middle of the nineteenth century, when potato crops across Europe failed due to potato blight. Now, at the start of the twenty-first century, the most important public health concern appears to be the swift-arising overweight epidemic. The smell of French fries is present in nearly every corner of the street and meanwhile we are debating about the question whether a ‘fat tax’ could put a bridle on eating chips in front of the television.

This development becomes even more paradoxical if we consider that the population groups that used to suffer the most from poverty and food shortages now suffer the most from overweight. Owing to welfare growth and an extensive social security system, the kind of poverty that was present in the nineteenth-century does not occur anymore in the Netherlands. Yet, large social inequalities exist, which become manifest as, among others, considerable income differences. Curiously enough, overweight is increasingly concentrated among people with the lowest incomes, the lowest educational levels, and the least esteemed occupations.

It is this relationship between social stratification and overweight that this essay is about. We will analyze it as a part of a larger phenomenon, the persistent link between socioeconomic status and a large number of health problems. For virtually all health problems and their determinants applies that these are systematically overrepresented among people of lower educational, occupational or income levels. A gap in ‘healthy life expectancy’ of no less than ten to fifteen years exists between people of the lowest (primary school or less) versus the highest (higher vocational school and university) educational levels. [2]

These socioeconomic differences in health were discovered in the nineteenth century when mortality statistics showed that the mortality risk of back street dwellers was much higher than that of their well-off counterparts. Since then, a sound improvement of life circumstances has taken place. The average mortality rate of the population has dropped vastly. Infectious diseases have been replaced by chronic diseases such as cardiovascular diseases. Despite of all these changes in the nature of the health risks to which the population is exposed, the association with socioeconomic status has never disappeared. On the contrary, the relative differences in mortality have not changed since then. It appears that the characteristic health risks of each period are always concentrated at the lower end of the societal ladder. This mysterious phenomenon also occurs with overweight. How could this be?

SOCIOECONOMIC DIFFERENCES IN OVERWEIGHT: ZOOMING IN ON PEOPLE AND THEIR BEHAVIOR

The Dutch situation

Overweight is rampant in the Netherlands. Another remarkable observation, next to the rise in overweight and obesity, is that many overweight people belong to lower educational and income levels. Obesity is about thrice as common among people of the lowest educational group (primary school or less), compared to people of the highest educational group (higher vocational school or university level). [3]

Men and women alike show socioeconomic differences in body weight, however, socioeconomic inequalities in overweight among women are clearly greater than those among men. Women of higher vocational school or university level education are much less often overweight than men of similar educational attainment. Conversely, between men and women of lower educational attainment there are virtually no differences in overweight prevalence. This is remarkable, since for almost all other health determinants, the socioeconomic differences are larger among men. [4]

The higher prevalence of overweight among people of lower socioeconomic stance is one of the explanations for the presence of socioeconomic differences in health. People of lower educational attainment are at greater risk of developing an overweight-related chronic disease, such as type II diabetes, joint ailments or cardiovascular disease. [5] Overweight is also partly the cause of socioeconomic differences in mortality. [6]

Effects of overweight on social mobility

Most research on the association between socioeconomic status and overweight does not answer the question of which causal relationship is underlies the association: does a low societal position lead to overweight, or does overweight lead to a low societal position?

This chicken-or-egg question can only be answered using longitudinal research. Such investigations demonstrate that overweight indeed may lead to a lower socioeconomic status. People with overweight are less likely to climb up the social ladder through work or marriage, and are more likely to descend the social ladder. This especially applies to women. An explanation for this may be found in the greater amount of stigmatization of overweight that women face. [7]

However, there is another side to the story: the relationship between socioeconomic status and overweight is also partly caused by the socioeconomic status itself. Studies that first measured socioeconomic status and then measured changes in body weight show that people of lower socioeconomic status are more prone to weight gain. [8]

Although it is not a matter of chicken-*or*-egg, but of chicken-*and*-egg, the second relationship is stronger. Since the latter relationship can only be of an indirect nature, the question arises which specific factors determine the effect of a low socioeconomic status on body weight.

Differences in nutritional and exercise behavior

Overweight is the consequence of an unbalance between nutrition and exercise, which causes extra calories to be stored as fatty tissue. In that sense, the higher prevalence of overweight among people of lower socioeconomic status can be regarded as an increased caloric intake or a decreased caloric expenditure, or a combination of the two.

Unfortunately, it is unknown which of the two plays the most important role. That is unfortunate, because it is for this reason that we do not know exactly what the focus of preventative activities should be. To determine this, one would need to know the sum of all ‘input’ and ‘output’ of calories, calculated over many years, using a sample comprised of people from both lower and higher socioeconomic status.

Existing research is limited to cross-sectional data. In the Dutch National Food Consumption Surveys, a population sample keeps a diary on food intake. During the period 1987-1999, three of such surveys were conducted. The results showed no clear differences in caloric intake between socioeconomic groups. [9]

However, other studies did show that women from higher socioeconomic groups diet much more often. Girls and women from higher socioeconomic groups worry more about their body weight –even when ‘objectively’ there is no reason for this. Although dieting is common among girls and women of all social strata, significant differences exist between the various groups. Insofar as this dieting behavior is effective, it could explain (part of) the socioeconomic differences in overweight. Besides, pathological dieting behavior (anorexia nervosa) is also more common among girls and women of higher socioeconomic groups. [7]

Regarding physical activity, the results are less ambiguous. Various survey data Show that people of higher educational levels have, on average, more leisure time physical activity – for example by doing sports. In the past, physically demanding work was generally done by people of lower educational attainment, but nowadays, this may no longer be the case. [10]

Differences in material and psychosocial conditions

Despite of the fact that overweight can only develop in conditions of abundance, there is an association between the disproportionate prevalence of overweight in lower socioeconomic groups and unfavorable material conditions. This applies foremost to a lower income. Since healthy food is generally more expensive than unhealthy food, and since many forms of physical activity are rather dear, it is harder for people of lower income groups to maintain a healthy life style. Some researchers even suggest that obesity is largely an income problem, as energy density and cost price of nutrients are inversely related. Sugars and fats are cheap whereas lean meat, fish, vegetables and fruit are more expensive. In this respect, green lettuce is the most expensive 'parcel' for calories. [11]

Furthermore, there are indications that living in back-street areas has a negative impact on the ability to obtain healthy food and to get sufficient physical activity. A number of studies from outside the Netherlands demonstrated that the amount of healthy foodstuffs in back-street neighborhoods is more limited than elsewhere. However, it is unknown whether these 'food deserts' also exist in the Netherlands. A recent report from TNO Netherlands (a large research institute) showed that children from 'movement-unfriendly' neighborhoods (with little water and green, sports facilities and car-free zones) are less physically active. Not surprisingly, mostly groups of lower socioeconomic status live in these neighborhoods. [12]

Besides income position and living conditions, psychosocial factors determine the relationship between lower socioeconomic status and nutritional and exercise behavior. According to the Theory of Planned Behavior, [13] healthy nutritional and exercise behavior depend on the intention and the ability to actually carry out this behavior. In short, the theory states that the individual's own as well as other people's beliefs, and the perception of one's own possibilities together determine that individual's motivation to, for example, eat more healthily or exercise more often. The transformation of words ("I would like to exercise more") into actions (really get more physical exercise) is also affected by external factors, such as safety or intensity of traffic.

It is plausible that part of the differences in overweight can be explained by these factors. For example, clear differences in attitudes to (un)healthy nutrition and physical (in)activity exist between socioeconomic groups. Little attention to a healthy nutritional pattern and a passive style of problem solving are more common among lower socioeconomic groups. In addition, there are differences in the social norms about nutrition, physical activity and overweight. Success expectancy with regards to healthy behavior is generally lower in lower socioeconomic groups, for example because health is generally perceived as something determined by fate, on which little to no influence can be exerted. [14]

Outcomes of social-psychological research may help to gain greater understanding about the question *how* socioeconomic differences in overweight arise. However, such research does not answer the question *why* this is the case. For this, we should not zoom in, but rather zoom out. Thus, in the following paragraph we will widen our horizon to look at large-scale relationships, which become manifest by putting the problem of overweight in an international and historical perspective.

SOCIOECONOMIC DIFFERENCES IN OVERWEIGHT: ZOOMING OUT TO WELFARE AND CULTURE

International context: overweight as phenomenon of affluence

Overweight and obesity are, naturally, less common in poor countries than in rich countries. Up until a national income of 12,500 dollar per person per year for women and 17,000 dollar per person per year for men, an increase of general welfare level coincides with a steady increase of the Body Mass Index (BMI) of the population. Above these income limits, the BMI remains more or less constant. When welfare levels increase even further, a slight decrease in BMI can even be observed. The relationship between welfare level and BMI among lower national incomes may be explained by a direct relationship between dispensable income and food intake. [15]

But what is the relationship between economical development and differences in overweight *within* countries? International overviews show that the negative association between socioeconomic status and overweight that is visible in the Netherlands also exists in most other affluent countries. However, this does not apply on everywhere in the world. Until recently, overweight could only be seen among the elite in developing countries. The vast majority of studies indicated that that overweight was more common among men, women and children of higher socioeconomic groups. [7]

However, this is changing rapidly. The most recent studies indicate that these associations have either weakened (men) or changed in direction (women). While in the poorest countries overweight is still more common among higher socioeconomic groups, it is more common among lower social classes in countries with a slightly higher income. [16]

All these findings are pointing in the same direction: as long as the dispensable in come for the majority of the people puts restraints to food intake, especially energy intake, a ‘positive’ association between socioeconomic status and overweight can be observed. Only the privileged can afford to eat more than they should. As soon as the restraints disappear, a ‘negative’ association appears, because the less-privileged more than make up arrears.

Why does the development of overweight among groups of lower socioeconomic status dip, as it were, and why this occurs sooner and/or more intensely among women? Economic factors alone may not provide the answer to this question. Cultural factors are needed for this.

Historical development: overweight as a form of ‘descending cultural capital’

The number of overweight or obesity on the Netherlands has risen rapidly in the past few decades. In the early 80s, about one-third of the population was overweight or obese; currently this is about half of the population. Incidentally, a comparison of these figures demonstrates no clear changes in the socioeconomic distribution of overweight. A rapid rise in the prevalence of overweight and obesity can be seen in lower and higher educational groups alike.

Yet, the socioeconomic differences in overweight we see today have not always been present. Anecdotic information, such as portraits of wealthy people of times gone by and observations of medical practitioners, show that well into the nineteenth century, overweight was a phenomenon of the higher social classes. The scarce information indicates that a flip has taken place in the course of the twentieth century. Older studies still indicate that overweight is more common among higher socioeconomic groups, especially among men. [7]

In this regard, an interesting study using data of Dutch conscripts exists. This study showed that, between 1933 and 1978, the average BMI of conscripts has clearly increased. Also, during this period, a flip the socioeconomic differences in overweight takes place. Until 1963, the BMI of conscripts from higher occupational classes was equal to, or even higher than, that of conscripts of lower occupational classes. Only after 1963 the familiar pattern of higher body weight among lower classes starts to emerge. [17]

A comparable flip in the association between socioeconomic status and risk factors for disease has also occurred in other areas such as smoking. These changes have been linked to the theory of diffusion of innovations. [18] This theory states that novel behavioral patterns behave like any other innovation. That is, novel behavior is adopted at an earlier stage by those who are also ahead in terms of educational or income level. Thus, people with a higher socioeconomic position can be regarded trendsetters. The dynamic in socioeconomic differences in health can be attributed to a delay in the adoption of novel behavioral patterns, so says the theory.

This dynamics is best understood by construing behavior, be it healthy or unhealthy, as a status symbol. The choice for a certain lifestyle expresses that one belongs to a certain class. This applies to nutritional habits, language use, leisure time activities, musical preferences and many other aspects of daily culture. In his book *Distinction* (1979) the French sociologist Pierre Bourdieu has given an extensive, and by now classic, description of this topic. [19] Many cultural class differences show a very clear dynamic. Novelties in lifestyle are first adopted by the higher social classes and only later become widespread. At that time, they quickly loose their distinctive ability; a good moment for the higher social classes to go and try another tack.

This theory of ‘descending cultural capital’ probably also applies to nutritional and exercise behavior. Until the end of the nineteenth century, eating too much and moving too little was reserved to the privileged, but this has readily been adopted by the less privileged as soon as they were able to. The theory may also apply to the new norm to watch one’s weight and stay slim – a norm that has first found its way into the privileged.

The role of cultural factors in the origination of overweight is clarified further when we consider that the prevention of overweight requires conscious effort. Humans do not have effective biological mechanisms to prevent weight gain during periods of abundance of food and lack of physical exercise. On the contrary, the human body has mechanisms that ensure optimal use of the extra calories and store fat for later use in perhaps less abundant times. Thus, to prevent overweight, conscious action is required. Restrictions needs to be imposed in terms of food intake and/or leisure time needs to be sacrificed to ‘useless’ physical exercise. The theory of descending cultural capital is very well able to explain that higher social classes collectively chose these behaviors at an earlier stage.

A cultural explanation like this is confirmed by research into which meanings are attributed to overweight and its determinants by various socioeconomic groups. These groups differ in their opinions on food palatability. Taste preferences of people of lower socioeconomic groups can be characterized by a regime of ‘much, fat and sweet’ and a ‘taste of necessity’, compared to a ‘taste of luxury’. [20] The higher social classes emphasize the health aspect of their nutritional pattern, whereas the lower social classes value recently acquired luxury products such as white bread, sweets and snacks. This does not only coincide with Bourdieu’s theory, but also reminds of the times when food abundance was not something that could be taken for granted.

Cultural differences are also relevant when it comes to preferences for body size. This especially goes for women, who, more than men are subject to the aesthetical norm of the slimness ideal. [7] The interaction between cultural class differences and gender-specific aesthetical norms probably explains why overweight and socioeconomic status are linked more strongly among women than among men.

HOPE ON RE-DISTRIBUTION

If it would not be tragic, one might find it ironic that, after making up material arrears, socioeconomic differences now predominantly become manifest through cultural ways. Material arrears used to be an important determinant of socioeconomic differences in health. Nowadays, however, these differences are largely determined by behavioral differences, such as smoking, over-eating, and lack of exercise. In part owing to the decrease in material arrears these welfare problems have now reached the bottom of the societal ladder. People on the top by now distinguish themselves by moderation –at least in terms of smoking, eating and exercise behavior. The socioeconomic differences in overweight may be the best illustration of this.

Although the average Dutch person's health has taken a huge leap, the health inequalities are still present. People on the favorable end of the societal ladder still live much longer in good health. A significant reduction is possible only if we reduce the underlying behavioral differences. However, there are not many concrete starting points for this. No proven, effective intervention for overweight with a long-lasting effect exists to this day. The development of interventions that also – or especially- target lower socioeconomic groups is still in its infancy. These will somehow have to go in tandem with a re-distribution of 'cultural capital'. It seems, because of its intangibility, that this is an ever greater task than the re-distribution of material capital.

Notwithstanding, we remain optimistic. Investments in research and in the development of interventions will help to control the overweight problem. If the societal trend of descending cultural capital also does its share, then there may be hope for the twenty-first century.

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Part II

International variations in the size of socioeconomic differences in overweight and obesity

Chapter 3

Social inequalities in the prevalence of overweight *

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ABSTRACT

Background. In Western societies, a lower educational level is often associated with a higher prevalence of overweight. However, there may be important international differences in the strength and direction of this relationship, perhaps in respect of differing levels of socioeconomic development.

Objectives. To describe educational inequalities in overweight across Europe, and to explore the contribution of level of socioeconomic development to cross-national differences in educational inequalities in overweight adults in Europe.

Methods. Cross-sectional data were derived from national health interview surveys from 19 European countries (*N* = 127,018; age range = 25-44 years). Multivariate regression analysis was employed to measure educational inequalities in overweight. Gross Domestic Product per person was used as a measure of level of socioeconomic development.

Results. Inverse educational gradients in overweight (i.e. higher education, less overweight) are a generalized phenomenon among European men and even more so among women. Baltic and Eastern European men were the exceptions, with weak, positive associations between education and overweight. Educational inequalities in overweight were largest in southern European women. There was a weak relationship between level of socioeconomic development and inequalities in overweight. When levels of socioeconomic development increased, overweight became increasingly more common among men of lower education, while the opposite was true for men of higher education. There was no clear association of level of socioeconomic development with inequalities in overweight among women.

Conclusion. In most European countries, people of lower educational attainment are now most likely to be overweight. In terms of overweight prevalence, men of higher educational attainment appeared to benefit from an increasing level of socioeconomic development, while for men of lower educational attainment the opposite was true.

INTRODUCTION

Socioeconomic inequalities in overweight and obesity ('overweight' for short) have recently been reviewed [1] in order to update a paper which was previously published. [2] Although the observed patterns were less pronounced than in the mid-1980s, the review concluded that for women overweight was more common among women of lower socioeconomic position (SEP). The results for men were less consistent. The magnitude of the inequalities in overweight varied depending on what aspect of SEP was studied. Educational level usually showed the strongest relationships with overweight levels. [1]

One factor that determines the size of the 'overweight gap' is the level of socioeconomic development of a country. [1 3 4] Overweight, at least until recently, [5] is more common among people of higher SEP in developing countries, whereas in developed countries, the opposite is true. There are indications that, above a certain level of socioeconomic development, the burden of overweight shifts to the socioeconomically disadvantaged. [4 5] Similarly, inverse associations between SEP and overweight may become increasingly more common when the level of socioeconomic development increases, while positive associations become increasingly less common. [1] The onset of the shift of overweight towards those of lower SEP occurs at an earlier stage of socioeconomic development for women than it does for men. [5] In summary, socioeconomic factors at the individual and societal levels appear to mutually interact. However, level of socioeconomic development might not completely determine all international variations in inequalities in overweight.

A second factor relates to the sharp divide in health and mortality between central/eastern and western Europe, [6] a divide that has even widened shortly after the collapse of the communist regimes in 1989. [7] This divide also becomes manifest as a high prevalence of overweight in central/eastern Europe, which were estimated to be at about 80 % in one study. [8] Unhealthy diet, alcohol use [6 9] and other behaviors may all be linked to the high levels of overweight in this region. Although economic hardship probably plays a role in this, a broad set of social circumstances may also be involved. [6 10] Those population groups with the smallest resources for coping with stress, such as those of lower SEP, may be most vulnerable to the effects of the social and political transition. [11]

The objectives of this study are to provide an up-to-date pan-European overview of inequalities in overweight, and to explore the contribution of socioeconomic development to international variations in those inequalities. Key features of this study are that (1) nineteen countries are covered, including Eastern European and Baltic countries, (2) the surveys are relatively large, and (3) comparatively recent surveys are used, which is important given the sharp rise in the prevalence of overweight during the past decades. [12 13] Our research questions were (1) whether inverse gradients in overweight are currently a generalized phenomenon in Europe; (2) whether there are important international differences in the size of these inequalities; and (3) whether these variations were associated with the level of socioeconomic development.

METHOD

Data sampling and participants

Table 1 gives an overview of the cross-sectional survey data that were used in this study. The total sample size was *N* = 127,018 and varied from *N* = 635 (Slovak Republic) to *N* = 41,613 (Italy). Most surveys dated from after 2000. Data of height and/or weight were missing in 3.1 % of all cases on average, ranging from 0.01 % (Italy) to 7.0 % (France). To reduce confounding by morbidity, we limited our analyses to participants aged between 25-44 years.

Throughout this paper, we will present the countries according to their geography, in a counter-clockwise order (i.e., north, west, south, east) starting with Finland.

Table 1. National surveys used in this study

Country	Name of survey and responsible institute	Year(s) of survey	GDP/capita (EUR)	N_{total}
Finland	Finbalt Health Monitor National Public Health Institute, Helsinki	1994/'96/'98/ '00/'02/'04	27,318	8223
Sweden	Swedish Survey of Living Conditions (ULF) Statistics Sweden, Stockholm	2000/'01	29,483	3990
Norway	Norwegian Survey of Living Conditions Statistics Norway, Oslo	2002	41,820	2529
Denmark	Danish Health and Morbidity Survey (DHMS/ SUSY) Danish National Institute of Public Health, Copenhagen	2000	34,320	5821
Ireland	Living in Ireland Panel Survey Economic and Social Research Institute (ESRI), Dublin	1995/'02	34,984	2064
England	Health Survey for England (HSE) Department of Health, London	2001	27,227	5583
Netherlands	General social survey (POLS) Statistics Netherlands, Voorburg	2003/'04	28,589	5607
Belgium	Health Interview Survey Institute of Public Health (IPH), Brussels	1997/'01	25,939	6932
Germany	German National Health Examination and Interview Survey Robert Koch Institute (RKI), Berlin	1998	25,575	2786
France	French Health, Health Care and Insurance Survey (ESPS) IRDES, Paris	2004	25,207	6048
Italy	Health and health care utilization National Institute of Statistics (ISTAT), Rome	1999/'00	22,223	41613
Spain	National Health Survey Ministry of Health and Consumption (MSC), Madrid	2001	19,393	7741
Portugal	National Health Survey Instituto Nacional de Saude Dr Ricardo Jorge (INSARJ), Lisbon	1998/'99	12,241	12297
Slovakia	Health Monitor Survey Public Health Institute of Slovak Republic, Bratislava	2002	5,823	635
Hungary	National Health Interview Survey Hungary NPHMOS, Budapest	2000/'03	7,838	3618
Czech Rep	Health Interview Survey Institute of Health Information and Statistics, Czech Republic	2002	8,030	789
Lithuania	Finbalt Health Monitor (see under Finland)	1994/'96/'98/ '00/'02/'04	4,948	5465
Latvia	Finbalt Health Monitor (see under Finland)	1998/'00/'02/'04	4,499	3537
Estonia	Health Behavior among Estonian Adult Population National Institute for Health Development, Tallinn	2002/'04	6,490	1740

Variables
Sexes were always analyzed separately. Country data were usually (except for pooled estimates) analyzed separately. Gross Domestic Product per capita (GDP/capita, in Euros) was used as a measure for level of socioeconomic development (International Monetary Fund, World Economic Outlook Database, September 2005).

Educational attainment was re-coded according to the International Standard Classification of Education (ISCED), [14] a classification designed to improve international comparability of educational classifications. This variable had four levels: (1) ‘Tertiary, or *highest*, education’ (corresponding to ISCED 5-6); (2) ‘Upper secondary and post-secondary non-tertiary’, or *second-highest*, education (ISCED 3-4); (3) Lower secondary, or *second-lowest*, education (ISCED 2) and ‘No or only primary’, or *lowest*, education (ISCED 1).

The BMI was calculated from the self-reported weight (kilograms) divided by the squared height (meters). It was dichotomized into overweight (BMI ≥ 25) and obesity (BMI ≥ 30).

Statistical analyses
Prevalence rates were age-standardized using the direct method. The European Standard Population of 1995 was used as a reference population. In pooled analyses, a weight for country size was used to simulate equal sample sizes for each country. The Prevalence Ratio (PR) expresses the prevalence of overweight in the group of interest relative to the prevalence of overweight in the highest educational level. PRs and their 95% confidence intervals were estimated by regression analysis with the log link function [15] using the Genmod procedure. [16] PRs were always adjusted for five-year age category and, where applicable, for country.

When model and data did not converge, PR estimates were calculated using the COPY Method, [17] using 1000 copies. This method consists of expanding the original data set to include 1000 copies of the original data set together with one copy of the original data set with cases and controls reversed. The estimated standard error of the PR on the expanded data set is then adjusted to obtain the correct estimate of the standard error of the PR.

We summarized the association between being overweight and educational level by calculating the Relative Index of Inequality (RII) and its 95% confidence intervals. [18-20] The RII is a regression-based measure that assesses the linear association between being overweight and the relative position of each educational level separately. The relative position is measured as the cumulative proportion of each educational level 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 overweight at the very top as compared to the very lowest end of the educational hierarchy. An RII above (below) one indicates a negative (positive) relationship between educational level and being overweight. The RII could be used to make international comparisons, provided that a detailed and hierarchical educational classification is available for each country.

RESULTS

Table 2 shows educational inequalities in overweight (BMI ≥ 25) among men across Europe. The inequalities are measured by means of prevalence rates according to educational level, and are summarized by means of the RII. The prevalence of overweight among men ranged from 31.8 % (France; high-educated men) to 70.4 % (Slovak Republic; high-educated men). The size and the direction of the relationship between educational level and overweight prevalence showed considerable variation between countries. Estonia, Lithuania, Latvia, Slovak Republic and Hungary showed an increase in prevalence of overweight with an increasing level of education (PR < 1). Of all other countries, France showed the largest educational inequalities in overweight (PR = 1.63).

Table 2. Age-adjusted prevalence (%) of overweight by educational level across the studied countries (*men*)

Country	**Overweight/education**					**RII**	
	Overall	**Highest**	**2nd highest**	**2nd lowest**	**Lowest**	RII	95 % confidence interval
Finland	*46.8*	45.3	50.9	51.8	39.0	1.16	(1.02- 1.32)
Sweden	*53.8*	39.7	52.1	60.1	63.4	1.62	(1.37- 1.93)
Norway	*52.2*	47.3	56.1	53.3	-	1.25	(1.02- 1.54)
Denmark	*48.6*	38.6	46.4	52.3	56.9	1.53	(1.31- 1.79)
Ireland	*58.7*	59.8	54.9	62.9	57.0	1.02	(0.84- 1.24)
England	*64.9*	63.0	66.4	65.6	64.5	1.02	(0.92- 1.13)
Netherlands	*42.9*	35.9	41.4	48.8	45.4	1.47	(1.24- 1.73)
Belgium	*44.3*	37.6	46.4	50.5	42.5	1.38	(1.21- 1.58)
Germany	*61.7*	50.1	61.8	65.8	69.2	1.25	(1.08- 1.45)
France	*39.3*	31.8	39.9	43.2	42.3	1.63	(1.31- 2.02)
Italy	*44.2*	33.3	42.3	49	52.0	1.46	(1.38- 1.54)
Spain	*54.8*	47.3	54.3	58.1	59.5	1.23	(1.11- 1.37)
Portugal	*49.2*	42.5	49.9	51.1	53.3	1.20	(1.08- 1.33)
Slovak Republic	*58.5*	70.4	60.4	62.7	40.6	0.64	(0.46- 0.89)
Hungary	*57.9*	58.4	59.8	58.7	54.6	0.91	(0.79- 1.06)
Czech Republic	*51.3*	43.0	59.3	53.7	49.0	1.05	(0.76- 1.46)
Lithuania	*47.0*	53.2	46.8	46.1	41.7	0.84	(0.72- 0.98)
Latvia	*41.6*	49.6	40.3	36.7	39.6	0.71	(0.57- 0.89)
Estonia	*45.7*	48.5	48.5	43.9	41.9	0.83	(0.63- 1.09)
Total	*50.9*	*47.1*	*51.5*	*53.4*	*51.5*	*1.1*	*(1.07- 1.13)*

Note. Hyphen = could not be calculated (*N* = 3); RII = relative index of inequality, adjusted for age group (all) and country (only total).

Table 3 is similar to the previous table but for women. The prevalence to be overweight ranged from 9.9 % (Italian high-educated women) to 73.5 % (Swedish low-educated women). Educational inequalities in overweight were smallest in Ireland (PR = 1.36) and largest in Portugal and Italy (PR ≥ 3.30), at least in relative terms. The latter two countries had the lowest overall prevalence of overweight among women.

Table 3. Age-adjusted prevalence (%) of overweight by educational level across the studied countries (*women*)

Country	Overweight/education					RII	
	Overall	**Highest**	**2nd highest**	**2nd lowest**	**Lowest**	RII	95 % confidence interval
Finland	*29.2*	24.1	32.2	35.4	25.1	1.65	(1.37- 1.98)
Sweden	*42.2*	23.2	32.7	39.4	73.5	2.09	(1.60- 2.73)
Norway	*32.3*	25.0	34.2	37.6	-	1.67	(1.19- 2.35)
Denmark	*34.4*	23.4	30.5	40.5	43.1	1.95	(1.57- 2.44)
Ireland	*36.2*	30.4	35.3	35.4	43.7	1.36	(1.00- 1.84)
England	*51.4*	39.3	51.0	54.7	60.5	1.62	(1.40- 1.87)
Netherlands	*37.1*	24.0	35.5	40.9	48.0	2.12	(1.75- 2.56)
Belgium	*32.1*	18.1	30.8	34.0	45.6	3.01	(2.47- 3.68)
Germany	*36.0*	21.6	34.7	49.6	38.1	2.46	(1.90- 3.19)
France	*30.4*	16.2	25.7	31.0	48.6	2.91	(2.18- 3.89)
Italy	*21.9*	9.9	16.5	23.8	37.5	3.3	(2.98- 3.65)
Spain	*28.9*	18.4	20.1	31.5	45.4	2.89	(2.34- 3.56)
Portugal	*28.6*	18.0	24.2	27.6	44.6	3.72	(3.17- 4.37)
Slovak Republic	*30.7*	18.9	26.4	34.2	43.1	2.22	(1.18- 4.19)
Hungary	*36.9*	28.5	35.0	42.1	41.8	1.46	(1.20- 1.77)
Czech Republic	*31.3*	18.7	23.6	38.7	44.2	3.12	(1.77- 5.51)
Lithuania	*36.9*	26.2	36.6	40.8	44.0	1.64	(1.38- 1.94)
Latvia	*34.3*	29.0	36.5	36.2	35.4	1.28	(1.02- 1.60)
Estonia	*34.5*	22.1	31.5	35.0	49.3	2.11	(1.52- 2.95)
Total	*34.1*	*22.9*	*31.2*	*37.3*	*45.1*	*1.98*	*(1.91- 2.06)*

Note. See notes of Table 2.

Table 4 shows educational inequalities in obesity (BMI ≥ 30) across Europe among men. The overall prevalence of obesity was 11 %, and ranged from 6.0 % (France) to 21.6 % (England). Considerable international variation in inequalities among men could be observed. The RII indicated a positive relationship between educational level and obesity in Lithuania and Latvia (although not significant). In all other cases, educational level and obesity prevalence were negatively related. Sweden, Czech Republic and the Netherlands showed the largest educational inequalities in obesity (RII ≥ 3.61) and Ireland, Latvia and Lithuania the smallest (RII ≤ 1.34).

Table 4. Prevalence (%) and educational inequalities in obesity across the studied countries (*men*)

Country	**Obesity/education**					**RII**	
	Overall	Highest	2nd High	2nd Low	Lowest	RII	95 % confidence interval
Finland	*8.8*	7.3	9.7	9.3	8.8	1.52	(1.01- 2.29)
Sweden	*11.6*	4.4	10.6	12.6	18.8	4.33	(2.39- 7.83)
Norway	*10.1*	5.6	12.1	12.5	-	3.42	(1.70- 6.92)
Denmark	*9.7*	5.3	7.5	12.9	13.1	3.11	(1.87- 5.17)
Ireland	*10.6*	8.1	10.9	9.8	13.5	1.34	(0.67- 2.65)
England	*21.6*	16.3	20.1	23.4	26.5	1.70	(1.26- 2.29)
Netherlands	*10.1*	4.9	8.9	12.2	14.3	3.61	(2.28- 5.73)
Belgium	*10.1*	6.5	11.1	11.3	11.3	2.17	(1.48- 3.19)
Germany	*14.5*	9.1	16.0	17.9	15.0	1.66	(1.06- 2.61)
France	*6.0*	4.4	6.0	9.7	3.9	3.28	(1.74- 6.19)
Italy	*7.0*	4.1	6.0	8.1	9.7	2.31	(1.90- 2.79)
Spain	*10.4*	6.4	8.3	11.6	15.4	2.72	(1.88- 3.93)
Portugal	*8.1*	4.1	7.8	10.1	10.3	2.02	(1.42- 2.87)
Slovak Republic	*10.3*	12.8	9.1	19.5	-	1.58	(0.53- 4.76)
Hungary	*17.7*	16.7	15.2	18.3	20.9	1.44	(0.97- 2.15)
Czech Republic	*11.1*	7.7	4.6	12.3	19.6	3.64	(1.09- 12.16)
Lithuania	*8.6*	8.5	8.9	8.4	8.7	0.96	(0.59- 1.56)
Latvia	*8.6*	11.3	6.2	7.3	9.8	0.86	(0.45- 1.62)
Estonia	*13.3*	9.6	12.3	15.3	15.7	1.69	(0.84- 3.38)
Total	*11.0*	*8.1*	*10.1*	*12.8*	*13.1*	*1.97*	*(1.81- 2.15)*

Note. See notes of Table 2.

Table 5 shows that, among women, the overall prevalence of obesity (BMI ≥ 30) was 11 %, and ranged from 5.0 % (Italy) to 23.3 % (England). The educational inequalities in obesity were smallest in Latvia, Finland and Norway (RII ≤ 1.75) and largest in Portugal (RII = 6.78). However, the Czech, the Slovakian and the Belgian estimates were imprecise, as indicated by wide 95 % confidence intervals.

Figure 1 plots countries against the prevalence of overweight (BMI ≥ 25; *y*-axis) and the level of socioeconomic development (GDP/capita in Euros; *x*-axis). A distinction is made by educational attainment. Men of the lowest educational levels showed an increase in the prevalence of overweight when socioeconomic development level increased (R^2 = 23 %). Conversely, men of the highest educational level showed a decrease in the prevalence of overweight with increasing level of socioeconomic development (R^2 = 10 %). Men of the intermediate educational level were in between these two patterns. For obesity prevalence, a similar picture emerged (figure not shown).

Women of all educational levels showed a slight increase in the prevalence of overweight (BMI ≥ 25) with increasing level of socioeconomic development ($1 \% < R^2 < 3 \%$). The level of inequality in overweight was similar across all levels of socioeconomic development.

Table 5. Prevalence (%) and educational inequalities in obesity across the studied countries (*women*)

Country	Obesity/Education					RII	
	Overall	Highest	2nd High	2nd Low	Lowest	RII	95 % confidence interval
Finland	*7.4*	6.9	9.4	11.0	2.2	1.59	(1.06- 2.37)
Sweden	*13.5*	4.7	9.9	11.3	28.2	3.87	(2.12- 7.04)
Norway	*6.8*	5.9	8.2	6.4	-	1.75	(0.76- 4.01)
Denmark	*12.2*	7.0	9.0	13.8	19.1	2.70	(1.70- 4.29)
Ireland	*8.1*	4.4	9.3	7.9	10.7	1.98	(0.94- 4.19)
England	*23.3*	15.6	22.2	26.1	29.4	2.19	(1.66- 2.87)
Netherlands	*11.4*	6.4	9.7	12.6	17.0	2.87	(1.89- 4.34)
Belgium	*10.7*	4.2	8.6	10.7	19.1	6.25	(4.05- 9.65)
Germany	*15.2*	4.9	11.1	20.4	24.6	5.07	(2.95- 8.71)
France	*11.1*	5.0	8.8	10.9	19.9	4.21	(2.46- 7.21)
Italy	*5.0*	1.5	3.1	5.5	9.7	6.03	(4.71- 7.71)
Spain	*7.0*	3.0	4.4	8.1	12.3	5.09	(3.08- 8.44)
Portugal	*6.6*	3.0	4.2	7.1	12.0	6.78	(4.55- 10.10)
Slovak Republic	*11.3*	3.6	5.3	8.5	-	5.85	(1.41- 24.24)
Hungary	*13.9*	6.2	14.6	15.3	19.8	2.28	(1.57- 3.31)
Czech Republic	*10.0*	1.7	8.6	11.0	18.6	5.30	(1.54- 18.22)
Lithuania	*11.7*	7.3	10.5	15.8	13.2	2.68	(1.84- 3.90)
Latvia	*9.7*	8.0	10.8	12.7	7.2	1.50	(0.92- 2.45)
Estonia	*12.1*	4.6	10.5	10.4	22.8	3.33	(1.67- 6.66)
Total	*11.0*	*5.5*	*9.4*	*11.9*	*17.4*	*2.99*	*(2.75- 3.26)*

Note. See notes of Table 2.

DISCUSSION

Summary of the results

The well-known phenomenon of inverse educational gradients in overweight (higher SEP, lower overweight prevalence) has occurred recently almost everywhere in Europe, especially among women. The exceptions were men in all Baltic and most Eastern European countries of the study, where overweight was slightly more common among men with higher educational attainment. The inequalities were greatest among women of Southern Europe. With increasing level of socioeconomic development, overweight became increasingly more common among men of lower education, while the opposite was true for men of higher education. For women, the level of inequality in overweight was independent of the level of socioeconomic development.

Evaluation of data and methods

Some limitations of the present paper must be acknowledged. People with a high true BMI have a tendency to under-report their weight, while most people over-report their height. [21] Data based on self-reported BMI may therefore underestimate the true prevalence of overweight and obesity.

Most studies found that people with lower education overestimated their height more than their higher educated counterparts, which would lead to underestimates of the size of inequalities in BMI. [22 23] However, other studies have supported an opposite pattern [24] or found no class pattern at all. [25] One study found that the mean difference between self-reported and measured height was 0.7 cm, which leaves little room for large socioeconomic variations in the magnitude of bias. [26] Thus, although it may have influenced our inequality estimates, we estimate that, in absolute terms, the effect of self-report bias on inequality estimates is probably small. [27]

Misclassification of educational level is another potential source of bias. We applied the ISCED classification in order to make educational classification as comparable as possible between countries. This approach yielded population distributions that were similar to distributions according to European statistics. [28] Nonetheless, some international comparability problems may have remained. However, we employed the RII, a measure that can be used to make international comparisons, provided that a detailed and hierarchical educational classification is available for each country. The educational classifications for all countries are all hierarchical in nature, and moreover are fairly detailed. Therefore, we deem it unlikely that any remaining problems with educational classifications would have substantially biased our international overviews of educational inequalities in overweight.

Comparison to previous studies

The general finding of an inverse relationship between education and overweight among women has been shown many times. The international literature provides a less consistent picture for men. [1 2] A cross-European study yielded similar results, [29] but did not look at individual European countries.

A worldwide MONICA-based study of 26 countries also showed an inverse association between educational level and BMI in almost all female, and about half of the male populations. [30] French, German, Belgian and Czech women showed the largest inequalities. As with our study, England showed small inequalities for both men and women. Educational inequalities in BMI were either absent or positive among Czech, Polish, Yugoslavian and Russian men. The latter finding coincides with the Eastern European and Baltic results of this and a related study. [31]

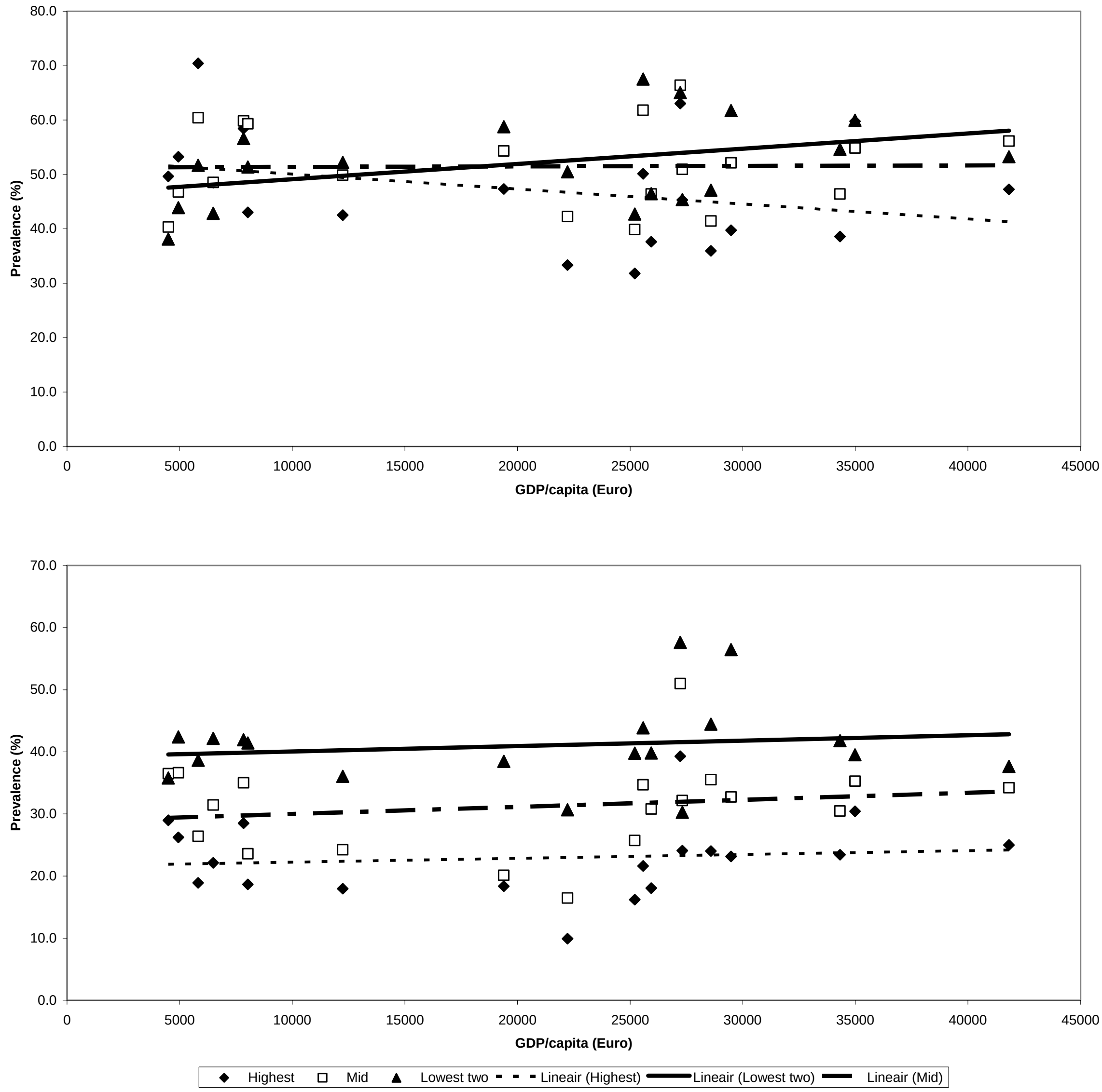
Explanation and interpretation of results

Socioeconomic development leads to changes in nutrition and physical exercise, but the impact of these factors within societies is not equal. Given a sufficiently high level of socioeconomic development, the burden of overweight may fall disproportionately on persons of lower SEP. [1 5] Socioeconomic development may lead to the dissipation of factors that are protective of overweight among poor people. [32] Cheap, energy-dense foods become widely available, especially for those of lower SEP, while at the same time levels of physical activity decrease. Seen from this perspective, men of the poorest countries of our study may be in the early stages of the ‘obesity shift’.

Women, even in the poorest countries of our study, seem already to be beyond this shift. Among women, the shift of obesity towards the poor apparently occurs at earlier stages of the economic development. [5] It appears that, above a certain level of socioeconomic development, an increase in socioeconomic development is no longer associated with a further increase of the inequalities in overweight.

While socioeconomic development may partly explain the findings in the relatively poor Baltic and Eastern European countries (especially among men), there is an additional explanation for the small inequalities that characterize these countries. Given the communist past of these countries, socioeconomic segregation may be less advanced than in the other countries of our study. [33] As a result, overweight may be a more generalized (but not necessarily common) phenomenon, only weakly linked to SEP.

Figure 1. Educational inequalities in overweight (BMI ≥ 25) by level of socioeconomic development in Europe for MEN (above) and WOMEN (below)



Note. Solid line/triangle = Lowest two educational levels; Long dash/square = Intermediate educational level; Short dash/rhombus = Highest educational level.

Another striking finding of this study is the observation of the largest educational inequalities in overweight among women (but not men) of the Mediterranean countries. The explanation may be found in large education-related differences in labour force participation. Labour participation is generally higher among women of higher education, who generally choose to have fewer children. [34] Lower-educated women, on the other hand, often assume more traditional role patterns [35] and conform to the Mediterranean 'male breadwinner model', which is maintained by gender inequities in social policies. [36] For example, it is scarcely possible for women to do part-time work and child-support is less than generous. [37]

Inequalities in labour force participation may be linked to inequalities in overweight in several ways. The direct effects may be that higher parity itself is closely related to overweight [38] and that a lower degree of labour participation is related to smaller amounts of leisure time physical activity. [39] Second, the dual role of worker and mother that is disproportionately expected from women of higher education (and that is often not shared by their spouse), is (literally) more energy demanding than full-time motherhood. Third, working women, especially those of higher educational levels, work in a social environment where the social norm emphasizes thinness and healthy food patterns. [1]

The Mediterranean diet may be a contributing factor. [40] This diet is rich in olive oil and starch; ingredients with a relatively high energy density. Thus, there has been some debate about a possible link with overweight. [41,42] People may consume similar food volumes, independent of the energy density of the diet consumed. [43] Consequently, energy-dense diets such as the Mediterranean diet may render people more likely to over-consume and become overweight. This factor may be especially important as adherence to the Mediterranean diet is greater among people of lower SEP. [44]

Implications and conclusion

This study underlines that educational inequalities in overweight must be viewed from an international perspective to understand their origins and explanations. Our study indicated that level of socioeconomic development only partially explained international differences in educational inequalities in overweight. Future research may include cultural and institutional factors, as these factors may help explain why inequalities in overweight are larger in some countries and smaller elsewhere. Despite their importance in explaining inequalities in overweight, society-level socioeconomic factors have hitherto received relatively little attention in studies on inequalities in overweight.

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Chapter 4

Different socioeconomic indicators for overweight [*]

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[*] Roskam AJR, Kunst AE (2008). The predictive value of different socio-economic indicators for overweight in nine European countries. *Public Health Nutrition* 11(12):1256-66.

ABSTRACT

Objectives. To assess which socioeconomic indicator best predicts overweight in the European Union: educational attainment, occupational class and household income.
Setting. The prevalence of overweight is strongly related to socioeconomic position. The relative importance of different socioeconomic dimensions is uncertain, and might vary between countries.
Method. Cross-sectional self-report data of the European Community Household Panel were obtained from nine countries (*N* = 52 855; age 25-64 years). Uni- and multivariate regression analyses were employed to predict overweight (body mass index ≥ 25) in relationship to socioeconomic indicators. Occupational class was measured using the new European Socio-Economic Classification
Results. Large socioeconomic differences in overweight were observed in all countries, especially for women. For both sexes, a low educational attainment was the strongest predictor of overweight. After control for education, overweight was negatively related to household income in women, but positively in men. Similar patterns were found for occupational class. For women, but not for men, educational inequalities in overweight were generally greater in Southern European countries. A similar pattern of inequalities in overweight was observed for all ages between 25 and 64 years.
Conclusions. Across Europe, overweight was more strongly and more consistently related to educational attainment than to occupational class or household income. People with lower educational attainment should be a specific target group for the programs and policies that aim to prevent overweight.

INTRODUCTION

In Europe, overweight and obesity are estimated to account 8% of the overall burden of disease [1] and 5% of the total healthcare expenditures. [2] Numerous studies have shown that Body Mass Index (BMI) differs by socio-demographic variables. A consistent finding is an inverse association of socio-economic position (SEP) with BMI, especially in females. [3 4]

The unequal distribution of overweight across socio-economic groups offers an entry point for prevention activities. Overweight prevention approaches might be more cost-effective if they specifically target groups of lower SEP. However, SEP is a multidimensional construct of which individual components, such as educational attainment, occupational class, or income level, represent different dimensions. These different dimensions do point to different mechanisms (e.g. different critical phases in life course), and in addition they represent in part different groups of people. It is therefore important to know which aspect of SEP is most closely related to overweight.

In this study, we were interested specifically in the magnitude of the independent effects that educational, income and occupational levels have on the prevalence of overweight. While many studies have reported associations between one SEP indicator and overweight, few studies have investigated the relative importance of different SEP indicators.

An American study that investigated simultaneously the associations between different components of SEP and researcher-measured body weight among women, showed that there was a significant relationship between education, but not income. [5] Among men, the relationship with educational attainment was inconsistent, while a positive relationship between income and BMI was found. [6]

In the UK, lower occupational level predicted female obesity better than educational level or an indicator of material deprivation. The same study found that researcher-measured BMI was negatively related to income among men, while occupational level showed irregular patterns. [7]

Another study that used a pooled sample of men and women from 15 countries of the European Union (EU) found that educational level had the greatest relative predictive value for self-reported obesity, compared to social class. [8] However, the measure of "social class" was defined by level of income in some countries, while in others it was defined by occupation in other countries.

An Australian study found that researcher-measured BMI and SEP domains were associated. [9] Lower scores on the employment domain were associated with a higher risk of being overweight. However, educational attainment was not measured in this study.

Our study aimed to investigate the relative contribution of three complementary dimensions of SEP (educational attainment, household income, occupational class) to the risk of overweight. Data from the European Household Panel (ECHP) [10] were used to measure inequalities in overweight across nine EU member states. The ECHP is a standardized, internationally comparable survey conducted using large samples. It contains detailed measurements of educational attainment, household income, and occupational class. Occupational class was measured using the European Socioeconomic Classification (ESEC), a new and finely-graded measure designed to enable better international comparability of the variable. [11]

We analyzed our data in three major steps. First, we utilized the pooled data from all countries to analyze the relative contributions of each SEP in the EU at large. Second, we investigated variations between countries by stratifying the analysis per country. Third, we analyzed the data by age group to assess variations between age groups in the relative importance of education, income and occupation. Men and women were consistently analyzed separately.

METHOD

Data

We used cross-sectional data of the European Community Household Survey (ECHP) conducted by Eurostat. [10] The ECHP is a survey based on a standardized questionnaire, which is employed in the annual interviewing of a representative panel of households and non-institutionalized individuals aged 16 years and older in each EU member state. All surveys were based on a non-stratified random sampling design. All persons in the panel households were individually interviewed. The data collection was carried out in most EU countries by paper-and-pencil interviewing by National Statistical Institutes or research centers. Design, procedure [10 12] and statistical issues [13] of the ECHP were described in more detail elsewhere.

Data used in this study were from the survey conducted in 2000 (Wave 7). Data from nine member states of the EU were available for the analyses: Finland, Denmark, Belgium, Ireland, Austria, Italy, Spain, Greece and Portugal.

Participants

Basic information on the study population can be found in Table 1. A total of 52,855 non-institutionalized persons (50.8% females) aged 25 to 64 comprised the data that were used in the analyses. The 25-64 years age range was selected because of the variations in age ranges available per country. Also, the validity of BMI as a measure for fat mass may be hampered in the elderly, as muscle mass may decrease above the age of 60. [14]

All countries except Ireland (ca. 75%) had a response rate of above 80%, while Greece, Italy and France obtained the highest response rates (> 95%). Main reasons for not responding were contact failure (person temporarily away) and lack of co-operation (inability or unwillingness to respond).

Independent variables

We utilized three SEP indicators: educational, occupational and income level. Educational attainment was defined as the highest level of general or higher education completed. Data were coded according to the International Standard Classification of Education (ISCED). [15] This classification was designed to enable international comparability of educational systems. This variable had three descending levels: (1) recognized third level education (corresponding to ISCED 5-7, or > 12 years of education); (2) second stage of second level education (ISCED 3, or 10-12 years of education); and (3) less than second stage of second education (ISCED 0-2, or ≤ 9 years of education).

Occupational class was measured using the new ESEC scheme. The ESEC distinguishes nine social classes that differ in terms of employment relationships. It is an occupationally based classification that has rules to provide coverage of the whole adult population. The information required to assign people to these classes was: occupation coded to the minor groups (i.e. 3-digit groups) of the International Standard Classification of Occupations 1988; details of employment status, i.e. whether an employer, self-employed or employee; number of employees at the workplace; whether a worker is a supervisor. [11] Using this information, a total of nine quasi-hierarchical categories could be discerned (Table 2). Occupational class was assigned to each household member using the dominance approach, [16] which meant that the household member with the highest occupational class determined the class of each individual household member. Unclassifiable individuals were reported as ‘ESEC unknown’.

Household income was defined as the pooled net household income divided by the square root of the number of persons in the household. [17] Each country-specific sample was divided into income percentiles in order to (a) enable international comparability of different currencies (b) create a relative measure of poverty.

Dependent variable
BMI was defined as the self-reported weight (kilograms) divided by the squared self-reported height (meters). For most purposes, the BMI was categorized into (1) underweight (10 ≤ BMI < 18); (2) normal weight (18 ≤ BMI < 25); (3) moderately overweight (25 ≤ BMI < 30) and (4) obese (BMI ≥ 30). BMIs below 10 were considered missing (N = 1). When BMI was dichotomized, the cut-off point was set at BMI = 25 (with BMI ≥ 25 referred to as "overweight").

Statistical analyses
Prevalence rates were age-standardized using the direct method with the 1995 EU population as the standard. The Prevalence Ratio (PR) expresses the prevalence of overweight in the group of interest relative to the prevalence of overweight in best-off socioeconomic group. PRs and their 95% confidence intervals were estimated through regression with the log link function [18] using SAS'[19] Genmod procedure.

In the next step we summarised the association between overweight and each SEP indicator by calculating the Relative Index of Inequality (RII) and its 95% confidence intervals. [20-22] RII is a regression-based measure that can be applied to each SEP indicator. It assesses the association between overweight ratios and the relative position of each socioeconomic group separately. This relative position is measured as the cumulative proportion of each socioeconomic group within the socioeconomic hierarchy, with 0 and 1 as the extreme values. The resulting measure, the RII, can be interpreted as the risk of being overweight at the very top of the socioeconomic hierarchy as compared to the very lowest end of the socioeconomic hierarchy. An RII above (below) 1 indicates a negative (positive) relationship between SEP and overweight. The RII can be compared between the three SEP indicators, provided that a detailed and hierarchical classification is used for each indicator. In the same way, the RII can be used to make comparisons between countries and between age groups.

The RII was estimated with log linear regression with control for 5-year age group, using a methodology similar to that of the PR estimations. We conducted two types of hierarchical analyses which controlled for: (1) age category and country (confounders) and one SEP indicator; or (2) confounders and all SEP indicators. The last step aimed to eliminate the effect of the other SEP indicators on the association between the SEP indicator of interest and overweight prevalence.

RESULTS

Table 1 shows that overall prevalence of overweight (BMI ≥ 25) were 35.7% (females) and 55.9% (males). Overweight was most prevalent in Greece and Finland (both sexes) and Spain (men). For women, the prevalence of overweight ranged from 26.8% in Italy to 43.1% in Finland. For men, the prevalence of overweight ranged from 49.9% in Italy to 65.1% in Greece. Percentages of missing values were comparable between countries and were within the normal range (≤ 2.7%), with the exception of Spain (8.1 % for women and 7.1% for men).

Table 2 shows generally showed strong negative gradients for women, meaning that overweight prevalence rates sharply increased when SEP decreased. Based on Prevalence Ratios (PR), this gradient was strongest for education. Differences between adjacent educational categories were significant. Controlling for the other SEP indicators caused an important reduction in educational differences in overweight. For example, the lowest educational group's PR was 2.76 before and 1.93 after controlling for the other SEP indicators.

Table 1. Sample sizes (*N*) missing values and age-adjusted prevalence (%) of overweight and obesity (BMI ≥ 25) and obesity (BMI ≥30).

Country	**Females**				**Males**			
	N_{total}	Miss.*	BMI≥25†	BMI≥30†	N_{total}	Miss.*	BMI≥25†	BMI≥30†
	N	%	%	%	N	%	%	%
Finland	2626	1.6	43.1	13.5	2621	0.7	57.6	12.6
Denmark	1514	2.6	35.7	9.3	1483	0.6	50.5	11.4
Belgium	1935	2.7	34.2	10.9	1753	2.1	52.2	11.2
Ireland	2043	2.3	35.0	8.3	1994	2.0	56.2	9.7
Austria	2200	1.9	36.1	9.0	2102	0.5	54.4	10.1
Italy	5471	1.1	26.8	5.0	5443	1.2	49.9	8.5
Spain	4302	8.1	35.3	9.1	4168	7.1	62.7	14.8
Greece	3196	0.1	40.6	8.2	3065	0.7	65.2	11.0
Portugal	3583	1.1	34.3	8.1	3356	2.0	54.0	8.5
Total	*26870*	*2.5*	*35.7*	*9.1*	*25985*	*2.2*	*55.9*	*10.9*

Note. * Miss: Missing values; i.e. no data for weight, height or both; † BMI = Body Mass Index (kg/m^2)

Compared to educational level, occupational differences in overweight was smaller (and slightly irregular), but still pronounced. Controlling for the other SEP predictors only slightly reduced the predictive value of occupational class. Occupational class and overweight were more or less negatively linearly related, with slight irregularities in the gradient for the categories ‘Lower salariat’, ‘Farmers’, and ‘Higher grade blue collar’. Most adjacent occupation categories were not significantly different from each other, but differences between the highest two occupational levels and the lowest three categories attained statistical significance.

The income-related gradient in overweight was relatively weak (and slightly irregular), but like the occupational gradient, it remained pronounced. Controlling for the other SEP predictors caused a sharp reduction in the predictive values of income. There was an inverse relationship between income and overweight (less income, more overweight) within the poorest seven income deciles. The relationship was absent within the three richer deciles, i.e., the relationship flattens with increasing income. Only the highest two differed from the lowest two income deciles with statistical significance.

Table 3 shows the prevalence rates and PRs of overweight for male participants. After control for confounders and other SEP indicators, the PRs of overweight indicated that overweight was associated with lower education (PR = 1.48). For the other indicators, the patterns were irregular (occupation) or even slightly curvilinear (income). After controlling for other SEP predictors, the associations with income and occupational class were not statistically significant. Adjustment for other SEP indicators had virtually no effect on the predictive value of education.

Table 2. Proportional distribution, crude prevalence and Prevalence Ratios of overweight (Body Mass Index ≥ 25 kg/m^2) by class variables across Europe (*women*).

Variable	**Propor-**	**Preva-**	**Prevalence Ratio (PR)** *					
Level	**tion**	**lence**	**Model 1**			**Model 2**		
	(%)	(%)	PR (95%CI)			PR (95%CI)		
Education								
Highest ‡	18.3	23.1	1.00	-	-	1.00	-	-
Mid	30.9	29.2	1.59	(1.35-	1.87)	1.27	(1.16-	1.39)
Lowest	50.8	48.3	2.76	(2.38-	3.22)	1.93	(1.75-	2.12)
Occupational class								
Higher salariat ‡	18.6	31.1	1.00	-	-	1.00	-	-
Lower salariat	14.6	30.3	0.98	(0.85-	1.14)	1.04	(0.95-	1.15)
Higher grade white collar	11.6	31.8	1.14	(0.97-	1.34)	1.01	(0.91-	1.13)
Self-employed	13.3	38.2	1.37	(1.19-	1.57)	1.15	(1.04-	1.28)
Farmers	5.9	49.9	1.07	(0.89-	1.29)	1.25	(1.10-	1.43)
Higher grade blue collar	3.1	42.5	1.44	(1.15-	1.79)	1.28	(1.09-	1.51)
Lower grade white collar	8.5	40.7	1.32	(1.11-	1.56)	1.25	(1.11-	1.40)
Skilled workers	7.8	44.8	1.28	(1.09-	1.50)	1.29	(1.15-	1.46)
Routine	8.3	46.2	1.42	(1.21-	1.67)	1.34	(1.19-	1.50)
ESEC unknown †	8.3	45.3	1.08	(0.89-	1.31)	1.12	(0.99-	1.26)
Income decile								
Highest ‡	9.7	27.8	1.00	-	-	1.00	-	-
P90	9.6	31.9	1.20	(0.96-	1.51)	1.13	(1.00-	1.29)
P80	9.8	34.9	1.66	(1.34-	2.06)	1.28	(1.13-	1.45)
P70	9.8	36.8	1.75	(1.41-	2.17)	1.33	(1.17-	1.51)
P60	9.7	38.9	2.01	(1.63-	2.49)	1.43	(1.26-	1.63)
P50	9.9	39.5	1.87	(1.51-	2.31)	1.40	(1.23-	1.60)
P40	10.0	40.7	2.61	(2.13-	3.20)	1.46	(1.28-	1.67)
P30	10.3	40.9	2.24	(1.83-	2.76)	1.45	(1.28-	1.66)
P20	10.4	42.1	2.10	(1.71-	2.58)	1.46	(1.28-	1.66)
Lowest	10.7	43.1	2.32	(1.89-	2.84)	1.47	(1.29-	1.68)

Note. * PR, Prevalence Ratio; 95%CI, 95% confidence interval; Model 1 = Overweight predicted by one Socioeconomic Position. (SEP) variable and corrected for age category and country (confounders); Model 2 = Model 1 + other SEP variables. † ESEC, European Socioeconomic Classification (occupational class scheme). ‡ Reference category, therefore no 95%CI estimates (-)

Figure 1 shows a cross-country comparison of inequalities in overweight using the RII for education level, occupational class and household income, with mutual control among these SEP indicators. The first set of bars, which represents the pooled data, shows that for either sex, the independent contribution to predict the likelihood of being overweight was greatest for education. The odds for women of being overweight was three times greater for hypothetical lower end compared to the upper end of the educational hierarchy (RII = 2.98). For men, a similar but attenuated association was observed (RII = 1.66).

Table 3. Proportional distribution, crude prevalence, Prevalence Ratios of overweight (Body Mass Index ≥ 25 kg/m^2) by class variables across Europe (*men*).

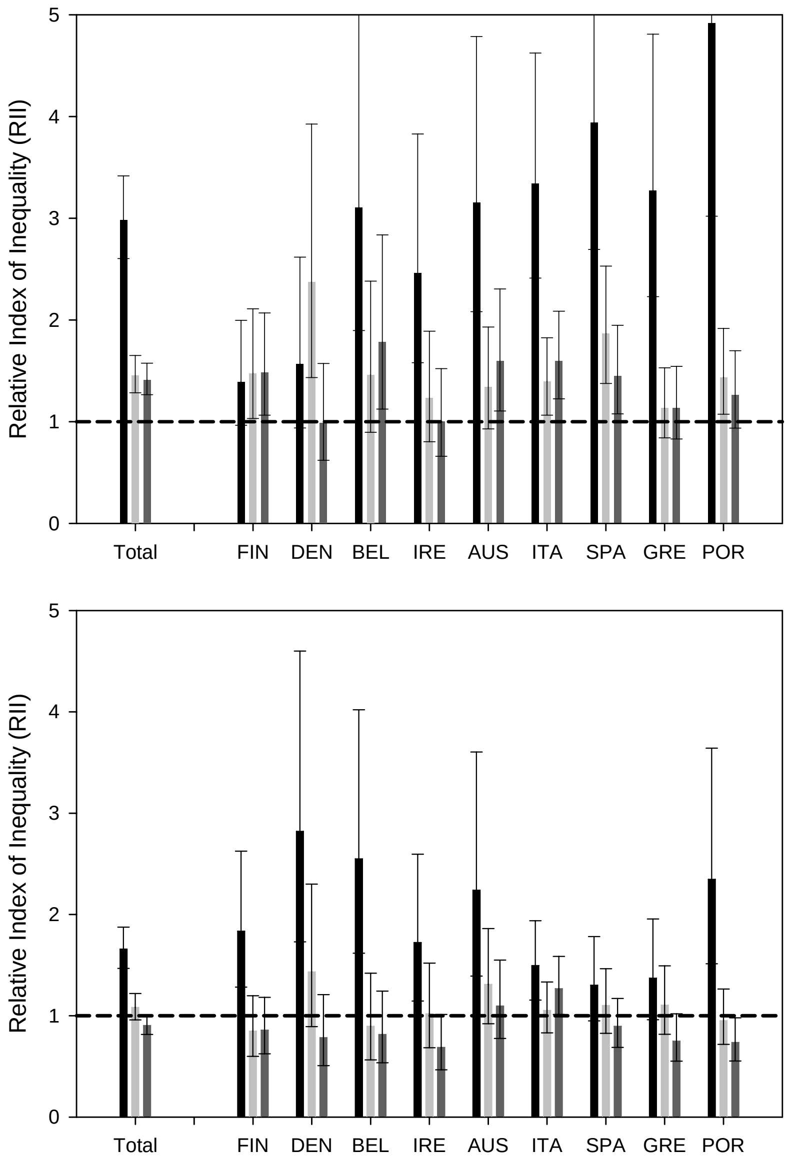
Variable	**Propor-**	**Preva-**	**Prevalence Ratio (PR)** *					
Level	**tion**	**lence**	**Model 1**			**Model 2**		
	(%)	(%)	PR (95%CI)			PR (95%CI)		
Education								
Highest ‡	17.9	49.3	1.00	-	-	1.00	-	-
Mid	34.2	53.8	1.32	(1.22-	1.42)	1.32	(1.21-	1.43)
Lowest	47.9	60.7	1.46	(1.36-	1.58)	1.48	(1.36-	1.61)
Occupational class								
Higher salariat ‡	19.4	54.9	1.00	-	-	1.00	-	-
Lower salariat	14.2	52.8	0.96	(0.88-	1.05)	0.93	(0.85-	1.02)
Higher grade white collar	10.4	53.9	1.05	(0.95-	1.15)	0.95	(0.85-	1.05)
Self-employed	14.4	59.8	1.21	(1.10-	1.32)	1.09	(0.99-	1.19)
Farmers	6.7	59.9	1.10	(0.98-	1.23)	0.98	(0.87-	1.11)
Higher grade blue collar	3.5	58.3	1.21	(1.04-	1.41)	1.05	(0.90-	1.23)
Lower grade white collar	7.9	58.5	1.22	(1.10-	1.37)	1.07	(0.95-	1.20)
Skilled workers	9.3	55.1	1.07	(0.96-	1.18)	0.93	(0.83-	1.03)
Routine	8.4	58.8	1.19	(1.07-	1.32)	1.04	(0.93-	1.16)
ESEC unknown †	5.8	54.9	0.98	(0.87-	1.11)	0.91	(0.80-	1.04)
Income decile								
Highest ‡	10.3	55.7	1.00	-	-	1.00	-	-
P90	10.4	54.9	1.03	(0.92-	1.15)	0.96	(0.86-	1.08)
P80	10.3	55.8	1.07	(0.96-	1.20)	0.98	(0.87-	1.09)
P70	10.4	57.6	1.16	(1.03-	1.29)	1.03	(0.92-	1.16)
P60	10.3	56.1	1.10	(0.98-	1.23)	0.96	(0.86-	1.08)
P50	10.1	57.8	1.19	(1.06-	1.33)	1.03	(0.91-	1.16)
P40	10.0	58.2	1.17	(1.04-	1.31)	1.00	(0.88-	1.12)
P30	9.7	57.8	1.18	(1.06-	1.33)	1.00	(0.89-	1.13)
P20	9.4	55.2	1.07	(0.95-	1.20)	0.90	(0.79-	1.01)
Lowest	9.1	53.6	0.97	(0.86-	1.09)	0.81	(0.72-	0.92)

Note. * PR, Prevalence Ratio; 95%CI, 95% confidence interval; Model 1 = Overweight predicted by one Socioeconomic Position. (SEP) variable and corrected for age category and country (confounders); Model 2 = Model 1 + other SEP variables. † ESEC, European Socioeconomic Classification (occupational class scheme). ‡ Reference category, therefore no 95%CI estimates (-)

For women in all countries, except in Denmark and Finland, education was the strongest predictor of inequality in overweight. In Denmark, occupational class was the strongest predictor. In Finland, the differences in the predictive value between the three indicators were negligible. Occupational level (RII ≅ 2) was usually about half as predictive for overweight as educational level (RII ≅ 3). Income level had the smallest independent effect in most countries. The magnitude of income-related inequalities in overweight, as expressed by the RII, ranged from 0.99 to 1.78, compared to 1.39 - 4.91 for educational level and 1.13 – 2.37 for occupational level.

For men, education was the strongest predictor of overweight in all countries. In most Southern European countries (Italy, Greece, Spain) the magnitude of educational inequality was relatively small compared to non-Southern countries. In most countries (except Austria and Italy), income was positively related to overweight. Differences in overweight according to occupational class were generally small and inconsistent in terms of directionality.

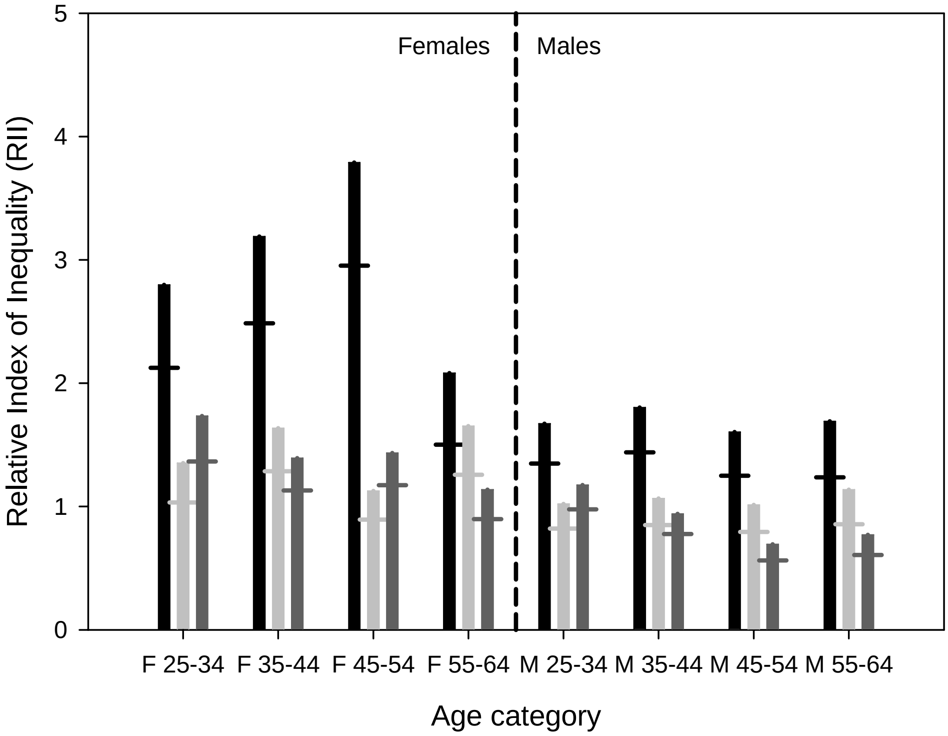
Figure 1. Inequalities in overweight for females (*above*) and males (*below*).



Note. Inequalities in overweight measured using educational (left bar) occupational (middle bar) or income level (right bar). FIN, Finland; DEN, Denmark; BEL, Belgium; IRE, Ireland; AUS, Austria; ITA, Italy; SPA, Spain; GRE, Greece; POR, Portugal. Error bars indicate the 95% confidence interval. Histogram bars that do not extend above the horizontal dashed line indicate a positive gradient between socioeconomic position and overweight

Figure 2 shows inequalities in overweight in four age groups using the RII for education level, occupational class and household income. Among women, education was the strongest predictor for overweight in all age groups. Compared with younger age groups, educational inequalities in overweight were much smaller in the oldest age group (55-64 years). Inequalities according to occupational class showed no clear variation between age groups. Household income showed smaller inequalities in the older age groups.

Figure 2. Country-adjusted inequalities in overweight for females and males of different age categories.



Note. Inequalities in overweight measured using educational (left bar) occupational (middle bar) or income level (right bar).

Among men, the pattern of inequalities in overweight was fairly similar between age groups. Level of education was negatively related to the prevalence of overweight in all age groups. Similar to women, educational level was also the strongest predictor for overweight. None of the age groups showed a systematic relationship between occupational class and overweight. Overweight was slightly positively related to income in all age groups, except for the youngest age quartile (in which a gradient was absent).

DISCUSSION

Our study revealed education attainment as a stronger predictor for overweight, especially among women, as compared to occupational class and household income. This finding holds for most EU countries and all age categories. For women, occupational class and income levels both show a relatively weak and negative relation to overweight. For men, the same relation was found between occupational level and overweight, while income level was weakly positively related to overweight (i.e. more overweight at higher income levels).

People with a high true BMI have a tendency to underreport their weight. [23] Given that people of low SEP are over-represented in higher BMI categories, under-reporting may occur more frequently in lower SEPs. However, there is no evidence that at any level of weight, the level of underreporting of weight depends on the SEP indicator used. Estimates of relative inequalities in overweight (such as the RII) may therefore remain unaffected even though absolute levels of overweight are underestimated. However, we acknowledge that we cannot entirely exclude the possibility that the various SEP indicators differentially predict underreporting of height and weight.

Ethnicity appears influence BMI independently of educational level. [24 25] We evaluated the possible confounding effect of ethnicity by excluding foreign-born respondents (1005 women and

877 men) from our regression analyses. Migrants were defined as being born abroad, or being born in the present country but having lived in a different country. The educational inequalities were notably larger among migrant women ($RII_{migrants}$ = 6.24), but their exclusion did not substantially influence the observed patterns ($RII_{nonmigrants}$ = 2.82 and RII_{total} = 2.98).

Countries strongly differ in their educational systems and this may have lead to problems regarding the comparability of educational classifications. Part of the international variation in the predictive value of education may therefore be an unavoidable classification artifact: the lowest educational level in country A may not be equal to that in country B. Income (being intrinsically quantitative in nature) and occupation (being measured with an internationally validated instrument) may be less sensitive to this comparability problem. Nevertheless, for the majority of countries, educational attainment appeared to be the best predictor of overweight. Also, this was observed when deploying the RII, a measure that could be applied in a comparable way to each country and each socioeconomic indicator with a detailed hierarchical classification.

To improve international comparability, educational level was measured according to only three standard categories. This rather crude categorization implies that there may be a significant educational heterogeneity *within* each category. The observed educational inequalities may have been greater with the use of a more finely graded educational categorization, especially within the lower educational levels. If so, this would imply that educational attainment would perform even better (as compared to occupation class and household income) in predicting variations in overweight.

The observed gender differences in the association between SEP and overweight were consistent with previous findings [4] and suggested that educational aspects of SEP impact differentially on body weight for men and women.

In accordance with our findings, Flegal [5] observed that the relative importance of education for the prediction of BMI was greater compared to income. A study that used a large sample of EU citizens also revealed educational level to have a stronger association with obesity than surrogate measures of occupational class. [8] Sarlio-Lähteenkorva et al. [26] found that educational inequalities in obesity were greater than occupational inequalities in Finland among men and women, but in Denmark only among men.

Our findings support these and some other findings. [27] However we are the first to show that a greater predictive power of educational level is observed almost consistently for each sex, country, and age group. Moreover, we deployed standardized instruments in our study for the measurement of educational attainment, occupational class and household income, thus reducing measurement bias

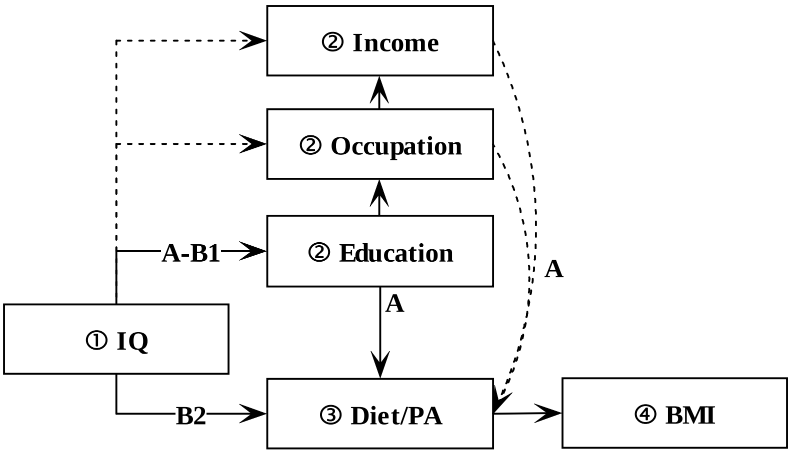
A UK research reported occupational level as the strongest independent predictor of obesity among women, but not among men. [7] Even though we observed similar results for some cases (e.g. women in Denmark), our results imply that the findings of this British study do not represent a generalized pattern.

Why is educational attainment so strongly related to overweight? A higher predictive value of educational level as compared to the other SEP indicators was observed for most populations across all parts of Western Europe. The persistency of this pattern suggests that causes of inequalities in overweight are intimately linked with educational level.

Both environmental and genetic factors might underlie the association between SEP and BMI. From a large twin study, genetic factors were concluded to be the main determinants of education-based BMI differences. [28] Intelligence was identified as one potential explanation for the correlation between education and BMI. [29]

The possible interrelationships of intelligence, SEP and BMI and its determinants are presented in Figure 3. There is a strong positive correlation between intelligence and educational attainment. Education in turn provides people with skills and knowledge to function in society and thus to achieve attain higher occupational position and income levels. Intelligence constitutes a marginal (but in itself insufficient) condition for the acquisition of skills and knowledge that are important for preventing overweight through appropriate life styles. [30]

Figure 3. Model relating Intelligence (1) Socioeconomic Position (2) and Body Mass Index (4) and its determinants Diet and Physical Activity (3).



From this perspective, intelligence may *moderate* the relation between SEP and overweight. The effects of health promotion messages, for example, may be less effective for those groups or population with lower intelligence, which could in turn contribute to greater educational inequalities in diets and levels of physical activity, thereby contributing to greater inequalities in BMI.

In addition to this modifying effect, the relation between childhood intelligence and obesity may be largely *mediated* via educational attainment and the other socioeconomic indicators [31] (Arrow A in Figure 3). Lawlor et al [32] found that the inverse association between childhood intelligence and adult BMI was largely attenuated by adjustment for educational attainment.

In conclusion, higher intelligence may set in motion a protective chain of events that lead to a reduction in later life obesity risk. [33] General cognitive abilities may represent more favorable outcomes in terms of education (but to a lesser extent occupation and income) and body weight. Within this chain, educational attainment may also exert an important independent effect on BMI. Educational attainment, hence, may be a better predictor of the behavioral, cognitive and attitudinal correlates of overweight than occupational and income levels. Also, education precedes the other two SEP indicators and is therefore more likely to exert a greater cumulative effect.

On the other hand, our results also suggest that occupational class and income exert an additional effect independent from educational level. [7] Income may be weakly related to overweight through access to material resources. Individuals with higher incomes have more options in food access and food choices as well as in voluntary energy expenditure, although actual caloric intake may not vary by income. [34] Occupational class as defined in the ESEC is related to overweight despite relatively small differences between occupational levels in industrialized societies in the amount of physical labor performed in the job. ESEC classes differ in terms of intrinsic job characteristics, including level of support, long-term economic security, and sense of control. [35] Social relationships at work may differ in more specific ways, such as the extent to which social pressures favor or disfavor excessive eating and favor physical exercise. Through these psychosocial factors, people’s occupational class may exert an additional effect on overweight independent of educational level.

Strong secular changes in the association between SEP and BMI have occurred in a relatively short period, [36,37] which suggests a crucial role for the environment. An underlying predisposition to overweight may or may not become manifest depending on the environment as a factor. Thus, the 'obesogenic' environment may have triggered overweight in vulnerable individuals, and an increase in knowledge about the harmful effects of overweight may have had a protective effect on others.

Why are the educational inequalities in overweight among women greater in Southern Europe? In Portugal, Spain, Italy and Greece the proportion of persons in the lowest educational category is much greater (67%) than in the other countries (35%). [38] Also, the expenditure per student on tertiary education is about 80% higher in the Northern European countries included in our study. [39] These differences may reflect variations in the quality and of national educational systems. Those with the lowest educational level in Southern Europe may be lower in terms of knowledge acquisition than those in the rest of Europe. When a certain minimum educational level of education cannot be acquired by a relatively large part of the population, this may yield larger educational inequalities in overweight.

The above explanations still do not answer the question why this mechanism would selectively impact women. Variations in the levels of educational participation between the two regions are slightly larger for women. [40] Perhaps more importantly, the fact that overweight is far more stigmatized in women than in men [41] may further increase the 'overweight gap', thus augmenting cross-national differences in educational inequalities overweight.

The results suggest that the educational dimension of SEP is much more strongly related to overweight than the occupational or income dimensions. This is crucial for understanding inequalities in overweight and for developing strategies and interventions to prevent overweight in lower socioeconomic groups. [42]

Causes of inequalities in overweight must primarily be thought of as inequalities in cognitive, attitudinal, and cultural factors that are best approximated by the level of education. People with lower educational attainment should be a specific target group for the programs and policies that aim to prevent overweight. These groups may benefit from a focus on health literacy, aimed at increasing their understanding of and abilities to modifying behaviors with regards to diet and physical activity. [7]

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SUPPLEMENTARY INFORMATION

Table 4. Prevalence (%) of overweight and by socioeconomic position and age group for males and females.

SEP indicator *	**Age group**							
Level	**Females**				**Males**			
	25-34	35-44	45-54	55-64	25-34	35-44	45-54	55-64
Education								
Highest	15.4	20.5	30.7	43.6	36.7	48.1	57.9	57.5
Mid	18.4	26.8	39.4	47.0	39.9	55.3	63.0	66.2
Lowest	26.4	39.8	52.3	58.5	46.3	58.6	64.4	65.1
Occupation								
Higher salariat	15.1	23.7	41.1	48.7	38.8	52.4	62.5	66.2
Lower salariat	17.6	24.9	35.3	51.5	38.0	52.7	60.3	58.9
Higher grade white collar	17.0	27.3	44.4	50.1	41.7	54.3	59.3	64.3
Self-employed	19.6	34.1	48.5	55.6	44.3	58.3	67.3	69.0
Farmers	27.8	39.6	56.5	60.7	46.7	56.5	65.5	64.4
Higher grade blue collar	25.9	36.3	49.5	56.7	45.7	55.7	69.4	63.5
Lower grade white collar	23.5	37.5	50.9	58.8	45.7	59.3	64.4	67.6
Skilled workers	28.6	36.9	51.0	62.3	40.2	54.8	63.2	62.7
Routine	24.9	43.2	51.7	61.1	44.2	59.5	60.9	66.5
Income quintile								
Highest	11.9	22.2	37.6	46.2	37.9	53.5	63.3	63.6
Second-highest	17.9	27.5	44.5	56.8	40.7	54.1	66.1	66.3
Middle	22.0	31.8	48.8	57.1	43.5	55.5	62.4	66.5
Second-lowest	21.9	36.0	49.6	59.3	43.8	57.6	62.2	67.4
Lowest	25.2	36.3	51.3	57.0	42.2	54.7	59.0	59.3
Total	*20.1*	*31.1*	*45.7*	*55.5*	*41.6*	*55.2*	*62.8*	*64.5*

Note. * SEP, Socioeconomic Position

Table 5. Prevalence (%) of overweight (Body Mass Index ≥ 25 kg/m^2) across various countries (FEMALES).

SEP indicator *	**Country** †									
	FIN	DEN	BEL	IRE	AUS	ITA	SPA	GRE	POR	*Total*
Education										
Highest	36.1	28.5	22.5	24.7	21.5	17.0	22.8	29.2	26.5	*26.8*
Mid	42.4	34.9	31.8	36.6	33.9	22.3	31.5	38.9	24.5	*32.1*
Lowest	45.7	40.9	43.9	41.0	47.9	36.1	45.1	48.8	47.1	*43.5*
Occupation										
Higher salariat	34.2	23.8	25.4	30.2	31.0	25.2	26.1	41.7	37.3	*30.9*
Lower salariat	38.3	35.8	26.9	34.8	34.5	26.6	29.0	32.2	34.0	*31.3*
Higher grade white collar	40.9	35.1	28.3	39.0	36.7	25.0	34.8	38.7	33.6	*33.4*
Self-employed	48.3	35.3	29.2	40.6	34.4	30.6	40.8	42.9	43.1	*38.4*
Farmers	42.1	25.8	40.6	42.0	44.5	27.9	51.5	45.3	47.3	*45.0*
Higher grade blue collar	41.1	37.3	38.4	40.9	38.2	38.9	47.3	36.7	41.8	*42.0*
Lower grade white collar	45.9	43.1	41.8	39.5	38.6	34.5	45.3	46.2	43.9	*42.2*
Skilled workers	48.9	37.6	51.9	42.5	39.9	32.2	46.1	50.1	51.2	*43.9*
Routine	42.3	39.8	41.8	40.4	51.1	42.7	45.9	46.3	50.2	*44.7*
ESEC unknown ‡	35.7	30.4	43.6	32.9	32.9	32.5	43.3	50.7	51.1	*38.0*
Income quintile										
Highest	38.9	30.9	22.1	29.1	26.7	23.4	26.2	35.4	30.3	*28.3*
Second-highest	38.8	30.4	24.6	39.9	37.4	27.5	38.9	39.5	43.2	*35.2*
Middle	42.2	36.5	32.3	38.7	37.8	30.2	41.3	45.3	46.4	*38.9*
Second-lowest	45.0	36.9	35.7	37.7	42.8	32.5	42.8	45.7	47.8	*40.7*
Lowest	43.2	35.4	41.8	39.3	39.6	36.8	44.9	48.7	47.5	*42.0*
Total	*40.9*	*32.7*	*30.3*	*36.6*	*37.5*	*29.8*	*35.6*	*44.6*	*44.3*	*36.8*

Note. * SEP = Socioeconomic Position; † FIN, Finland; DEN, Denmark; BEL, Belgium; IRE, Ireland; AUS, Austria; ITA, Italy; SPA, Spain; GRE, Greece; POR, Portugal; ‡ ESEC, European Socioeconomic Classification (occupational class scheme)

Table 6. Prevalence (%) of overweight (Body Mass Index ≥ 25 kg/m2) across various countries (MALES).

SEP indicator [*]	**Country** [†]									
	FIN	DEN	BEL	IRE	AUS	ITA	SPA	GRE	POR	*Total*
Education										
Highest	51.6	39.9	43.9	50.2	40.3	41.0	57.3	61.7	52.2	*50.0*
Mid	57.1	50.5	53.8	57.4	56.1	50.0	64.8	64.8	49.3	*55.6*
Lowest	60.6	58.5	54.9	58.8	61.0	53.9	62.0	65.8	58.3	*59.1*
Occupation										
Higher salariat	53.3	42.4	50.1	55.6	55.2	49.9	56.7	63.9	58.9	*54.4*
Lower salariat	59.1	48.3	47.0	53.4	47.8	46.6	65.6	58.0	51.4	*51.8*
Higher grade white collar	61.6	51.6	57.0	53.8	50.1	44.7	61.4	66.8	55.7	*54.7*
Self-employed	67.2	53.5	43.5	61.5	59.6	54.3	61.5	65.8	59.0	*59.4*
Farmers	51.2	73.0	58.2	57.0	58.5	49.3	64.5	67.2	58.7	*58.6*
Higher grade blue collar	55.5	49.1	50.0	68.6	61.5	55.5	58.3	57.2	72.1	*58.7*
Lower grade white collar	64.4	61.9	46.0	57.8	62.4	54.3	61.6	62.2	59.7	*59.5*
Skilled workers	50.5	48.3	56.3	56.9	59.4	51.0	62.5	64.1	54.8	*55.8*
Routine	53.4	57.1	59.1	53.5	58.5	54.7	63.0	67.1	60.1	*58.4*
ESEC unknown [‡]	47.2	45.4	48.1	61.5	48.8	54.9	55.1	64.8	39.3	*52.9*
Income quintile										
Highest	60.7	49.1	47.3	56.0	51.6	47.7	60.5	63.8	55.7	*54.2*
P80	58.4	48.9	52.0	59.0	54.3	50.0	60.8	64.3	59.9	*56.2*
P60	55.6	53.8	50.6	57.3	58.0	51.1	62.9	66.2	58.6	*57.1*
P40	57.4	48.3	51.9	59.2	61.2	53.0	63.2	64.5	57.8	*57.8*
Lowest	55.2	48.3	49.2	52.1	51.9	52.6	58.1	62.7	53.5	*54.4*
Total	*57.1*	*49.0*	*49.2*	*56.1*	*55.8*	*50.1*	*56.3*	*64.6*	*55.8*	55.0

Note. [*] SEP = Socioeconomic Position; [†] FIN, Finland; DEN, Denmark; BEL, Belgium; IRE, Ireland; AUS, Austria; ITA, Italy; SPA, Spain; GRE, Greece; POR, Portugal; [‡] ESEC, European Socioeconomic Classification (occupational class scheme)

Part III

International variations in the size of socioeconomic differences in direct risk factors for overweight and obesity

Chapter 5

Social inequalities in the prevalence of physical activity *

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* S. Demarest, H. Van Oyen, A.J.R. Roskam, B. Cox, E. Regidor, J.P. Mackenbach, A.E. Kunst (2009). Socioeconomic inequalities in leisure time physical activity (submitted).

ABSTRACT

Objectives. Evidence of the association between leisure time physical activity and socioeconomic status is scarce and non-conclusive. In this paper the patterns and magnitudes of socioeconomic inequalities in leisure time physical activities are studied and the question whether these patterns differ between the Member States of the European Union is examined.
Methods. Comparable cross-sectional data on subjects aged 16 to 64 years derived from national health interview surveys from 15 European countries were used for the analysis. Log-binominal regression analysis was used to assess educational inequalities in leisure time physical activity.
Results. Countries differ to a large extent in their overall levels of sedentary lifestyle: the age adjusted prevalences range from 14.5% to 62.8% in males and from 12.1 tot 75.4% in females. In every country, a low socioeconomic status is associated with a high level of sedentary lifestyle. The prevalence of sedentary lifestyle is lowest in the highest educational group (males: 27.2%; females: 34.4%) and highest in the lowest educational group (males: 51.2%; females: 56.9%). Socioeconomic inequalities are most pronounced in a number of countries with an intermediate prevalence of sedentary lifestyle like Germany, Spain, Italy and Belgium.
Conclusions. Throughout Europe, sedentary lifestyle is negatively associated with socioeconomic status. This association differs in strength and should be considered in the context of country-specific differences in overall levels of sedentary lifestyle. Hence, reducing socioeconomic inequalities in leisure time physical activities necessitates different strategies determined by the ‘state of the art’ in every country.

INTRODUCTION

Evidence for socioeconomic inequalities in physical activities is heterogeneous and at times contradictory. Results of the Health Survey for England for example, show that for the total physical activity among males, the higher socioeconomic groups have lower levels of physical activity, while females display fewer differences between the socioeconomic groups. If one focuses on sports activities alone, the relation shows the opposite: higher socioeconomic groups have higher levels of participation in sports. [1] Although the emphasis in physical activity assessment has mainly been on the measurement of leisure-time physical activities (LTPA), it has been acknowledged that measuring LTPA leads to an underestimation of total physical activity, especially for those people with physically demanding jobs. [2] Recent surveys show that, in general, there are socioeconomic differences in total physical activity, i.e. a person with higher education is more active than a lower educated person. Nonetheless, LTPA remains the most widely studied form of physical activity[3].

Restricted to LTPA, the link between physical activity and socioeconomic characteristics remains unclear. In the Greek ATTICA study a positive association was observed between (leisure time) physical activity and occupation, but no associations were found between physical activity levels and other social status indices (education level and annual income).[4] Contrasting results were found in the National Fitness Survey in Scotland: while inequalities in all levels of LTPA were less straightforward when examined by occupation, clear differences were observed in relation to education. [5] Other studies conclude that a low level of education is associated with a high level of physical inactivity, [6] that both low education and low occupational status are strongly associated with low LTPA [7] and that white-collar employees are more often engaged in vigorous leisure time activities than blue-collar workers. [8]

In analyzing a 10-year trend in LPTA in the eastern Finnish adult population it was found that in this period males and females with low education or income increased their level of LPTA more than those with high education and income, reducing the inequalities in LTPA over time. The authors conclude that socioeconomic characteristics, such as income and education, appear to have lost importance as determinants of leisure time physical activity. [9] Other studies show however that relatively low percentages of a sedentary lifestyle in both males and females can disguise significant differences between high and low educated people. [10,7]

In a study aimed to determine the prevalence of sedentary lifestyles in 15 Member States of the European Union, it was found that participants belonging to the primary education level group were more sedentary than those with higher levels of education, with greater differences among females. [11] Although the results show wide inter-country differences in the prevalence of sedentary lifestyle, with Northern European countries showing lower prevalences of sedentary lifestyle as compared with some Mediterranean countries, no details were presented on the magnitude of the potential association between socioeconomic characteristics and physical activities within and between European countries. It remains to be analyzed whether high overall prevalences of sedentary lifestyle imply more outspoken socioeconomic inequalities or, conversely, whether countries with relatively low prevalences of sedentary lifestyle are those where inequalities are the largest.

The aim of this study, which was done in the framework of the Eurothine-project, [12] is to study the patterns and magnitudes of socioeconomic inequalities in leisure time physical activities and to investigate whether these patterns differ between the Member States of the European Union.

METHODS

Data

In the framework of EUROTHINE, Member States were asked to provide national micro-data from their (most recent) national health interview or similar surveys on, among others, leisure time physical activity and a set of socioeconomic background indicators. Fifteen countries delivered data on LTPA (Table 1). Most of the data is based on information gathered by means of a face-to-face interview with the sampled respondents. Special attention must be paid to the data collected in the framework of the Finbalt Health Monitor (organized in Finland, Lithuania and Latvia); Not only do the totals refer to pooled data derived from several successive surveys, the method of data collection – surveys by mail – also deviated from the other surveys used in this analysis.

Table 1. Overview of the national surveys

Country	Name of survey	Year(s) of survey
Norway	Norwegian Survey of Living Conditions	2002
Finland	Finbalt Health Monitor	1994/'98/'00/'02/'04
Denmark	Danish Health and Morbidity Survey (DHMS/ SUSY)	2000
Estonia	Health Behavior among Estonian Adult Population	2002/'04
Lithuania	Finbalt Health Monitor	1994/'98/'00/'02/'04
Latvia	Finbalt Health Monitor	1998/'00/'02/'04
Czech Rep	Health Interview Survey	2002
Slovakia	Health Monitor Survey	2002
Netherlands	General social survey (POLS)	2003/'04
Belgium	Health Interview Survey	1997/'01
Germany	German National Health Examination and Interview Survey	1998
Italy	Health and health care utilization	1990/’00
Spain	National Health Survey	2001
Portugal	National Health Survey	1998/’99
Hungary	National Health Interview Survey Hungary	2000

The questions used to estimate the leisure time physical activity were to a large extent country-specific, but covered the whole spectrum of possible leisure time physical activities. This heterogeneity was the main reason to dichotomize the indicator into the categories ‘non sedentary lifestyle during leisure time’ and ‘sedentary lifestyle during leisure time’, acknowledging that by doing so information on potential different levels (high, moderate, light) in leisure time physical activities is ignored.

The original wording of the questions and the corresponding response categories are presented in Table 2. Response categories classifying subjects as sedentary are marked in bold. In this international comparison it was not possible to consider physical activity during working hours or while performing domestic tasks.

Data on leisure time activities were only collected for subjects aged 16 years and older. Since for 6 out of the 15 countries no information was available on subjects older than 64 years, the data are presented for the ages 16–64 years.

Table 2. Overview of the (original) questions and response categories used to estimate the level of leisure time physical activities

Country	Wording of the question	Original response categories
NOR	How many hours a week do you perform LTPA that make you sweat/ out of breath?	3 hrs or more /1-2 hours /less than 1 hr /none
FIN, LIT, LAT, EST, SLO	How often do you do physical exercise at leisure lasting at least 30 min. and making you at least mildly short of breath and perspire?	daily/4–6 times a week/2–3 times a week/ once a week/ 2–3 times a month /a few times a year or less/I cannot exercise because of damage or illness
DEN	If we look back on the past year, what would you say best describes your spare time activities?	Heavy training and competitive sports regularly and several times a week/ Exercise or heavy gardening at least 4 hours a week /Walk, bike or other easy exercise at least 4 hours a week /Read, watch TV or other sedentary occupation
CZR	During the past 7 days, on how many days did you do jogging and other recreational sports or heavy gardening and work in household?	7 days/week 6 days/week 5 days/week 4 days/week 3 days/week 2 days/week 1 days/week 0 days/week
NET	How many hours a week do you spend (bicycling, wandering, gardening, doing odd jobs)?	7 days/week 6 days/week 5 days/week 4 days/week 3 days/week 2 days/week 1 days/week 0 days/week
BEL	What describes best your leisure time activities during the last year?	Hard training and/or sport for more than 4 hours a week / Sport for less than 4 hours a week and/or light activities/Sedentary activities
GER	How often are you practicing sport activities?	regularly, more than 4 hours per week /regularly, 2-4 hours per week/= regularly, 1-2 hours per week /less than 1 hour per week/no sport activities
ITA	In the last 12 months have you continuously done during leisure time one or more physical activities which required intensive training?	Yes, more than 4 hours in a week /Yes, 4 hours in a week /Yes, less than 4 hours in a week/No
SPA	What type of physical activity do you do in your spare time? Which of the activities on the card best describes your hobbies?	Intense physical activity several times per week /Regular leisure activity several times per month (running, swimming, team plays, etc)/ Some occasional leisure activity as leisure biking, gardening, walking /Completely sedentary (reading, watching television, …)
POR	Do you practice any regular activity (run, ride bicycle or other) enough to make you feel tired at least once a week?	sport training/physically intensive leisure time activities/sedentary activities
HUN	How often did you do physical work or sport activities for at least 10 minutes (that cause significant sweating or increase heart rate) during the past 12 months?	At least once a day/Several times a week, but not every day/At least once a week/At least once a month/Less frequently /Never

The highest educational attainment was considered to be the most appropriate indicator to define the socioeconomic position. For those still attending school, the educational level refers to the level of school that the subject is currently attending. The national categories of the educational level were harmonised on the basis of a simplified version of the International Standard Classification of Education (ISCED), [13] resulting in 4 education categories: 'no or only primary education' (ISCED 1), 'lower secondary' (ISCED 2), 'upper secondary and post-secondary non-tertiary education' (ISCED 3+4), 'tertiary education (ISCED 5+6).

Analyses

Age-adjusted prevalence rates for a sedentary lifestyle were calculated by gender and educational attainment using the direct method. The European Standard population of 1997 was used as a reference. The prevalence rates for the pooled data for all countries in the study was estimated using weights to account for differences in the sample sizes, such that each country had an equal weight in the final analysis despite different sample sizes.

The rates of the lowest educated groups were subtracted from those of the highest educated groups to estimate the absolute difference in the prevalence of sedentary lifestyle. The relative difference is estimated by dividing the rate of the lowest education group by the rate in the highest education group. In our analysis, we estimated Prevalence Rate Ratios (PRRs) and 95% confidence intervals by regression analysis with the log-link function using the Genmod procedure of SAS. PRRs were always adjusted for age category and, where applicable, for country.

We summarized the association between sedentary lifestyle and educational attainment by calculating the Relative Index of Inequality (RII) and its 95% confidence intervals. [14;15] RII assesses the association between sedentary lifestyle and the relative position of each socioeconomic group separately. This relative position is measured as the cumulative proportion of each socioeconomic group within the socioeconomic hierarchy, with 0 and 1 as the extreme values. The resulting measure, the RII, can be interpreted as the risk of being sedentary at the very top of the socioeconomic hierarchy as compared to the very lowest end of the socioeconomic hierarchy. An RII above 1 indicates a negative relationship between educational attainment and sedentary lifestyle. The RII can be used to make comparisons between countries as it is not affected by differences in the educational distributions. The RII was estimated using a log-binomial regression model.

RESULTS

Table 3 shows demographic data and the overall age adjusted prevalence of a sedentary lifestyle. The national sample sizes summed up to N = 246,248 and varied from N = 1,481 (Slovakia) to N = 92,944 (Italy). The percentages of missing values on LTPA were 2.2% on average and ranged from 0.2 (Norway) to 14.9% (the Netherlands).

The overall age adjusted sedentary lifestyle was 37.1% in males (range: 14.5% (Denmark) – 62.8% (Portugal)) and 41.9% in females (range 12.1% (Denmark) – 75.4% (Portugal)). In some countries (Finland, Denmark, Estonia and Slovakia) the age-adjusted prevalence was higher in males than in females.

Table 3. Demographic data: absolute sample size, percentages of missing values, and age-adjusted prevalence of a sedentary lifestyle.

Country	**Number of persons (N_{total})**	**Sedentary lifestyle (%)**		**Missing (%)**
		Males	Females	
Finland	20,371	24.0	20.1	1.4
Norway	5,683	21.6	28.7	0.2
Denmark	13,675	14.5	12.1	0.9
Germany	6,114	39.0	42.4	2.4
Netherlands	12,955	16.1	16.2	14.9
Belgium	14,582	27.0	33.9	7.9
Spain	16,448	40.7	47.9	0.5
Portugal	31,117	62.8	75.4	0.7
Italy	92,944	33.5	40.5	0.0
Hungary	4,450	28.4	35.0	0.5
Slovakia	1,481	52.6	51.4	10.3
Czech Republic	2,052	54.3	67.1	0.6
Lithuania	11,605	41.2	47.0	7.1
Latvia	8,395	49.2	56.9	4.3
Estonia	4,376	57.6	55.3	3.0
Total	*246,248*	*37.1*	*41.9*	*2.2*

Table 4 shows the distribution and the prevalence of a sedentary lifestyle of the pooled sample, stratified by educational level. The prevalence of a sedentary lifestyle was lowest in the highest educational group (males: 27.2%; females: 34.4%) and highest in the lowest educational group (males: 51.2%; females: 56.9%). The PRR increased with a decreasing educational level in both males and females. For the lowest compared to the highest educational level, the PRR of a sedentary lifestyle was 1.53 (95% CI: 1.49–1.57) in males and 1.36 (95 % CI: 1.33–1.39) in females.

Table 5 and Table 6 show, for both genders and by country, the educational inequalities in sedentary lifestyle. The inequalities are expressed as absolute rate differences (highest versus lowest educational level), and as RII. In Figure 1 the geographical patterns in inequalities of sedentary lifestyle are presented.

The results show, that what could be found for the pooled sample is applicable for all countries included in the analysis: in all countries and in both males and females, the prevalence of a sedentary lifestyle is higher for the lowest educational level in comparison with the highest educational level. This finding should be evaluated given the sharp differences in sedentary between the countries. In e.g. Portugal, in both males and females, the prevalence of sedentary in the highest educational group is higher than the prevalence of sedentary in the lowest educational groups in Finland, Denmark or the Netherlands. Figure 1 allows us to distinguish – both in males in females - countries with a different profile; countries like Denmark, The Netherlands or Finland show – in comparison with other countries – relatively low prevalences in both the low and high educated groups. On the contrary, in countries like the Czech Republic, Estonia or, Latvia a sedentary lifestyle is predominant in both the low and high educated groups. Countries like Germany, Spain, Italy and Belgium find themselves between those extremes. Combining this information with what is presented in tables 5 and 6, the RIIs in the latter countries are in general the highest, indicating strong relative inequalities between the lowest and highest educated.

Table 4. Age-adjusted prevalence (%) and prevalence rate ratio (PRR) of a sedentary lifestyle by educational level. Pooled data of 15 European countries

Sex **Education**	**Proportion** **%**	**Prevalence** **%**	**PRR**	**(95 % CI)**
Males				
Lowest	17.8	51.2	1.53	(1.49 – 1.57)
2nd lowest	25.9	43.1	1.38	(1.34 – 1.41)
2nd highest	38.5	32.0	1.21	(1.18 – 1.24)
Highest	17.8	27.2	1	(reference)
Total	*100*	*37.7*	-	-
Females				
Lowest	18.4	56.9	1.36	(1.33 – 1.39)
2nd lowest	22.2	48.5	1.31	(1.28 – 1.33)
2nd highest	40.3	37.9	1.15	(1.12 – 1.17)
Highest	19.1	34.4	1	(reference)
Total	*100*	*42.9*	-	-

Note. Data were weighted for country size; PRR = prevalence rate ratio; ages: 16-64 years; N_{total} = 239,081; Total percentages for a sedentary lifestyle deviate from the ones reported in Table 2 due to missing values in the variable education

Table 5. Age-adjusted prevalence (%) of a sedentary lifestyle by educational level and absolute and relative (RII with 95% confidence interval (CI)) indices of inequality among *men*, aged 16-64 years, in 15 European countries.

Country	**Sedentary lifestyle/education**				**Abs. dif.**	**Relative Index of Inequality (RII)**	
	Lowest	2nd lowest	2nd highest	Highest		RII	(95% CI)
Finland	25.2	32.1	23.8	16.4	8.8	1.87	(1.61 – 2.17)
Norway	*	30.4	23.5	14.2	16.2	2.71	(2.04 – 3.58)
Denmark	23.2	16.5	14.2	8.3	14.9	3.18	(2.51 – 4.03)
Germany	55.7	48.4	38.6	19.1	36.6	2.24	(1.93 – 2.61)
Netherlands	22.6	17.3	17.2	14.3	8.3	2.17	(1.66 – 2.85)
Belgium	48.8	31.3	26.3	19.3	29.5	2.81	(2.42 – 3.28)
Spain	53.3	43.9	33.2	24.7	28.6	2.46	(2.21 – 2.73)
Portugal	68.5	57.9	54.5	50.9	17.6	1.60	(1.50 – 1.69)
Italy	47.6	36.6	28.9	26.0	21.6	1.97	(1.87 – 2.08)
Hungary	35.9	27.8	23.6	26.6	9.3	1.76	(1.34 – 2.32)
Slovakia	50.1	58.0	48.1	49.5	0.6	1.12	(0.85 – 1.47)
Czech Republic	72.0	60.3	48.8	44.6	27.4	1.76	(1.38 – 2.23)
Lithuania	48.4	45.5	37.9	39.8	8.6	1.40	(1.24 – 1.59)
Latvia	56.9	52.7	48.4	42.4	14.5	1.45	(1.28 - 1.64)
Estonia	67.6	56.7	62.8	42.0	25.6	1.35	(1.17 – 1.55)

Note. * empty category; Abs. diff. = Absolute difference in prevalence between the lowest and the highest educated group

Table 6. Age-adjusted prevalence (%) of a sedentary lifestyle by educational level and absolute and relative (RII with 95% confidence interval (CI)) indices of inequality among *women*, aged 16-64 years, in 15 European countries.

Country	Sedentary lifestyle/education				Abs. dif.	Relative Index of Inequality (RII)	
	Lowest	2nd lowest	2nd highest	Highest		RII	(95% CI)
Finland	26.1	24.6	20.2	17.6	8.5	1.45	(1.23 – 1.71)
Norway	*	40.3	31.0	19.8	20.5	2.56	(2.03 – 3.23)
Denmark	21.9	15.3	10.6	10.1	11.8	3.30	(2.51 – 4.33)
Germany	64.5	51.1	42.0	24.7	39.8	1.20	(1.69 – 2.35)
The Netherlands	23.5	17.7	16.0	12.6	10.9	2.45	(1.89 – 3.18)
Belgium	53.4	42.7	33.0	25.2	28.2	2.55	(2.24 – 2.89)
Spain	59.7	50.5	40.3	34.1	25.6	2.10	(1.90 – 2.32)
Portugal	80.2	75.8	65.8	61.4	18.8	1.37	(1.31 – 1.43)
Italy	53.5	42.0	36.6	33.8	19.7	1.65	(1.57 – 1.73)
Hungary	43.6	37.0	32.2	28.6	14.0	1.50	(1.23 – 1.84)
Slovakia	53.9	63.4	48.1	50.3	3.6	1.34	(1.01 – 1.76)
Czech Republic	80.6	76.1	63.1	62.4	18.2	1.34	(1.13 – 1.59)
Lithuania	53.9	51.5	42.2	47.8	6.1	1.27	(1.14 – 1.41)
Latvia	57.8	59.9	59.5	49.3	8.5	1.27	(1.16 – 1.39)
Estonia	65.5	57.2	56.4	52.0	13.5	1.31	(1.15 – 1.49)

Note. * = Empty category; Abs. diff. = Absolute difference in prevalence between the lowest and the highest educated group.

DISCUSSION

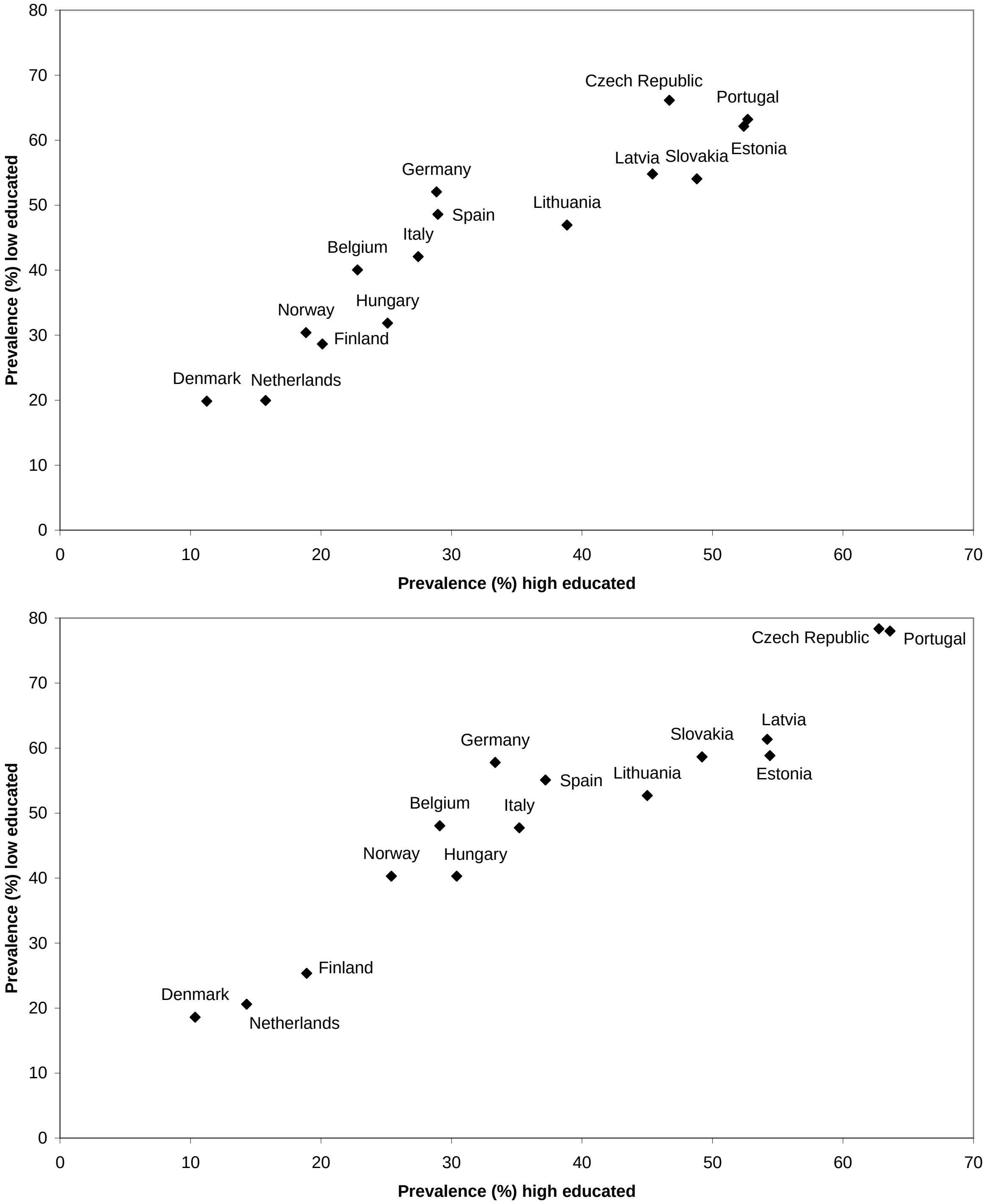
The Eurothine project offers the opportunity to analyze the association between socioeconomic status and sedentary lifestyle or the lack of physical activity during leisure time on a European scale. The data gathered in this project were provided by general health surveys organized in (more or less) the same period.

The educational level was selected as the most appropriate indicator for socioeconomic status since it is fairly stable beyond early adulthood and it is one of the socioeconomic indicators especially likely to capture aspects of lifestyle and behavior. [16] Since the educational systems of the countries included in the analysis strongly differ, transposing country specific information on education into broad categories of ISCED was necessary to enable comparison. This comparison remains partly artificial since it presupposes that, over the countries, the scoop and content of every educational level is more or less alike. Moreover, applying this procedure unarguably implied a loss of specificity since it bypasses the potential heterogeneity within each category.

The wording and the response categories of the instruments measuring leisure time physical activity were heterogeneous. By reducing the number of response categories to two well distinct categories (sedentary versus non sedentary lifestyle), the risk of misclassification in an erroneous category was reduced. Although this procedure contributed to a better comparability, it led to a loss of information. Despite this procedure, it should be acknowledged that the comparability of data on leisure time activities remains questionable. International variation is, at least partially, due to differences in the instruments used to measure these kinds of activities.

The data used in the analysis only highlights the lack of physical activity during leisure time. It does not reflect the total physical activity performed during the day. Physical activity required by the work content, domestic and transport-related activities, involve energy expenditures equivalent to moderate-intensity but are not considered here. Because many people, such as females and elderly adults tend to spend substantial amounts of time engaged in e.g. household chores rather than or as a supplement to leisure time physical activities, prevalence estimates of physical activity in these groups based on leisure time physical activity may be underestimated. [17]

Figure 1. Prevalence (%) of a sedentary lifestyle among men (above) and women (below) of the lowest two vs. the highest two educational levels



The results of the study show that a very considerable part of both males and females in the age group 16 to 64 years describe their leisure time activity as predominantly of a sedentary nature. Wide variations of sedentary lifestyle were observed between the countries. These findings are in line with previous research. [11,18,19] Both in males and females, sedentary lifestyle is the dominant lifestyle in most of the Baltic and Eastern countries.

In all countries an inverse relation between socioeconomic status and the prevalence of sedentary lifestyle can be observed: less educated people are more likely to describe their leisure time physical activity as sedentary. The relationship between the magnitude of socioeconomic inequalities and the prevalence of sedentary lifestyle is remarkable: socioeconomic inequalities are most pronounced in a number of countries with an intermediate prevalence of a sedentary lifestyle. Since data of cross-sectional surveys were used in the analysis, this observation may only present a snapshot of asynchronously evolving prevalence levels of lifestyle risk factors among and within countries. As illustrated by the smoking epidemic, the uptake of specific lifestyles can diffuse gradually within countries (with higher socioeconomic groups adapting these lifestyles first, and lower groups to follow with one or more decades delay) and between countries (with northern countries being first, and other regions of Europe to follow). It is possible that a similar diffusion pattern exists for physical activity: the uptake of a non-sedentary lifestyle can be ‘introduced’ by those who are better off and can result in a - temporary– further widening of socioeconomic inequalities in the prevalence of sedentary lifestyle. The absolute gap in prevalence rates may narrow only when lower socioeconomic groups start to reach higher activity levels. Consequently the overall level of sedentary lifestyle drops.

The uptake of a more active lifestyle is not an isolated fact, but can be accelerated in the framework of health promotion programs. There is evidence that links socioeconomic inequalities to differences in the presence and content of national initiatives to promote physical activity, [20] the perception of environmental opportunities for physical activities, perceived safety of area of residence, lack of interest and perception of health benefits of physical activities. [21,22,23] It has nevertheless been shown that health promoting messages are differentially taken up by different social class groups; better-off and better educated people are more likely to take up healthy physical activities than poorer and less well educated people. [24,25,26] Any public health policy to promote an active lifestyle will be confronted with the dilemma that universal initiatives can result in a selective take-up by those who are less at risk, aggravating instead of reducing inequalities. Evaluating the potential impact of possible interventions in terms of reducing (or not) the socioeconomic gaps is in this perspective a necessity. Interventions to promote physical activity in deprived populations may require different strategies from those targeting more affluent groups. [27]

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Chapter 6

Social inequalities in the prevalence of vegetable use *

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ABSTRACT

Objective. The relationship socio-economic status and vegetable consumption is examined in nine European countries. The aim is to analyse whether the pattern of socio-economic variation in regard to vegetable consumption is similar in countries with high vs. low vegetable availability and affordability, and, whether educational level has an independent effect on vegetable consumption once the effects of other socio-economic factors have been taken into account.
Setting. The data was obtained from national surveys conducted in Finland, Denmark, Germany, Estonia, Latvia, Lithuania, France, Italy, and Spain in 1998 or later. These surveys included comparable data on the frequency of use of vegetables. Food Balance Sheets indicated that the availability of vegetables was best in the Mediterranean countries. The prices of vegetables were lowest in the Mediterranean countries and Germany.
Results. Educational level was positively associated with vegetable consumption in the Nordic and Baltic countries. In Germany, the effect of educational level was small and entirely attributable to the association with occupation. In the Mediterranean countries, educational level was not directly associated with the use of vegetables, but after adjusting for place of residence and occupation, it was found that those with a lower educational level consumed vegetables more often. Manual workers consumed vegetables less often than non-manual workers, but otherwise there was no systematic association with occupation.
Conclusions. The pattern of socio-economic variation in relation to vegetable consumption differed by country. The Mediterranean countries, with high vegetable availability and affordability, differed from the other countries in that the socio-economic differences were smaller. In order to increase vegetable consumption among the lower socio-economic groups in the Northern Europe the availability and affordability of vegetables should be improved.

INTRODUCTION

Socio-economic differences in the consumption of vegetables have been demonstrated in several European countries. [1,2] People with a higher educational level or in higher occupational status groups generally eat vegetables more often than those in lower socio-economic groups.
Socio-economic differences in dietary habits seem to contribute to health inequalities, as the differences in regard to vegetable consumption are in line with those observed in relation to overweight, obesity [3,4] and cardiovascular diseases. [5] In the Nordic countries and in England and Wales, half or more of the socio-economic gap in total mortality is due to an excess risk of cardiovascular disease in the lower socio-economic groups. In France, Switzerland, Italy, Spain and Portugal, however, cardiovascular diseases account for a small fraction of the higher risks of premature mortality. [5-7] Multivariate explanatory studies have nevertheless provided direct evidence of the contribution of vegetable consumption to observed socio-economic differences in all-cause and cardiovascular mortality. [8]

The contribution of diet to health inequalities is not well understood. Diet, like other health behaviours has been assumed to function as a specific determinant mediating the effect of socio-economic position on health.[7] According to this assumption people belonging to higher socio-economic groups follow a healthier diet, and thus more often avoid overweight and other risks of chronic disease. In the lower socio-economic groups people may have less money to buy healthy food, have poorer access to shops offering a good variety of fruit and vegetables, and may be less motivated to maintain a healthy diet. [9]

Previous studies in Europe have mainly analysed socio-economic differences in food habits within a single country at a time.[10-13] However, there are two systematic reviews based on published reports from 15 European countries [1,2] and one review that also covers North American and Australian studies.[14] The studies included in the reviews used different designs and methods. Some of them were based on nationally representative samples of individuals, while others were conducted only within selected regions or used entire households as their sampling unit. These previous studies have demonstrated a link between education and occupation and the consumption of vegetables; in most countries people with a higher educational level or higher occupational status consumed vegetables more often.

The previous European studies have not been able to analyse the relative importance of both education and occupation as determinants of vegetable consumption because they have typically included only one indicator of socio-economic status, usually education. However, as education and occupation have mutual causal interdependencies, it may be important to include both measures in the analyses. [see e.g., 15]

This paper is based on secondary analyses of national health surveys from nine European countries. The countries were selected to represent both Northern and Southern Europe. Educational and occupational differences are compared between the countries, and place of residence is also included because the availability of vegetables may be different in rural and urban areas and place of residence may be associated with socio-economic status.

The study questions are (i) Do the Northern countries differ from the Southern European countries in regard to availability and affordability of vegetables? (ii) Is the pattern of socio-economic variation in regard to consumption of vegetables similar in all the European countries studied? (iii) Does educational level have an independent effect on vegetable consumption once the effects of occupational status and place of residence have been taken into account? (iv) Do countries showing a high general level of vegetable availability and affordability demonstrate less consistency in the relationship between education or occupation and vegetable consumption than countries with a low availability and affordability?

Following the study by Roos et al.,[2] which suggested that socio-economic differences in the consumption of vegetables were more systematic in Northern Europe than in Spain and Greece, where the availability of vegetables was good, we have made the assumption that educational level differences are larger in countries where vegetables are poorly available and where their affordability is low, that is, their prices are high.

METHOD

Estimating availability and affordability of vegetables

The availability of vegetables in the countries studied was estimated on the basis of the FAO Food Balance Sheets.[16] The Food Balance Sheets present figures that are based on national statistics about production, export and import of various food groups. They take into account vegetables produced to feed animals but not waste in consumption. They give the annual per capita amount of vegetables *available* for human consumption but do not show how much was *actually consumed*. The countries in this study were classified into groups based on high and low availability of vegetables. The trends from 1993 to 2003 were compared in order to find out whether the supply of vegetables was increasing or not.

Affordability refers to the relative prices of vegetables. Price levels in the countries studied can be compared using the Eurostat Comparative Price Level Index (PLI) for vegetables. Eurostat also publishes a volume index of Gross Domestic Product (GDP) per capita, which measures economic activity and can be used to estimate purchasing power in different countries. In order to compare vegetable prices in the countries studied, and taking purchasing power into account, we used figures obtained by dividing the PLI by per capita GDP.[17] Both the PLI and GDP figures were available for the year 2001.

National health surveys

The study data were obtained from nine European health surveys conducted in 1998-2004 and identified in the EUROTHINE-project.[18] All the surveys were based on nationally representative samples. The response rates in the studies are mostly satisfactory, the lowest rates being in Estonia (61-67%). Micro datasets from each national survey were submitted to the coordination centre of the EUROTHINE –project.[19]

The coordination centre first harmonised the data sets delivered from individual countries and then compared the available information for each variable, identified any inconsistencies and constructed common measures applicable to the maximum number of countries. All common variables were judged for their degree of comparability. This confirmed that the variables of the present study can be used to compare the countries with respect to the general association between the selected health and socio-economic variables.

For inclusion in the present study, the dataset from each national survey had to fulfil certain criteria. Its variables had to include the frequency of use of vegetables and a set of independent variables comprising sex, age, education, occupation and place of residence, and the year of data collection had to be 1998 or later. The national surveys meeting these criteria were those from Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, and Spain. The datasets for Estonia, Finland, Lithuania and Latvia are each from a continuous series of repeated cross-sections, and so these were combined into four larger data files covering the period from 2000 to 2004. The characteristics of the surveys are presented in Table 1.

Table 1. Overview of national surveys included in the study

Country	N	Response rate %	Study years	Survey
Finland	9940	65-69	2000, -02, -04	Finbalt Health Monitor
Denmark	16690	74	2000	Danish Health and Morbidity Survey 2000
Germany	7124	61	1998	German National Health Examination and Interview Survey
Estonia	4378	61-67	2002, -04	Finbalt Health Monitor
Latvia	6166	60-68	2000, -02, -04	Finbalt Health Monitor
Lithuania	5888	61-73	2000, -02, -04	Finbalt Health Monitor
France	13771	70*	2004	Health, Health Care and Insurance Survey
Italy	167618	82*-87	1999, 2000	Health and health care utilization 1999-2000
				Multipurpose Family Survey 2000
Spain	20748	85	2001	National Health Survey 2001

Note.* Response rate of households

Dependent variable

Vegetable consumption was measured as frequency of use. This was the most common and comparable vegetable-related variable in the surveys. In order to improve the comparability of the data, a dichotomous variable '1 = daily (incl. almost daily)' and '0 = not daily' was used in the statistical analyses. The category 'not daily' included 'three to five times per week', 'once or twice per week' and 'never or almost never'. The Danish, Finnish, Latvian, Lithuanian and German surveys included separate questions for fresh (raw) and non-fresh (boiled or preserved) vegetables. In these surveys a combined variable with the corresponding classes was created in which the category 'daily' included those who used either type of vegetables daily or both types at least three times per week. In Estonia, the question included only fresh (raw) vegetables. The Estonian data was included in the comparison because data from other countries having both vegetable questions showed that the gender and socio-economic patterns were similar for both fresh and all vegetables.

Independent variables and confounders

The independent variables in this study were place of residence, occupational class and educational level. Age and sex were considered as confounders. Only subjects who were 20 to 64 years of age were included in this study. Age was grouped into 5-year intervals: 20–24, and so on, up to 60–64 years.

The place of residence variable measures the degree of urbanization of the residential location of the respondent. We distinguish two broad categories: urban and rural areas. Urban areas include major metropolitan areas and cities larger than 50,000 inhabitants, while rural areas include sparsely populated areas and settlements of up 50,000 inhabitants.

The education variable refers to the level of education, which was available in comparable form for all the countries. Educational level was classified into four categories under the International Standard Classification of Education (ISCED). The categories were 1 = no or primary education (ISCED 1), 2 = lower secondary (ISCED 2), 3 = upper secondary and post-secondary non-tertiary (ISCED 3+4), and 4 = tertiary education (ISCED 5+6).

Occupational class consists of four categories: non-manual (upper non-manual and lower non-manual), manual (skilled manual workers and unskilled, routine workers), self-employed and other. The last of these categories included unemployed persons, housewives, retirees and those who could not be classified on the basis of their last occupation. The original finer classifications of the manual and non-manual occupations given in the parentheses above were reclassified into the two categories non-manual and manual to improve comparability of the data. Comparison of the differences between occupational groups is more complicated than comparison of educational differences, because the categories ‘self-employed’ and ‘others’ are very heterogeneous. Therefore, our commentary on occupational groups is confined to the differences between the manual and non-manual groups, and the manual occupation is used as the reference category. The other occupational groups were nevertheless included in the analyses, and the results concerning these are shown in the tables.

Statistical analysis

The dependent variable ‘daily use of vegetables’ was modeled using logistic regression analysis. The models were estimated separately for each country. The data was adjusted for age using the 5-year age groups in all models. The variables were fitted to the models according to their assumed chronological order: education, place of residence and occupation.

All the analyses were first carried out separately for men and women. The preliminary analyses showed that the socio-economic patterns of vegetable use were similar among men and women. In order to increase the statistical power of the models, men and women were therefore

Table 2. Distribution of respondents by gender, use of vegetables and socio-economic measures in the national surveys

Country			**Vegetables**	**Education**	**Place of residence**	**Occupation**	
		N	Daily (%)	High (%)	Urban (%)	Manual (%)	Non-manual (%)
Finland	men	4035	39.1	20.7	40.4	23.5	39.2
	women	4908	59.1	26.0	43.6	26.2	57.3
	total	*8943*	*50.1*	*23.6*	*42.2*	*25.0*	*49.1*
Denmark	men	6293	35.1	20.6	38.8	26.0	41.2
	women	6349	52.2	22.8	38.4	14.0	49.9
	total	12642	43.7	21.7	38.6	19.9	45.6
Germany	men	2792	29.7	19.1	36.3	43.5	38.0
	women	2903	43.3	11.6	38.0	24.5	61.9
	total	*5695*	*36.6*	*15.3*	*37.2*	*33.8*	*50.2*
Estonia*	men	1521	16.1	20.9	64.2	42.1	26.1
	women	2180	25.0	31.1	68.2	9.7	54.0
	total	*3701*	*21.3*	*26.9*	*66.6*	*23.0*	*42.6*
Latvia	men	2059	23.9	19.9	44.8	31.8	21.2
	women	2928	32.8	28.5	49.7	7.4	46.7
	total	*4987*	*29.1*	*24.9*	*47.7*	*17.5*	*36.2*
Lithuania	men	2429	27.5	18.6	43.8	30.7	31.7
	women	3102	33.4	23.1	47.2	10.5	52.8
	total	*5531*	*30.8*	*21.1*	*45.7*	*19.4*	*43.5*
France	men	4419	33.6	32.7	45.4	38.6	45.0
	women	4711	44.9	36.1	46.9	12.0	74.4
	total	*9130*	*39.4*	*34.5*	*46.2*	*24.9*	*60.2*
Italy	men	17524	30.1	8.7	36.1	27.6	32.5
	women	18059	38.7	8.7	37.1	12.6	25.5
	total	*35583*	*34.4*	*8.7*	*36.6*	*20.0*	*29.0*
Spain	men	7416	24.7	17.7	48.4	55.1	20.3
	women	7535	36.9	16.3	48.9	44.5	14.8
	total	*14951*	*30.9*	*17.0*	*48.6*	*49.8*	*17.5*

Note. *The Estonian data included only raw vegetables combined in the logistic regression analyses, and the analyses were adjusted for sex, without sex interaction. The differences between men and women are shown only in the descriptive table on the proportions of daily users in each of the countries (Table 2).

The first three models included only one socio-economic variable at a time, and are termed the 'main effect models'. As the purpose was to examine the independent effect of education once the effects of place of residence or occupation have been taken into account, the second set of models included educational level plus either place of residence or occupation; these are termed the 'pair wise models'. The 'final models' included all three socio-economic variables adjusted for each other.

For each explanatory variable, differences are presented as gender- and age-adjusted odds ratios and their 95% confidence intervals. The lowest educational level, rural place of residence and manual occupational class were used as reference categories.
The educational distributions of the national surveys varied, for example, in Italy 8,5% of respondents belonged to the highest educational group but in France 34,5%. Therefore, we did not compare the absolute educational differences but focused on the relative differences between the educational groups. This was done by constructing a ranking measure for educational level and utilizing this in the calculation of a Relative Inequality Index (RII) for the use of vegetables. The ranked variable gives stepwise-increasing educational categories with values between and including 0 (lowest) and 1 (highest). [19] The RII is a regression-based measure that assesses the association between the cumulative ratios of daily vegetable users and the relative position of each educational group. [see e.g., 20] The relative position is measured as the cumulative proportion of each educational group within the educational hierarchy, with 0 and 1 as extreme values. The RII can be interpreted as the odds of being a daily user of vegetables at the very top of the educational hierarchy as compared to the very lowest end of the educational hierarchy. The outcome measures can be compared between countries, provided that a detailed and hierarchical classification of educational level is used in each country. For this paper the RII was estimated using logistic regression controlled for sex and age. We will also present the RIIs for education adjusted for place of residence and/or occupational class.

RESULTS

Availability of vegetables in 1993-2003 and prices of vegetables in 2001

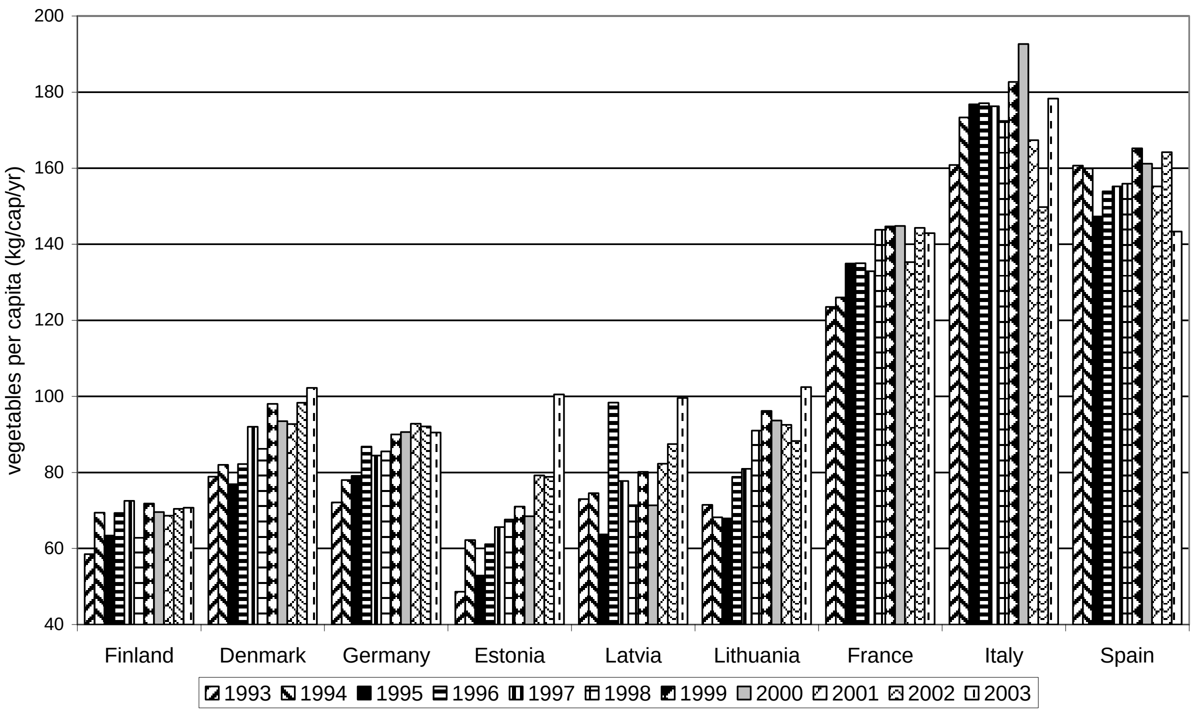
The annual per capita availability of vegetables is presented in Figure 1. The Southern European countries, France, Italy and Spain, show high availability – over 100 kg/capita/year in 1993 – and small changes in availability over time. In Finland, Denmark, Germany and the Baltic countries, the availability of vegetables is much lower – between 68 and 86 kg/capita/year. However, all these countries show a larger increase in availability than the Southern European countries. All in all, the Food Balance Sheets from 1993 to 2003 support the assumption that vegetable consumption in the Mediterranean countries is traditionally high, while in the other European countries it is the lower but increasing.

Table 3. Comparative Price Level Index (PLI) for vegetables divided by volume index of Gross Domestic Product (GDP) per capita, 2001 (EU27 = 1.00 for both PLI and GDP)

Northern/Central Europe	PLI/GDP	Baltic countries	PLI/GDP	Southern Europe	PLI/GDP
Finland	1.02	Estonia	1.64	France	0.97
Denmark	1.12	Latvia	1.62	Italy	0.85
Germany	0.86	Lithuania	1.54	Spain	0.82

The price levels of vegetables are presented in Table 3. Values close to 1 indicate either that both the PLI and GDP are close to the average EU level, or that a higher (or lower) PLI level coincides with a much higher (or lower) GDP level. Values above 1.00 suggest that prices of vegetables are higher than elsewhere in EU when purchasing power is taken into account. This is the case for the Baltic countries. On the other hand, values below 1.00 imply that vegetables are relatively cheaper than elsewhere, as is the case for Germany, Italy, France and Spain.

Figure 1. Trends in the supply of vegetables 1993-2003 (kg/capita/year) in the countries studied. [16]



Prevalence of daily use of vegetables by place of residence and socio-economic status

Educational level was associated with daily use of vegetables in all countries except Germany. In the Nordic and Baltic countries those with the highest educational level were more often daily users of vegetables, while in France, Italy and Spain, the lowest educational level group used vegetables more often than the other groups (Table 4). The figures presenting percentages of daily users in the four educational level groups are in line with the RII for vegetable consumption based on the ranked educational variable. Even in Germany, where the differences between educational groups did not reach statistical significance, the RII is above 1, which indicates that groups with higher educational level consume vegetables more often than other groups. In France, Italy and Spain, the RIIs did not deviate significantly from 1 (Table 5).

Urban respondents were more often daily users of vegetables in Denmark, Finland, Estonia, Latvia, Lithuania and Italy, although in Italy the urban/rural difference barely achieved statistical significance. In France, Germany and Spain, vegetable consumption did not vary by place of residence. The differences between urban and rural areas were largest in Estonia and Latvia (Table 4).

Daily use of vegetables was more common in the non-manual than the manual group in all the countries studied (Tables 4). The differences in vegetable consumption between manual and non-manual workers were somewhat smaller in Spain and Italy than in the other countries. The direction of difference between manual workers and self-employed respondents was varied among the countries. In France, Spain, Italy, Germany and Denmark, the self-employed were more often daily users than the manual workers, while in Finland and the Baltic countries the reverse was true.

Table 4. Daily use of vegetables by education, place of residence and occupation in nine European countries, odds ratios (OR) and 95% confidence intervals (CI) for main effect models

Main effect models	**Finland** *OR* *(95% CI)*	**Denmark** *OR* *(95% CI)*	**Germany** *OR* *(95% CI)*	**Estonia** *OR* *(95% CI)*	**Latvia** *OR* *(95% CI)*	**Lithuania** *OR* *(95% CI)*	**France** *OR* *(95% CI)*	**Italy** *OR* *(95% CI)*	**Spain** *OR* *(95% CI)*
Education*									
Edu1	1	1	1	1	1	1	1	1	1
Edu2	0.99	1.04	0.87	1.80	1.18	1.37	0.68	0.84	0.82
	(0.81-1.20)	(0.87-1.25)	(0.60-1.27)	(1.29-2.52)	(0.95-1.46)	(1.05-1.78)	(0.58-0.79)	(0.79-0.89)	(0.75-0.90)
Edu3	1.19	1.40	0.82	1.64	1.44	1.72	0.67	0.89	0.81
	(1.04-1.36)	(1.26-1.57)	(0.57-1.19)	(1.19-2.24)	(1.19-1.74)	(1.71-2.22)	(0.56-0.79)	(0.84-0.95)	(0.73-0.89)
Edu4	1.98	2.29	1.21	2.36	2.04	2.23	0.82	0.93	1.06
	(1.71-2.31)	(2.02-2.60)	(0.82-1.77)	(1.71-3.25)	(1.67-2.49)	(1.71-2.91)	(0.70-0.96)	(0.85-1.02)	(0.95-1.18)
Residence*									
Rural	1	1	1	1	1	1	1	1	1
Urban	1.18	1.23	0.99	1.50	1.58	1.20	0.94	1.05	0.99
	(1.09-1.28)	(1.14-1.32)	(0.89-1.11)	(1.26-1.79)	(1.40-1.79)	(1.07-1.35)	(0.86-1.02)	(1.00-1.10)	(0.92-1.06)
Occupation*									
Manual	1	1	1	1	1	1	1	1	1
Non-manual	1.42	2.02	1.47	1.56	1.34	1.44	1.40	1.16	1.20
	(1.28-1.57)	(1.83-2.23)	(1.30-1.66)	(1.26-1.92)	(1.12-1.60)	(1.23-1.69)	(1.26-1.55)	(1.09-1.24)	(1.09-1.32)
Self-employed	0.75	1.77	1.43	0.83	0.72	0.65	1.83	1.22	1.13
	(0.66-0.85)	(1.53-2.06)	(1.16-1.77)	(0.54-1.29)	(0.54-0.96)	(0.49-0.85)	(1.53-2.18)	(1.12-1.33)	(1.02-1.25)
Other	0.85	1.56	0.99	1.10	0.88	0.90	1.14	1.22	1.05
	(0.72-1.00)	(1.40-1.74)	(0.80-1.23)	(0.88-1.39)	(0.73-1.05)	(0.76-1.07)	(0.96-1.36)	(1.15-1.30)	(0.95-1.15)

Note. Edu1, lowest educational level; Edu4, highest educational level; * Adjusted for age and sex

Table 5. Daily use of vegetables by education, place of residence and occupation (manual work as a reference category) in nine European countries, odds ratios (OR) and 95% confidence intervals (CI) for main effect models, pair wise models and final models

Model	Finland *OR* *(95% CI)*	Denmark *OR* *(95% CI)*	Germany *OR* *(95% CI)*	Estonia *OR* *(95% CI)*	Latvia *OR* *(95% CI)*	Lithuania *OR* *(95% CI)*	France *OR* *(95% CI)*	Italy *OR* *(95% CI)*	Spain *OR* *(95% CI)*
Main effect model*									
RII (education)	2.42	2.92	1.25	2.03	2.52	2.27	1.06	0.91	0.94
	(2.06-2.85)	(2.52-3.39)	(1.02-1.54)	(1.51-2.74)	(1.99-3.19)	(1.82-2.83)	(0.90-1.24)	(0.84-0.99)	(0.83-1.07)
Pair wise models*									
RII (education)	2.35	2.81	1.26	1.88	2.20	2.19	1.07	0.90	0.95
	(1.99-2.78)	(2.42-3.26)	(1.02-1.55)	(1.39-2.54)	(1.73-2.80)	(1.75-2.74)	(0.91-1.26)	(0.83-0.98)	(0.83-1.08)
Urban	1.10	1.13	0.98	1.44	1.46	1.14	0.93	1.05	0.99
	(1.01-1.20)	(1.05-1.22)	(0.88-1.10)	(1.20-1.71)	(1.29-1.66)	(1.01-1.28)	(0.86-1.01)	(1.01-1.10)	(0.92-1.06)
RII (education)	1.84	2.28	1.00	1.72	2.15	1.74	0.89	0.89	0.83
	(1.54-2.20)	(1.95-2.66)	(0.81-1.25)	(1.26-2.35)	(1.68-2.75)	(1.37-2.21)	(0.75-1.07)	(0.81-0.98)	(0.72-0.95)
Non-manual	1.27	1.71	1.47	1.45	1.23	1.30	1.44	1.20	1.26
	(1.14-1.41)	(1.54-1.90)	(1.29-1.67)	(1.17-1.80)	(1.03-1.47)	(1.11-1.53)	(1.29-1.61)	(1.12-1.28)	(1.13-1.39)
Self-employed	0.76	1.63	1.43	0.85	0.75	0.66	1.84	1.22	1.18
	(0.66-0.87)	(1.40-1.89)	(1.15-1.78)	(0.55-1.32)	(0.56-1.00)	(0.50-0.87)	(1.54-2.20)	(1.12-1.33)	(1.06-1.31)
Other	0.86	1.46	0.99	1.14	0.91	0.90	1.19	1.22	1.06
	(0.73-1.02)	(1.31-1.63)	(0.79-1.24)	(0.90-1.43)	(0.76-1.09)	(0.75-1.06)	(0.99-1.43)	(1.15-1.30)	(0.97-1.17)
Final model*									
RII (education)	1.82	2.24	1.01	1.62	1.91	1.72	0.90	0.88	0.83
	(1.53-2.18)	(1.91-2.61)	(0.81-1.25)	(1.18-2.22)	(1.49-2.45)	(1.35-2.18)	(0.75-1.08)	(0.80-0.97)	(0.72-0.96)
Urban	1.05	1.09	0.97	1.41	1.44	1.08	0.93	1.04	0.99
	(0.96-1.15)	(1.01-1.17)	(0.87-1.09)	(1.18-1.69)	(1.26-1.63)	(0.96-1.21)	(0.86-1.02)	(1.00-1.09)	(0.92-1.06)
Non-manual	1.26	1.69	1.47	1.47	1.28	1.30	1.45	1.19	1.25
	(1.14-1.41)	(1.52-1.87)	(1.29-1.68)	(1.19-1.82)	(1.07-1.53)	(1.11-1.54)	(1.30-1.62)	(1.11-1.28)	(1.13-1.39)
Self-employed	0.76	1.62	1.43	1.02	0.88	0.68	1.83	1.22	1.18
	(0.67-0.87)	(1.40-1.88)	(1.15-1.78)	(0.65-1.60)	(0.66-1.19)	(0.51-0.90)	(1.53-2.18)	(1.12-1.33)	(1.06-1.31)
Other	0.87	1.44	1.00	1.17	0.96	0.90	1.20	1.22	1.06
	(0.73-1.02)	(1.29-1.61)	(0.80-1.24)	(0.93-1.48)	(0.80-1.15)	(0.76-1.07)	(0.99-1.44)	(1.15-1.29)	(0.97-1.17)

Note. RII, relative index of inequality; * Adjusted for age and sex

The independent effects of education, place of residence and occupation on the daily use of vegetables

According to the pair wise models incorporating education and place of residence, but not occupation, the effect of education diminished when place of residence was taken into account. In Denmark, Finland, Estonia, Latvia and Lithuania, the effect of education nevertheless remained significant. In Germany the weak effect of education remained unchanged (Table 5).
Adding occupation into the model diminished somewhat the effect of education (Table 5). The pair wise models showed similar but weaker associations between each socio-economic measure and vegetable consumption than the non-adjusted main-effect models including only one socio-economic variable at a time.

Finally, education, place of residence and occupation were all included in the model at the same time. Educational level had an independent effect on the consumption of vegetables in Denmark, Finland, Estonia, Latvia and Lithuania. In Germany, the effect of education was attenuated after adjusting for the other socio-economic variables. In France, Italy and Spain, those with a lower educational level used vegetables more often, even though in France the difference did not reach statistical significance (Table 5).

According to the final models, place of residence had an independent effect on vegetable consumption only in Denmark, Estonia and Latvia: people living in urban areas were more often daily users of vegetables regardless of their socio-economic status. When manual occupation was used as a reference category, having a non-manual occupation was independently associated with the daily use of vegetables in all countries (Table 5). Differences between manual workers and the self-employed or other occupational groups were non-systematic and difficult to interpret.

DISCUSSION

The results of the study, based on national surveys conducted in Europe between 1998 and 2004, indicate that the pattern of socio-economic variation in regard to consumption of vegetables was not similar in every country. The most obvious difference was observed between the Mediterranean and the Northern European countries in regard to educational differences. In France, Spain and Italy, educational level had a weak effect on the use of vegetables: after adjusting for place of residence and occupation those having a higher educational level were found to consume slightly less often vegetables than those with a lower educational level. In the Nordic and Baltic countries, the educational differences were greater and their direction of the association was different: those with a higher educational level were more often daily users of vegetables. The effect remained even after adjustment for place of residence or occupation. In Germany, vegetable use did not vary with educational level.

Compared to previous international overviews in this field, the present study has improved the comparability of estimates by acquiring, harmonising and reanalysing micro datasets from several countries. Moreover, we excluded surveys that were conducted before 1998 and those with a response rate of below 60%. We also utilized the previous judgements of comparability carried out by the EUROTHINE project coordination centre [19] and did not accept variables that could not be used to compare the countries with respect to general association between the outcome and explanatory variables. To improve the comparability of the results we took into account the between-country variation in the educational distributions and used, in addition to the standard classification of education (ISCED) also a ranking measure of educational level, the Relative Inequality Index (RII).

There are methodological limitations, however, that need to be considered when interpreting the results. The datasets are based on national health surveys conducted at different times around the

turn of the millennium. The data collection methods were either self-administered questionnaire or face-to-face-interview. All the surveys focused on health and risk factors, but the context for socio-demographic and behavioural questions varied. In addition, the questions concerning the frequency of eating vegetables did not require information on the quantity of vegetables consumed.
The picture of the overall use of vegetables revealed by the surveys was not consistent with that given by the statistical data. The discrepancy between the survey data and the statistical data the latter being based on vegetable availability figures from the Food Balance Sheets is understandable in view of the differences between the data collection methods. It also highlights the fact that the survey questions dealt only with behavioural frequencies and did not provide quantitative estimates of vegetable consumption. Neither the statistical availability data nor the survey data on frequency of use indicate the amount really consumed. Trends obtained from the Food Balance Sheets and from the few repeated national surveys are nevertheless in accordance.[13,21]

The simple frequency questions analysed in this study can be understood as indicators of a generally recommendable diet. On the basis of these frequencies the respondents can be roughly categorised into two groups: high vs. low users of vegetables. Despite the methodological limitations, our results concerning the associations of gender or education with vegetable consumption in the individual countries are not contradictory with more detailed dietary surveys from the same countries.[10,14,22-25] Simple frequency questionnaires can be used to estimate differences between populations or trends over time. [26,27] We are therefore satisfied that our data can be used to compare the patterns of socio-economic differences in regard to vegetable consumption among the countries studied, thus meeting the purpose of our study.

Our results support the assumption that a positive association between educational level and vegetable consumption is related to the availability of vegetables. The positive association is observed in countries with a low availability and high prices (Nordic and Baltic countries), as compared to countries where the availability and affordability are higher (France, Italy, Spain). In the latter countries a weak but opposite association is observed. The fact that the socio-economic patterns in Germany are somewhere between those of the Southern and Northern countries could be due to the low vegetable prices in Germany. In France, Spain and Italy, availability has been high and stabile during the last decade, whereas in the countries with a lower availability the trend has been one of increasing availability. Furthermore, the result that vegetable consumption was similar in both rural and urban areas in Germany, France, Spain and Italy but not in Denmark, Finland and the Baltic countries might be associated with the availability of vegetables. Urban dwellers in the Northern Europe consume more vegetables because of availability throughout the year as compared to rural areas.

Availability and affordability cannot be the only explanations for the varying educational patterns in regard to vegetable consumption. Cultural factors expressed in dietary traditions can also have an impact. Vegetables are essential components of the so-called Mediterranean diet. In the Mediterranean countries, local production of fruit and vegetables has a long history. Local products were available throughout the year, [28] and therefore even the lower socio-economic groups could adapt them as an essential part of everyday cooking. In Northern Europe, vegetables were available only during summer, while in spring and winter imported products would occasionally be available but at a very high price. Therefore, Northern Europeans have not developed a tradition of using vegetables on a daily basis. When new foods entered the market, the higher socio-economic groups were the first to buy them and to adopt modern food habits. This is the case in Finland, for example, where those with a higher educational level have set the trend regarding regular use of vegetables and low-fat milk products. [29,30]

To conclude, the positive association between educational level and vegetable consumption is more consistent in countries where their availability and affordability are poor and where the use of vegetables in everyday cooking has not been a long-standing cultural tradition. In order to increase the use of vegetables among the lower socio-economic groups in Northern Europe it is important to improve the availability and affordability of vegetables.

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Part IV

International variations in the size of socioeconomic differences in overweight- and obesity-related morbidity

Chapter 7

Social inequalities in the prevalence of diabetes *

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ABSTRACT

Background. In Western societies, a lower educational level is often associated with a higher prevalence of diabetes. Although obesity is a known risk factor for diabetes, it remains unclear to what extent inequalities in obesity can explain inequalities in diabetes, and whether this contribution differs between countries.

Methods. Data were derived from national health interview surveys from 16 European countries (n per country = 1,391 to 71,125; lower age limit 45 years). Multivariate regression analyses were applied to measure educational inequalities in diabetes prevalence. The explanatory role of obesity was assessed by controlling for body mass index.

Results. Diabetes was 1.5 times (men) and 2.7 times (women) more common among persons with a lower education level compared with persons with a higher education level. Obesity was 1.6 times (men) and 1.9 times (women) more common among persons with a lower education. Inequalities in both diabetes and obesity were generally largest among women in southern European countries. In the Baltic countries, however, diabetes was more common among the highly-educated population. Large inequalities in diabetes appeared to go together with similarly large inequalities in obesity, and vice versa. In Europe, body mass index explained 26% (men) and 36% (women) of the inequalities in diabetes.

Conclusions. Obesity is a major explanatory factor for inequalities in diabetes. In Europe, inequalities in obesity appear to translate in similar-sized inequalities in diabetes. Tackling inequalities in obesity will also contribute to smaller inequalities in diabetes, especially in southern Europe.

INTRODUCTION

Diabetes and obesity are strongly linked. Indeed, the intimate relationship between diabetes (specifically type 2 diabetes) and obesity has given rise to the term "diabesity" to characterize the close association between the two disorders. [1] Obesity and its associated risks may cause about 320,000 deaths annually in Western Europe, [2] emphasising the urgency of finding effective and efficient entry points for obesity prevention.

The prevalence of both diabetes and obesity varies within the population. In Western countries, the risk of developing diabetes and risk factors associated with the disease are linked to a low socioeconomic position (SEP). [3 4] The relationship between SEP and diabetes has been demonstrated with SEP operationalized as area deprivation, [4 5] educational level, [6 7] income [7 8] or occupational class. [9 10] For example, more diabetic and obese patients were found to live in deprived areas. [4] Prevalence rates of diabetes were found to decrease with increasing levels of education in both men and women, although the inverse relationship between diabetes prevalence and educational level was not always perfectly regular. [6 11] As is the case with obesity. [12 13] the SEP gradient of diabetes is generally found to be steeper or more regular in women as compared to men. [14]

It is reported that established risk factors for diabetes, such as physical activity and obesity, contribute in part to, but can not fully account for the SEP differences in diabetes. [11] For example, a Swedish study showed that among individuals of the lowest occupational level, BMI explained 21% (men) and 35% (women) of the excess risk of having diabetes. [10] This approach was used in many studies to provide proof for the existence of other, unknown, risk factors for diabetes. Because of the focus on unexplained variations, most studies have not quantified the unique contribution of individual risk factors (such as obesity) to the risk of diabetes.

In the Alameda County study, the associations between education and diabetes were found to be largely eliminated after adjustment for behavioral risk factors (physical activity, smoking status, and alcohol consumption). [6] Before adjustment, men and women with less than 12 years of education had a 50% excess risk of diabetes compared to those with more education. This percentage was halved after control for BMI and behavioural factors. Re-calculation of published data showed that controlling for BMI led to an 8-35% reduction of the risk of diabetes for high- and low-educated persons, respectively. [6]

The Whitehall study evaluated the explanatory value of several risk factors in the relationship between occupational status and diabetes. After controlling for confounders and physiological mediators (blood pressure, height, etc.) adjustment for BMI, exercise and smoking led to a 5% (women: 8%) decrease in odds for the incidence of diabetes in the middle occupational class, and to a 15% (women: 12%) decrease in the odds for diabetes in the lowest occupational class. [9]

In conclusion, from the reported findings we conclude that BMI contributes 5-35% to inequalities in diabetes. This is a relatively wide range that may be related to international, secular and methodological variations. Also, countries differ in the overall rates of diabetes and obesity, for example because of international differences in welfare level or lifestyle factors. Thus, there is a need for a comprehensive and international approach covering comparable data from different countries.

The objective of this study is to quantify the contribution of obesity to inequalities in diabetes prevalence in 16 European countries. We will assess this contribution in three steps. We first describe the magnitude of inequalities in diabetes across Europe. Next, in analyses of data from each individual country, we assess to what extent obesity can explain inequalities in diabetes. Finally, we evaluate whether large inequalities in diabetes are associated with large inequalities in obesity across Europe. European overviews of this kind are absent. We utilized a unique database compiled from national health surveys from most member states of the European Union, which cover different geographical parts of Europe. Harmonization of available data and utilization of identical methodologies for each country facilitated making this international overview.

METHODS

Data

Table 1 gives an overview of the cross-sectional survey data that were used in this study. Data of 16 European countries were included and most surveys dated from after 2000. Throughout this paper, we will present the countries according to their geographical position, in a counter-clockwise order (i.e., north, west, south, east) starting with Finland.

Table 1. Overview of the national surveys used in this study

Country	Name of survey and responsible institute	Year(s) of survey
Finland	Finbalt Health Monitor National Public Health Institute, Helsinki	1994/’96/ '00/'02/'04
Sweden	Swedish Survey of Living Conditions (ULF) Statistics Sweden, Stockholm	2000/’01
Norway	Norwegian Survey of Living Conditions Statistics Norway, Oslo	2002
Denmark	Danish Health and Morbidity Survey (DHMS/ SUSY) Danish National Institute of Public Health, Copenhagen	2000
Netherlands	General social survey (POLS) Statistics Netherlands, Voorburg	2003/'04
Belgium	Health Interview Survey Institute of Public Health (IPH), Brussels	1997/'01
Germany	German National Health Examination and Interview Survey Robert Koch Institute (RKI), Berlin	1998
France	French Health, Health Care and Insurance Survey (ESPS) Institut de recherche et documentation en économie de la santé (IRDES), Paris	2004
Italy	Health and health care utilization National Institute of Statistics (ISTAT), Rome	1999/'00
Spain	National Health Survey Ministry of Health and Consumption (MSC), Madrid	2001
Portugal	National Health Survey Instituto Nacional de Saude Dr Ricardo Jorge (INSARJ), Lisbon	1998/’99
Hungary	National Health Interview Survey Hungary National Public Health and Medical Officer Service (NPHMOS), Budapest	2000/’03
Czech Rep	Health Interview Survey Institute of Health Information and Statistics of the Czech Republic, Prague	2002
Lithuania	Finbalt Health Monitor	1994/’96/'00/'02/'04
Latvia	Finbalt Health Monitor	1998/'00/'02/'04
Estonia	Health Behavior among Estonian Adult Population National Institute for Health Development, Tallinn	2002/'04

Participants

Table 2 presents the study characteristics and the distribution of the survey population. The total sample size amounted to 196,660 persons (53.4% women) and ranged per country from 1,391 (Czech Republic) to 71,125 (Italy) persons. The lower age limit was 45 years. There was generally no upper age limit, except in Finland, Estonia and Latvia where it was 65 years. Percentages of missing values for diabetes and BMI were generally below 5%. The exceptions were the Netherlands with 14% missing values for diabetes, and Spain with 15% of the height and/or weight data missing. Countries were selected based on availability of data. Due to its small sample size, we excluded data of the Slovak Republic (*n* = 565).

Table 2. Number of respondents, educational distribution and missing data.

Country		**Educational distribution**						
	Number of respondents [a]	Lowest	Second lowest	Second highest	Highest	Diabetes missing	BMI missing[b]	Highest age category
	N	%	%	%	%	%	%	
Finland	11,017	24.3	10.8	48.5	16.5	0.0	1.3	65 years
Sweden	6,896	22.7	7.5	43.8	26.0	0.0	3.3	none
Norway	4,003	-	23.0	52.2	24.6	0.1	2.2	none
Denmark	10,198	27.5	3.3	51.7	17.6	0.2	2.0	none
Netherlands	9,717	19.5	24.7	33.8	22.1	14.0	2.3	none
Belgium	11,071	29.6	23.9	24.3	22.2	1.3	3.4	none
Germany	4,285	2.3	51.8	30.7	15.2	4.9	0.7	none
France	10,392	28.3	38.6	13.4	19.8	3.4	7.0	none
Italy	71,125	53.3	21.6	19.1	5.9	0.0	0.0	none
Spain	11,569	62.1	18.8	10.2	8.8	0.0	14.7	none
Portugal	25,852	84.8	7.0	3.4	4.8	0.1	2.6	none
Hungary	6,487	41.7	22.0	23.0	13.3	0.4	1.9	none
Czech Republic	1,391	23.7	38.3	24.9	13.0	0.0	0.4	none
Lithuania	6,213	20.9	26.0	34.7	18.4	0.0	1.9	none
Latvia	4,188	22.2	21.2	36.2	20.5	0.0	2.6	65 years
Estonia	2,256	19.3	26.0	35.4	19.4	4.0	1.5	65 years
Total	*196,660*	*30.1*	*22.8*	*30.3*	*16.8*	*1.9*	*3.0*	-

Note. [a] Aged 45 years and older; [b] Missing values in height, weight, or both; Hyphen = category does not exist

Variables

Educational attainment generally had four levels, which were coded according to the International Standard Classification of Education (ISCED). [15] This classification was designed to enable international comparability of educational systems, and is based on level of education. The four descending levels are: (1) ‘Tertiary education’ (corresponding to ISCED 5-6), or *highest*; (2) ‘Upper secondary and post-secondary non-tertiary’ (ISCED 3-4), or *second highest*; (3) Lower secondary education (ISCED 2), or *second lowest* and (4) ‘No or only primary education’ (ISCED 1), or *lowest*.

The survey questions on diabetes aimed to measure whether the respondent currently had diabetes. In the questions, no distinction was made between type 1 and type 2 diabetes. All surveys are based on self-reports by respondents. The presence of this disease was measured (if available) for a recall period of 12 months. In the original surveys this disease was called ‘*diabetes*’ (most countries) or '*diabetes mellitus*' (Belgium) or '*high blood sugar (diabetes)*' (Estonia). In Sweden the answers had been scored by a general practitioner according to the ICD-10 classification system. [16] It had either two ('*yes*', '*no*') or three ('*yes', 'have had', 'have never had*') response categories. Respondents who *currently* had diabetes were considered cases; all others were considered non-cases.

The BMI was calculated from the self-reported weight (kilograms) divided by the square of self-reported height (meters). When BMI was used to predict inequalities in diabetes, it was categorized into ten categories of three BMI points each (10-12, 13-15, …., 43-45). When used to calculate prevalence rates, BMI was divided into three categories: (i) normal weight (18 ≤ BMI < 25) (ii) moderately overweight (25 ≤ BMI < 30) and (iii) obese (BMI ≥ 30).

Statistical analyses

Prevalence rates were age standardized using the direct method. The European Standard Population of 1995 was used as a reference. The prevalence rate ratio (PRR) was also calculated to express the prevalence of diabetes in the educational group of interest relative to the prevalence of that condition in the highest educational level. PRRs and 95% confidence intervals were estimated by regression analysis with the log link function and assuming binomial distribution [17] using the Genmod procedure (SAS Institute Inc., Cary, NC, USA). PRRs were always adjusted for 5-year age category and, where applicable, for country.

We summarized the association between diabetes and educational level by calculating the Relative Index of Inequality (RII) and its 95% confidence intervals. [18-20] The RII is a regression-based measure that assesses the association between diabetes prevalence and the relative position of each educational level separately. The relative position is measured as the cumulative proportion of each educational level 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 diabetic at the very top as compared to the very lowest end of the educational hierarchy. An RII above (below) one indicates a negative (positive) relationship between educational level and diabetes. Because of its focus on relative differences, and because the RII can be applied to each country for which a detailed and hierarchical educational classification is available, the RII could be used to make international comparisons.

Pooled analyses were weighted to simulate equal sample size for each country. Relatively small samples assigned relatively large weights to individual respondents, and vice versa. The RII was also used to summarize inequalities in obesity. Finally, the explanatory value of obesity for the relationship between educational level and diabetes was quantified by calculating the percentage change in the RII for diabetes before and after controlling for BMI category (10 units). [21 22]

RESULTS

Table 3 shows the prevalence of diabetes in three BMI categories (overweight, obesity and reference category normal weight). Among men, diabetes was 1.7 and 2.6 times more common among those with overweight and obesity, respectively (see 'total'). Among women, diabetes was 1.7 and 3.1 more common among those with overweight and obesity, respectively (see 'total').

Table 3. Age-adjusted prevalence (%) of diabetes in three BMI categories

Country	Men			Women		
	Normal weight[a]	Over-weight	Obese	Normal weight[a]	Overweight	Obese
Finland	3.0	4.8	13.1	1.9	2.7	10.9
Sweden	3.0	7.4	12.4	2.9	5.3	10.6
Norway	5.2	6.0	12.7	2.8	7.2	14.3
Denmark	4.6	5.2	10.7	1.9	5.2	10.1
Netherlands	5.6	9.0	17.9	3.4	8.0	15.2
Belgium	4.2	7.5	13.7	3.1	7.4	12.9
Germany	8.1	11.0	17.4	8.2	10.4	14.1
France	6.4	10.3	19.3	2.8	7.7	19.8
Italy	6.8	8.3	13.2	5.9	8.9	15.7
Spain	8.0	11.2	13.8	6.8	9.5	15.6
Portugal	6.6	11.0	15.8	8.5	11.5	16.9
Hungary	7.1	14.7	20.6	9.7	12.6	20.2
Czech Republic	7.3	12.0	16.5	10.7	16.7	21.3
Lithuania	3.1	12.1	5.6	0.6	2.2	4.4
Latvia	1.4	3.1	8.5	1.4	2.3	6.9
Estonia	4.0	5.9	9.9	3.0	7.5	20.8
Total	*5.3*	*8.7*	*13.8*	*4.6*	*7.8*	*14.4*

Note.[a] Underweight not included (age-adjusted prevalence of diabetes: 1.9% men; 4.7% women).
Normal weight: 18 ≤ BMI < 25; overweight: 25 ≤ BMI < 30; obese: BMI ≥ 30.

Table 4 shows the magnitude of educational inequalities in obesity, as expressed by the RII. For men in Europe at large the RII was 1.65. The RII was below one in Latvia, indicating a (non-significant) excess of obesity among men of higher education. The inequalities in obesity were largest in France, Norway and Italy (RII ≥ 2.46). Among women, inequalities in obesity were generally larger than those among men. For women in Europe at large the RII was 2.20.The inequalities were smallest in Lithuania, Latvia, Hungary and Norway (RII ≤ 1.77) and largest in southern European countries (RII ≥ 3.93).

Figure 1 presents an overview of the age-adjusted prevalence of diabetes by educational level across Europe for men and women.

Among *men*, diabetes was always more common in the two lowest educational categories. In most cases, a pattern of decreasing prevalence of diabetes with increasing level of education was observed. In Finland, Sweden and Norway, diabetes was most common among men of the second-lowest educational level. However, in Spain and Latvia, this relationship was absent or ‘reverse’, respectively. The inequalities were largest in France, Hungary, and Czech Republic.

For *women* the educational inequalities were more clearly graded. The educational differences in the prevalence of diabetes were generally large, especially in women from Czech Republic, Belgium and the southern European countries.

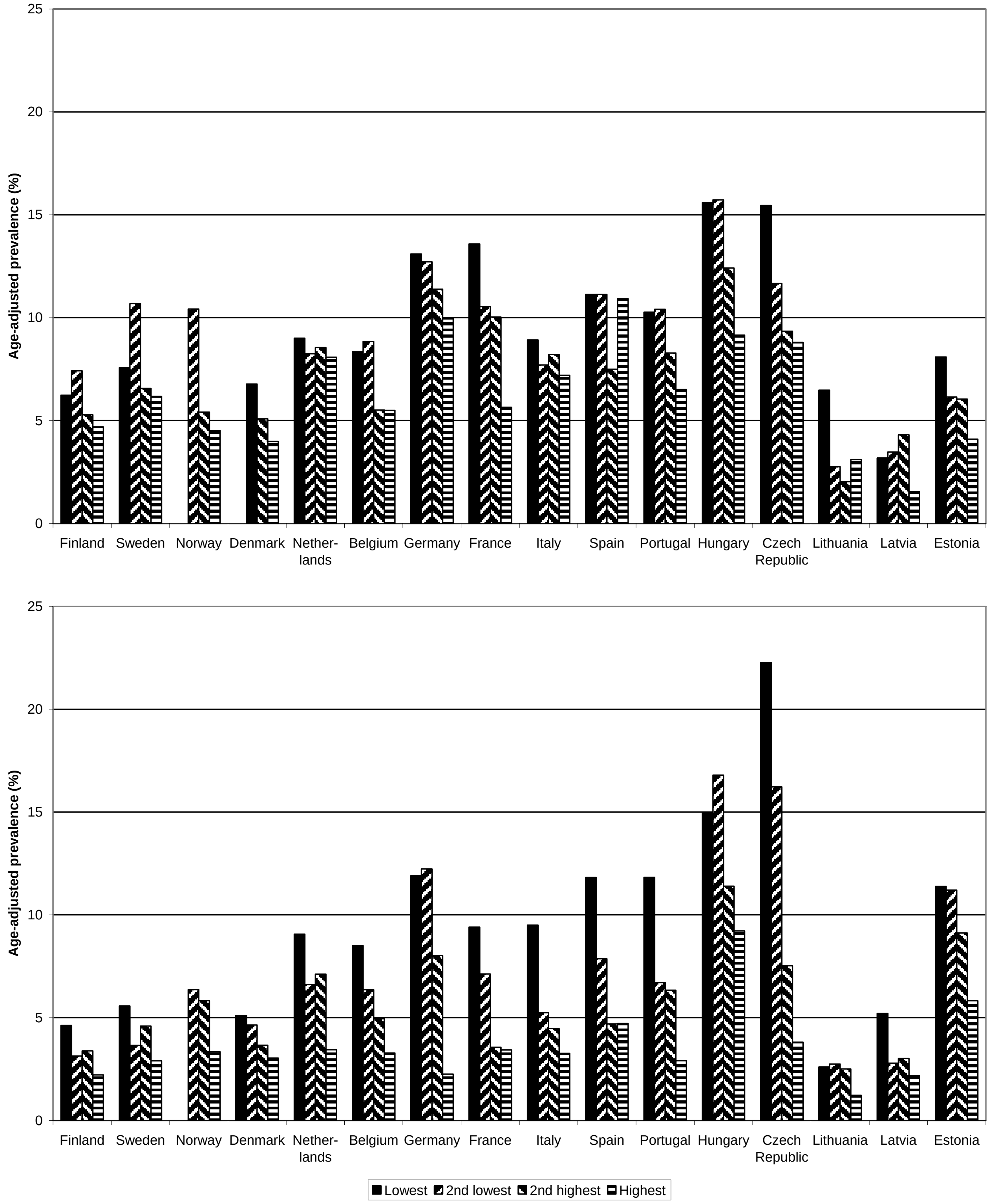
Table 4. The magnitude of educational inequalities in obesity, expressed in terms of RII

Country	Men		Women	
	RII	95 % CI	RII	95 % CI
Finland	1.71	(1.34- 2.18)	1.81	(1.41- 2.32)
Sweden	1.92	(1.34- 2.77)	2.02	(1.39- 2.93)
Norway	2.71	(1.51- 4.87)	1.77	(1.02- 3.07)
Denmark	2.41	(1.78- 3.26)	2.92	(2.10- 4.05)
Netherlands	2.27	(1.65- 3.11)	2.12	(1.55- 2.91)
Belgium	1.98	(1.56- 2.52)	3.75	(2.89- 4.87)
Germany	1.67	(1.25- 2.24)	3.07	(2.23- 4.22)
France	2.80	(2.02- 3.89)	4.62	(3.29- 6.50)
Italy	2.46	(2.18- 2.78)	4.65	(4.02- 5.37)
Spain	1.72	(1.29- 2.29)	3.93	(2.82- 5.46)
Portugal	2.36	(1.78- 3.13)	4.89	(3.58- 6.67)
Hungary	1.26	(0.97- 1.64)	1.70	(1.35- 2.13)
Czech Republic	1.76	(0.94- 3.30)	3.20	(1.96- 5.20)
Lithuania	1.01	(0.75- 1.38)	1.42	(1.14- 1.76)
Latvia	0.88	(0.59- 1.33)	1.44	(1.14- 1.82)
Estonia	1.18	(0.70- 1.98)	2.26	(1.57- 3.25)
Total	*1.65*	*(1.53- 1.78)*	*2.20*	*(2.06- 2.35)*

Note. RII = Relative Index of Inequality, 95 % CI = 95 % confidence interval.

Table 5 shows the magnitude of educational inequalities in diabetes among men, before and after controlling for BMI. The educational inequalities in diabetes varied greatly across Europe. The RII was about 2 or higher in Denmark, Norway, Estonia, Czech Republic, Hungary, Belgium, and France. The RII was smallest in Lithuania (RII = 0.82) and the average RII was 1.78.
In Europe at large, inequalities in body mass explained about 26% of the inequalities in diabetes among men. In Latvia and Hungary, BMI did not explain inequalities in diabetes. Conversely, BMI explained about 30% or more of the inequalities in diabetes in France, Germany, Italy, Estonia, and about 50% or more in the Netherlands, Finland and Sweden. The RII sometimes had wide confidence intervals (e.g. Portugal, Czech Republic), which indicates a lack of precision of those estimates.

Figure 1. Age-adjusted prevalence of diabetes by educational level across Europe for men (*above*) and women (*below*)



Note. (1) Norway does not have a category "Lowest education"; (2) In Denmark (men), the group size of the second-lowest educational group is $n = 8$. This prevalence estimate was therefore omitted.

Table 5. Age-adjusted educational inequalities (RII) in diabetes among *men*, before and after control for BMI.

Country	[1] Diabetes		[2] Diabetes, BMI-controlled [a]		Delta %[b]
	RII	95 % CI	RII	95 % CI	[1 - 2]
Finland	1.47	(0.93- 2.31)	1.22	(0.78- 1.90)	-53.6
Sweden	1.38	(0.80- 2.36)	1.18	(0.68- 2.04)	-51.9
Norway	3.46	(1.64- 7.30)	3.26	(1.52- 7.02)	-8.0
Denmark	1.93	(1.17- 3.19)	1.7	(1.03- 2.82)	-24.7
Netherlands	1.29	(0.85- 1.95)	1.03	(0.69- 1.55)	-89.0
Belgium	1.95	(1.30- 2.92)	1.71	(1.14- 2.56)	-25.7
Germany	1.50	(0.89- 2.54)	1.33	(0.78- 2.26)	-34.9
France	2.39	(1.55- 3.68)	1.84	(1.19- 2.84)	-39.4
Italy	1.37	(1.16- 1.62)	1.24	(1.05- 1.47)	-34.3
Spain	1.36	(0.92- 2.01)	1.25	(0.84- 1.86)	-30.7
Portugal	1.71	(1.17- 2.49)	1.53	(1.05- 2.24)	-24.8
Hungary	1.94	(1.29- 2.91)	1.98	(1.32- 2.97)	4.4
Czech Republic	2.16	(0.84- 5.55)	1.79	(0.72- 4.46)	-31.9
Lithuania	0.82	(0.36- 1.89)	0.87	(0.38- 2.01)	-28.1
Latvia	1.46	(0.50- 4.22)	1.66	(0.58- 4.73)	43.8
Estonia	2.17	(0.74- 6.38)	1.78	(0.63- 5.01)	-33.7
Total	*1.78*	*(1.58- 2.02)*	*1.58*	*(1.40- 1.79)*	*-25.6*

Note. [a] Controlled for body mass index (BMI) category; [b] Percentage change in RII of diabetes after controlling for BMI. Formula: Delta % = ($RII_{[before\ control]}$ - $RII_{[after\ control]}$) / (1 - $RII_{[before\ control]}$) * 100%; RII = Relative Index of Inequality; 95 % CI = 95 % confidence interval

Table 6 shows educational inequalities in diabetes among women, before and after controlling for BMI. The RII was larger than 3 in Czech Republic, Belgium, France, Italy, Spain and Portugal. Just like in men, the RII was smallest in Lithuania (RII = 1.57). The average RII was 2.83.

In Europe at large, inequalities in obesity explained about 36% of the inequalities in diabetes among women. The ability of obesity to explain inequalities in diabetes ranged from 20-25% in the Czech Republic, Lithuania and Hungary to 50% or more in Denmark, Finland, Estonia and France.

Figure 2 presents scatter plots illustrating the relationship, across countries, between educational inequalities in diabetes and inequalities in obesity. For men, the magnitude of the inequalities in diabetes more or less corresponded with those in obesity, clustering around RII = 2. Countries with large inequalities in obesity had generally large inequalities in diabetes, and vice versa. France showed large in inequalities in the prevalence of both diabetes and obesity.

For women, a similar but more pronounced association can be seen. Southern European countries (i.e. Portugal, Spain, Italy) had the largest inequalities in both measures, and northern European countries (i.e. Finland, Sweden Norway) had the lowest in both measures.

Table 6. Age-adjusted educational inequalities (RII) in diabetes among *women*, before and after control for BMI.

Country	[1] Diabetes		[2] Diabetes, BMI-controlled [a]		Delta % [b]
	RII	95 % CI	RII	95 % CI	[1 – 2]
Finland	1.76	(0.97- 3.19)	1.31	(0.73- 2.35)	-59.0
Sweden	2.44	(1.25- 4.79)	1.93	(1.00- 3.70)	-35.9
Norway	1.92	(0.86- 4.28)	1.52	(0.73- 3.16)	-43.3
Denmark	2.32	(1.28- 4.19)	1.64	(0.90- 2.98)	-51.4
Netherlands	2.28	(1.37- 3.79)	1.77	(1.07- 2.94)	-39.4
Belgium	3.23	(2.05- 5.08)	2.25	(1.43- 3.53)	-44.0
Germany	2.61	(1.26- 5.43)	2.17	(1.02- 4.60)	-27.8
France	4.49	(2.60- 7.75)	2.21	(1.29- 3.80)	-65.2
Italy	4.58	(3.65- 5.76)	3.48	(2.76- 4.37)	-30.9
Spain	4.4	(2.57- 7.51)	3.17	(1.84- 5.45)	-36.3
Portugal	6.55	(3.83- 11.20)	5.03	(2.94- 8.61)	-27.5
Hungary	1.96	(1.34- 2.86)	1.75	(1.20- 2.55)	-22.1
Czech Republic	4.96	(2.37- 10.41)	3.94	(1.93- 8.05)	-25.7
Lithuania	1.57	(0.80- 3.08)	1.43	(0.74- 2.79)	-24.6
Latvia	2.71	(1.21- 6.03)	2.05	(0.92- 4.54)	-38.4
Estonia	1.92	(0.99- 3.71)	1.25	(0.65- 2.39)	-72.7
Total	*2.83*	*(2.50- 3.21)*	*2.18*	*(1.92- 2.47)*	*-35.5*

Note. See notes of previous Table 5.

DISCUSSION

Our study revealed a strong relationship between inequalities in diabetes and inequalities in obesity, especially among women. In Europe at large, we found that obesity could account for 26% and 36% of the inequalities in diabetes in men and women, respectively. Across Europe, we observed an association between inequalities in diabetes and inequalities in obesity. Inequalities in diabetes and obesity were largest in southern Europe, especially among women.

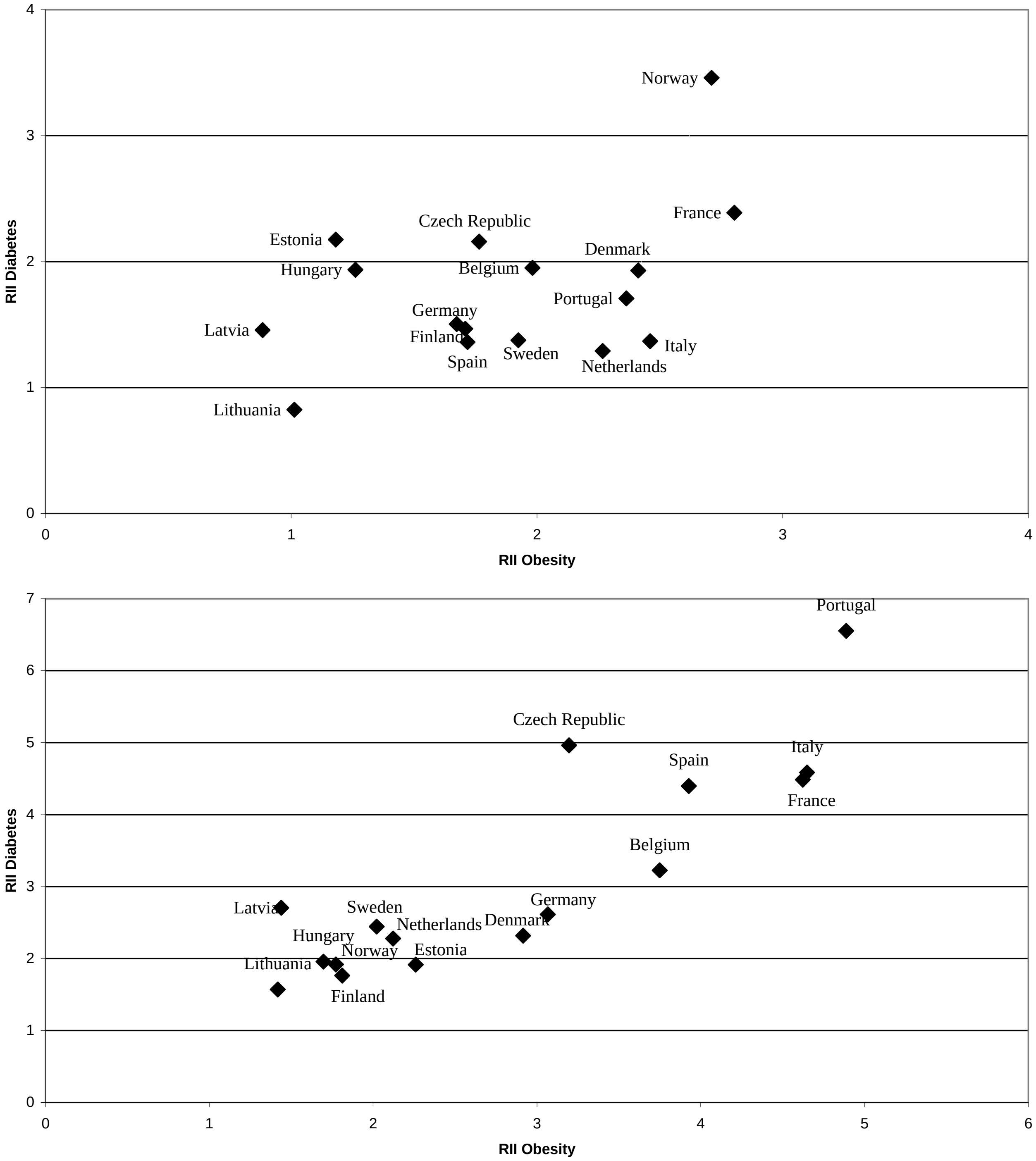
Some limitations of the present study must be acknowledged. A distinction between type 1 and type 2 diabetes could not be made in our data. However, type 2 diabetes is far more prevalent, comprising 90% of all people with diabetes. [23] Therefore, self-reported diabetes for people above 45 years of age is predominantly type 2 diabetes.

If diabetes has been diagnosed, this is usually also reported in surveys. [24] One study found that physician-diagnosed diabetes was usually (in 93% of the cases) also detected by self-reports. [25] However, diabetes has a sizeable submerged clinical ‘iceberg’. For instance, a recent estimate indicated that about 35% of all Americans with diabetes had not been diagnosed, [26] which probably means that self-reports yield similar underestimations. Notwithstanding this likely underestimation, several investigations showed that educational *inequalities* in underreporting of diabetes are small [27] or absent. [25 28-30] For instance, one study found that 96 % of true diagnoses of diabetes were detected by self-reports for both high- and low-educated respondents. [27]

People with a high true BMI have a tendency to underreport their weight, while most people over-report their height. [31] A self-report-based BMI is therefore likely to be an underestimation of the true BMI. Most studies [32-35] but not all [36 37] found that people with lower education overestimated their height more than their higher educated counterparts, which would lead to underestimations of inequalities in BMI. In absolute terms, however, the differences are likely to be small. [38]

In conclusion, we cannot exclude the possibility of an educational gradient in the self-report bias in diabetes, weight and height. In absolute terms, however, this effect may be small. The fact that diabetes often goes undetected and hence cannot be reported, does not necessarily imply that the estimates of relative educational differences in diabetes are strongly biased, but the possibility cannot be excluded.

Figure 2. Relationship between educational inequalities (RII) in diabetes (y-axis) and obesity (x-axis) across Europe for men (*above*) and women (*below*)



Note. RII = Relative Index of Inequality.

Other studies corroborate our finding that socioeconomic differences in diabetes [3 39] and obesity [40] were larger among women than among men. We also confirmed the results of other studies that obesity is responsible for a substantial part of the association between SEP and diabetes. [6 9 11] Regarding the explanatory value of BMI for inequalities in the prevalence of obesity, data from other studies range from 5 to 35% among women, whereas for men the percentages are generally lower. [6 9] In Europe at large, we found slightly higher estimates, with BMI explaining 26% (men) and 36% (women) of the inequalities in diabetes.

The socioeconomic differences in diabetes and obesity were generally largest among women in southern European countries. Other (unpublished) studies from the Eurothine project gave no clear indication that southern European countries also have larger inequalities with respect to the direct risk factors for obesity, i.e. nutrition and physical activity [41 42] This lack of correspondence is corroborated by findings of previous studies on social inequalities in the prevalence of nutrition-related behaviors [43] and (to a lesser extent) physical activity. [44] That is, the Mediterranean countries do not show larger inequalities in these two direct risk factors of obesity, at least as measured by relatively simple indicators of energy intake and expenditure.

This suggests that more complex or more fundamental factors may underlie the large inequalities in the prevalence of diabetes in Mediterranean women, by causing an imbalance between the intake and expenditure of energy. A ‘fundamental’ explanation may lie in the large educational differences in labor force participation among southern European women. Labor participation is generally high among women of higher education, but is very low among low-educated Mediterranean women. [45] Working women, especially those of higher educational levels, work in a social environment where the social norm emphasizes thinness and health. [13] A thinner body may be socially valued and materially viable to a greater extent for women of higher SEP, and these factors could help maintain SEP differences for women. [13] Similarly, strong traditional “housewife” roles may increase the exposure of low SEP women in southern countries to other risk factors for diabetes, such as limited physical activity.

In the Baltic countries and Hungary, the stage of socioeconomic development might explain the relatively small inequalities in obesity and diabetes prevalence. Chronic diseases like obesity and diabetes have long been viewed as ‘diseases of affluence’. [40] This view is consistent with the positive socioeconomic gradient in obesity that is observed in some developing countries. With increases in (among others) national welfare levels, this pattern would slowly shift to a situation where the burden of disease mostly lies with the socioeconomically disadvantaged. [46] The Baltic countries and Hungary may be in an earlier phase of socioeconomic development than the most ‘western’ countries, where pronounced negative gradients in both diabetes and obesity had emerged.

To conclude, almost anywhere in Europe, but especially in southern Europe, obesity is a major explanatory factor for inequalities in diabetes. Across Europe, larger inequalities in obesity appear to translate into comparably large inequalities in diabetes. Tackling inequalities in obesity prevalence is very likely to also impact inequalities in diabetes, especially among women in southern Europe.

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Chapter 8

Social inequalities in the prevalence of hypertension *

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ABSTRACT

Background. Less advantaged people are more likely to be hypertensive, but the level of inequality differs among European countries. It is unclear to what extent socioeconomic inequalities in hypertension vary throughout Europe, and what role obesity prevalence may have in this.
Objectives. To describe educational inequalities in hypertension across Europe. To assesses the contribution of obesity to those inequalities in hypertension, and the possible additional contribution of diabetes.
Methods. Cross-sectional self-report data on hypertension, height, weight and diabetes were derived from national health interview surveys from 16 European countries (N = 194,426; ages 40 years and older). Multivariate regression analysis was employed to measure educational inequalities in hypertension, and to assess the possible role of obesity and diabetes in the explanation of inequalities in the prevalence of hypertension.
Results. Inverse educational gradients in hypertension (i.e. higher education, less hypertension) are common among women but not among men. A clear north-south gradient was present among women: inequalities in hypertension were largest in southern Europe and smallest in Baltic and Nordic countries. Among men, generally no consistent geographic patterns emerged. Among women in most countries, inequalities in obesity could explain more than one half of inequalities in hypertension, with diabetes having a small additional effect. Educational inequalities in hypertension, obesity and diabetes prevalence among Mediterranean women were largest in Europe.
Conclusion. Inequalities in obesity prevalence importantly explain inequalities in hypertension prevalence in women, especially those from southern Europe. These inequalities might be reduced by making low-educated women a prime target of obesity prevention in Europe.

INTRODUCTION

In most developed countries, hypertension is more common among groups of lower socioeconomic position (SEP). [1-3] Inequalities in hypertension are usually larger among women. [1 4 5] The INTERSALT study (1982-1985) reported on data from 47 centers (from 27 countries) that hypertension prevalence and educational level were inversely related in 28 (men) and 38 (women) centers. [4] A review using studies between 1976-1996 reported that an inverse relationship between SEP and hypertension was usually, but not always, found in 7 different European countries. [1]

The latter two findings illustrate an important, yet often ignored point, namely that inequalities in hypertension and its risk factors might vary across Europe. A European overview showed that inequalities in hypertension were largest in France and smallest in Denmark, but no consistent international patterns in inequalities emerged. [5] Although educational differences in blood pressure may be larger in southern than in northern Europe, [6] the observed patterns are not always consistent. Many studies report pooled results of men and women, which at least in part ignores the striking gender differences in hypertension [4] and its risk factors. [7]

On the basis of single-country studies, it is even more difficult to draw conclusions on international patterns in inequalities in hypertension. In Finland, the differences in diastolic blood pressure (2.5 % and 3.2 % higher among low-educated men and women, respectively) seem to be small from an international perspective. [8] In the Czech Republic, hypertension was more common among low-educated men and women. It was concluded that the magnitude of educational inequalities was similar to those found in western countries. [9] Results from individual countries may even be contradictory. For example, a Spanish study observed a direct association of educational level with blood pressure in women. [10] Conversely, another Spanish study found that educational level was inversely associated with hypertension in both genders. [11]

Overweight and diabetes are both risk factors for hypertension. [12 13] One European study found that about 14 % of the prevalence of hypertension can be attributed to overweight. [14] Based on existing findings, we estimate that 9 % (men) and 16 % (women) of the prevalence of hypertension is attributable to diabetes. [12 15] The prevalence of obesity [7] and diabetes [5] are also inversely related to SEP. Educational differences in the prevalence of hypertension, diabetes and obesity are generally larger among women.

A substantial part of the (inverse) educational gradient in hypertension may be accounted for by the educational gradient in BMI. [1] However, the contribution of BMI to inequalities in hypertension is unclear. Estimates vary from nil (US) [16] to 18 % (UK) [17] to 28 % (Finland). [18] Often, the role of BMI cannot be identified from published studies because a whole range of risk factors is considered simultaneously to explain inequalities in hypertension. [10] This makes it impossible to assess the contribution of BMI to inequalities in the prevalence of hypertension.

In summary, the pan-European patterns in educational inequalities in hypertension, reported in the literature, are unclear. Therefore, the objectives of this study are (i) to describe the pan-European variations in educational inequalities in hypertension, and (ii) to assess the role of obesity in the inequalities in different countries. In addition, we will evaluate whether diabetes prevalence adds anything to this explanation. Data from national health interview surveys of sixteen European countries will be used, among which the Baltic and some eastern European countries.

METHODS

Data

Table 1 gives an overview of the cross-sectional interview survey data that were used in this study. Data of 16 European countries were included and most interview surveys dated from 2000 or earlier.

A more elaborate description of the interview surveys can be found in Mackenbach et al. (2008).[19] Throughout this paper, we will present the countries according to their geographical position, in a counter-clockwise order (i.e., north, west, south, east) starting with Finland.

Table 1. National surveys used in this study

Country	Name of survey and responsible institute	Year(s) of survey
Finland	Finbalt Health Monitor	1994/'96/'98/
	National Public Health Institute, Helsinki	'00/'02/'04
Sweden	Swedish Survey of Living Conditions (ULF)	2000/'01
	Statistics Sweden, Stockholm	
Norway	Norwegian Survey of Living Conditions	2002
	Statistics Norway, Oslo	
Denmark	Danish Health and Morbidity Survey (DHMS/ SUSY)	2000
	Danish National Institute of Public Health, Copenhagen	
Netherlands	General social survey (POLS)	2003/'04
	Statistics Netherlands, Voorburg	
Belgium	Health Interview Survey	1997/'01
	Institute of Public Health (IPH), Brussels	
Germany	German National Health Examination and Interview Survey	1998
	Robert Koch Institute (RKI), Berlin	
France	French Health, Health Care and Insurance Survey (ESPS)	2004
	IRDES, Paris	
Italy	Health and health care utilization	1999/'00
	National Institute of Statistics (ISTAT), Rome	
Spain	National Health Survey	2001
	Ministry of Health and Consumption (MSC), Madrid	
Portugal	National Health Survey	1998/'99
	Instituto Nacional de Saude Dr Ricardo Jorge (INSARJ), Lisbon	
Hungary	National Health Interview Survey Hungary	2000
	NPHMOS, Budapest	
Czech Rep.	Health Interview Survey	2002
	Institute of Health Information and Statistics of the Czech Republic	
Lithuania		1994/'96/'98/
	Finbalt Health Monitor (see under Finland)	'00/'02/'04
Latvia		1998/'00/'02/'04
Estonia	Health Behavior among Estonian Adult Population	2002/'04
	National Institute for Health Development, Tallinn	

Participants

Table 2 shows study characteristics and the survey population distribution. The total sample size amounted to 191,356 persons (53.4 % women) and ranged from 1,391 (Czech Republic) to 71,125 (Italy). The lower age limit was 40 years. There was generally no upper age limit, except in Finland, Estonia, Lithuania and Latvia, where it was 65 years. Percentages of missing values for hypertension, BMI and diabetes were generally below 5 %. For diabetes and hypertension, the Netherlands were the exception (both 14 %). In Lithuania, 13 % of the hypertension data were missing. In Spain, 15 % of the height and/or weight data were missing.

Table 2. Sample size (N) and missing values (N, %) of hypertension, BMI and diabetes

Country	Persons	Missing values					
		Hypertension		BMI		Diabetes	
	N	*N*	%	*N*	%	*N*	%
Finland	11,017	0	0.0	143	1.3	0	0.0
Sweden	6,896	0	0.0	228	3.3	0	0.0
Norway	4,003	5	0.1	89	2.2	3	0.1
Denmark	10,198	15	0.1	207	2.0	15	0.2
Netherlands	9,717	1338	13.8	225	2.3	1362	14.0
Belgium	11,071	75	0.7	372	3.4	142	1.3
Germany	4,285	309	7.2	31	0.7	211	4.9
France	8,158	266	3.3	573	7.0	266	3.3
Italy	71,125	0	0.0	0	0.0	0	0.0
Spain	11,569	0	0.0	1705	14.7	0	0.0
Portugal	25,852	80	0.3	672	2.6	36	0.1
Hungary	3,417	2	0.1	125	1.9	19	0.6
Czech Rep.	1,391	0	0.0	6	0.4	0	0.0
Lithuania	6,213	819	13.2	120	1.9	0	0.0
Latvia	4,188	0	0.0	110	2.6	0	0.0
Estonia	2,256	90	4.0	33	1.5	89	4.0
Total	*191,356*	*2999*	*2.7*	*4639*	*3.0*	*2143*	*1.8*

Variables

Educational attainment generally had four levels, which were coded according to the International Standard Classification of Education (ISCED). [20] The ISCED enables international comparability of educational systems. The levels are: (1) 'Tertiary education' (corresponding to ISCED 5-6), or *highest*; (2) 'Upper secondary and post-secondary non-tertiary' (ISCED 3-4), or *second highest*; (3) Lower secondary education (ISCED 2), or *second lowest* and (4) 'No or only primary education' (ISCED 1), or *lowest*.

All surveys were based on self reports by respondents, except for Sweden where the diseases had been scored by a GP according to the ICD-10 classification system. [21] Disease items had either two ('*yes*', '*no*') or three ('*yes*', '*have had*', '*have never had*') response categories. Respondents who *currently* had the disease (hypertension or diabetes) were considered cases; others were considered non-cases. The presence of a disease was measured (if available) for a recall period of 12 months.

The survey questions on hypertension aimed to measure whether the respondent was currently hypertensive, or treated for hypertension. In the original surveys this disease was called '*hypertension*' (Belgium, Germany, Hungary, Italy, Spain, Portugal), '*high/elevated blood pressure*' (Finland, Denmark, Lithuania, Latvia, Netherlands, France), or combinations between the two (Estonia, Czech Republic).

The survey questions on diabetes aimed to measure whether the respondent currently had diabetes. In the questions, no distinction was made between type I and type II diabetes. In the original surveys this disease was called '*diabetes*' (most countries) or '*diabetes mellitus*' (Belgium) or '*high blood sugar (diabetes)*' (Estonia).

The BMI was calculated from the self-reported weight (kilograms) divided by the square of self-reported height (meters). When used to calculate prevalence rates, BMI was divided into three categories: (i) normal weight ($18 \leq BMI < 25$) (ii) moderately overweight ($25 \leq BMI < 30$) and (iii) obese ($BMI \geq 30$).

Statistical analyses

Prevalence rates were age-standardized using the direct method, using the European Standard Population of 1995 as a reference. The risk of being hypertensive, diabetic or obese relative to the highest educational group was estimated by regression with the log link function and assuming binomial distribution. [22] We used the Genmod procedure of SAS version 8.2 (SAS Institute, Cary, North Carolina, USA). Models were always adjusted for 5-year age category and, where applicable, for country. Pooled analyses were weighted to simulate equal sample size for each country. For surveys with relatively small samples, we assigned relatively large weights to individual respondents, and vice versa.

We summarized the association between hypertension and educational level by calculating the Relative Index of Inequality (RII) and its 95% confidence intervals. [23] The RII is a regression-based measure that assesses the association between hypertension prevalence and the relative position of each educational level separately. The relative position is measured as the cumulative proportion of each educational level 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 hypertensive at the very top as compared to the very lowest end of the educational hierarchy. An RII above (below) one indicates a negative (positive) relationship between educational level and hypertension. Because of its focus on relative differences, and because the RII can be applied to each country for which a detailed and hierarchical educational classification is available, the RII could be used to make international comparisons. The RII was also used to summarize inequalities in obesity and diabetes.

The effect of controlling for obesity or diabetes on the magnitude of educational inequalities in hypertension was expressed as the percentage reduction of the RII before and after control. We used the following formula: Delta % = $(RII_{[before\ control]} - RII_{[after\ control]}) / (1 - RII_{[before\ control]}) * 100\%$.

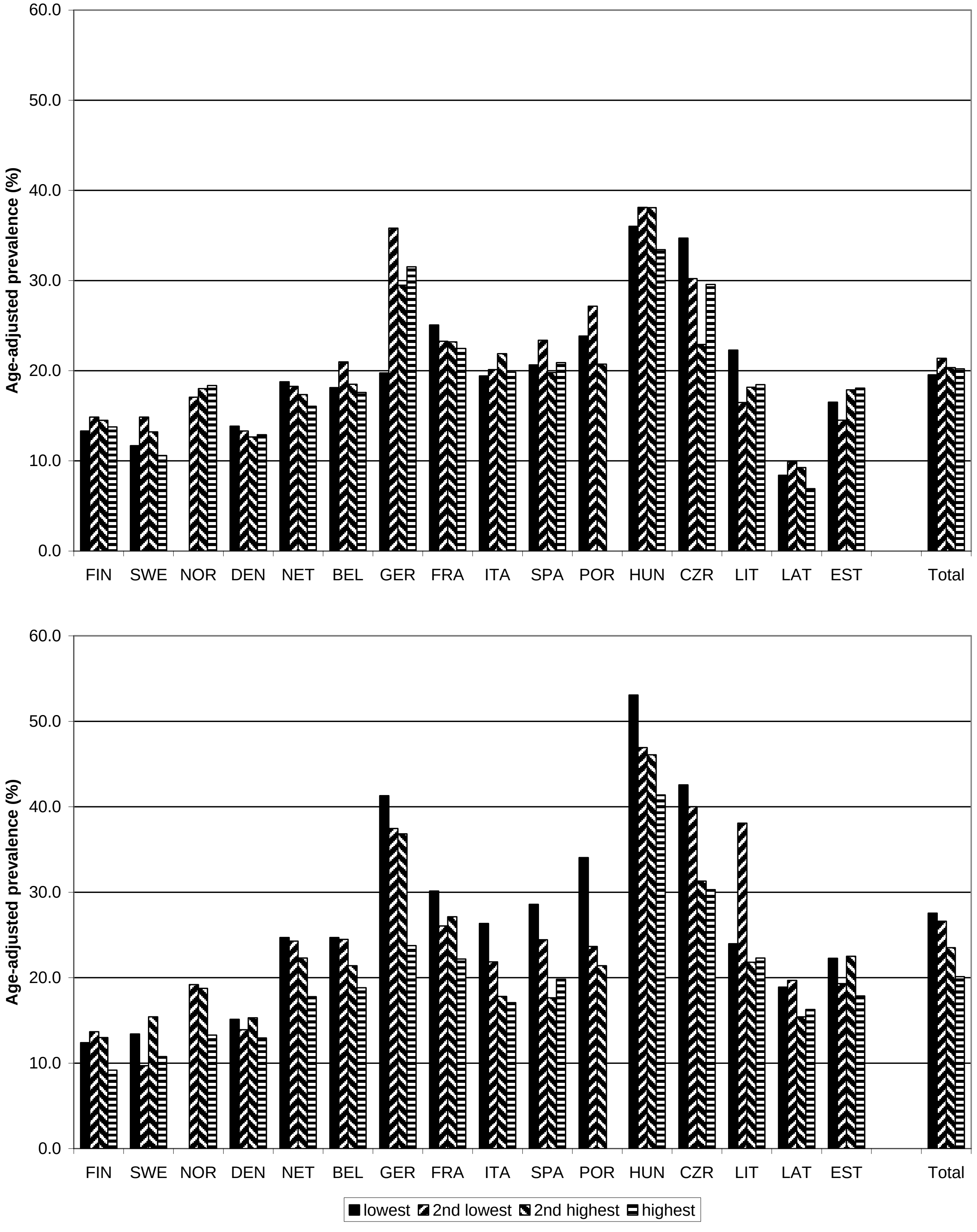
RESULTS

Figure 1 presents the age-adjusted prevalence of hypertension, stratified by educational level and sex. Among *men*, no clear educational gradients in the prevalence of hypertension emerged, with the exception of the Netherlands, where an inverse gradient was observed. In many countries, a curvilinear relationship emerged, with hypertension being relatively common in the second-lowest and the second-highest educational classes (Finland, Sweden, Belgium, Italy, Hungary, Latvia). In about two thirds of the countries, hypertension was more common in the lowest than in the highest educational category.

Among *women*, inverse gradients between educational level and hypertension prevalence were visible in almost all countries. In most countries, the relationship was graded: hypertension prevalence increased with decreasing level of education in a stepwise fashion. The educational differences in hypertension were largest in southern Europe (France, Spain, Portugal, Italy) and in Germany, Hungary and the Czech Republic.

Table 3 presents inequalities in hypertension (RII) among men. Among *men*, generally no consistent inequality patterns emerged. The RII of hypertension was below one in Estonia, Lithuania, Finland, Latvia, Hungary, Spain, Italy (only significantly in Italy), which indicates that hypertension is generally associated with a higher educational level. Among Swedish, Dutch, German and Czech men, the inverse relationship between educational level and hypertension prevalence reached borderline significance.

Figure 1. Age-adjusted hypertension by educational level, for men (*above*) and women (*below*)



Note. In Norway, the 'lowest' category is omitted; In Portugal, the 'highest' category is omitted.

Adjusting for BMI, diabetes, or their interaction, did not exert any clear effect on the educational inequalities in hypertension among men. When only (near-)significant RIIs were taken into consideration, BMI explained 53 % of the educational differences in hypertension in men. This includes Baltic men, who showed positive relationships between educational level and hypertension prevalence. BMI did not explain the positive gradient in hypertension prevalence in Italian men.

Table 3. Inequalities in hypertension (RII) before and after control for BMI or diabetes (Men)

Country	Hypertension		BMI-controlled [*]		Diabetes-controlled[*]		BMI*diabetes-contr. [†]	
	RII	CI 95 %	RII	CI 95 %	RII	CI 95 %	RII	CI 95 %
Finland	0.95	(0.79- 1.15)	0.88	(0.74- 1.06)	0.94	(0.79- 1.12)	0.90	(0.76- 1.07)
Sweden	1.32	(0.97- 1.81)	1.20	(0.88- 1.65)	1.32	(1.05- 1.67)	1.20	(0.87- 1.64)
Norway	1.02	(0.71- 1.47)	0.97	(0.67- 1.41)	1.00	(0.81- 1.23)	0.99	(0.69- 1.44)
Denmark	1.07	(0.80- 1.43)	0.92	(0.68- 1.23)	1.00	(0.77- 1.30)	0.88	(0.66- 1.17)
Netherlands	1.28	(1.00- 1.63)	1.00	(0.79- 1.27)	1.22	(0.98- 1.51)	0.98	(0.78- 1.24)
Belgium	1.01	(0.82- 1.24)	0.91	(0.74- 1.12)	0.96	(0.79- 1.17)	0.87	(0.71- 1.07)
Germany	1.25	(0.99- 1.58)	1.11	(0.89- 1.40)	1.23	(1.07- 1.42)	1.12	(0.89- 1.41)
France	1.10	(0.93- 1.30)	1.02	(0.87- 1.20)	1.07	(0.94- 1.22)	1.00	(0.86- 1.18)
Italy	0.87	(0.80- 0.95)	0.81	(0.74- 0.88)	0.86	(0.70- 1.05)	0.81	(0.74- 0.88)
Spain	0.97	(0.78- 1.22)	0.90	(0.72- 1.14)	0.97	(0.78- 1.21)	0.90	(0.72- 1.13)
Portugal	1.15	(0.89- 1.48)	1.08	(0.84- 1.39)	1.10	(0.83- 1.44)	1.04	(0.86- 1.25)
Hungary	0.98	(0.76- 1.26)	0.99	(0.77- 1.27)	0.96	(0.80- 1.15)	0.95	(0.75- 1.21)
Czech Rep.	1.55	(0.98- 2.45)	1.52	(0.95- 2.43)	1.47	(1.26- 1.72)	1.47	(0.92- 2.35)
Lithuania	0.90	(0.70- 1.15)	0.95	(0.76- 1.19)	0.90	(0.76- 1.07)	0.94	(0.75- 1.17)
Latvia	0.97	(0.60- 1.58)	0.99	(0.62- 1.59)	0.96	(0.96- 0.96)	0.99	(0.61- 1.59)
Estonia	0.79	(0.52- 1.18)	0.83	(0.57- 1.22)	0.83	(0.71- 0.97)	0.87	(0.60- 1.27)
Total	*1.07*	*(1.02- 1.13)*	*1.00*	*(0.96- 1.05)*	*1.05*	*(1.00- 1.10)*	*0.99*	*(0.95- 1.04)*

Note. RII = Relative Index of Inequality, with CI 95 % = 95% confidence interval; [*] Controlled for BMI category (four levels); [†] Interaction term between BMI category (four levels) and diabetes

Table 4 presents inequalities in hypertension (RII) among women. Among *women*, the educational inequalities in hypertension were largest in Italy, Spain, and Portugal (1.87 ≤ RII ≤ 2.53) and were smallest in Lithuania, Estonia, Denmark, Finland, and Sweden (1.05 ≤ RII ≤ 1.20). This indicates that hypertension was more common among low-educated women, especially among those of southern Europe.

Among women, adjustment for BMI led to a stronger reduction in educational inequalities in hypertension than adjustment for diabetes. In absolute terms, BMI explained most of the inequalities in hypertension in the southern European countries and Belgium, and least in Sweden, Denmark, Lithuania, Latvia and Hungary. In Europe at large, BMI explained 57 % of the educational differences in hypertension in women. Diabetes explained little of the inequalities in hypertension. Exceptions were exception of Latvia, Estonia, and Portugal, where diabetes explained about as much (or more) of the inequalities in hypertension as BMI did. In Europe at large, controlling for diabetes and the interaction between BMI and diabetes added little to the explanation of inequalities in hypertension prevalence in women.

Figure 2 depicts the relationship between educational inequalities in hypertension versus inequalities in obesity. Among men, no clear relationship between inequalities in hypertension and in obesity emerged (R^2 = 0.07), except that Lithuania, Latvia and Hungary showed small inequalities in both hypertension and obesity. Among other countries, variations in inequalities in obesity were not mirrored by similar variations in inequalities in hypertension.

Table 4. Inequalities in hypertension (RII) before and after control for BMI or diabetes (Women)

Country	Hypertension		BMI-controlled *		Diabetes-controlled*		BMI*diabetes-contr. †	
	RII	CI 95 %	RII	CI 95 %	RII	CI 95 %	RII	CI 95 %
Finland	1.20	(0.97- 1.48)	1.03	(0.84- 1.27)	1.17	(0.97- 1.43)	1.05	(0.86- 1.28)
Sweden	1.20	(0.90- 1.59)	1.09	(0.83- 1.44)	1.17	(0.94- 1.45)	1.08	(0.82- 1.43)
Norway	1.53	(1.07- 2.19)	1.36	(0.94- 1.95)	1.50	(1.22- 1.84)	1.35	(0.94- 1.94)
Denmark	1.18	(0.91- 1.51)	1.10	(0.86- 1.42)	1.13	(0.90- 1.42)	1.06	(0.82- 1.36)
Netherlands	1.36	(1.10- 1.68)	1.23	(1.01- 1.51)	1.33	(1.10- 1.60)	1.19	(0.98- 1.45)
Belgium	1.37	(1.15- 1.65)	1.08	(0.90- 1.30)	1.30	(1.09- 1.55)	1.04	(0.87- 1.25)
Germany	1.28	(0.99- 1.65)	1.05	(0.82- 1.33)	1.25	(1.07- 1.46)	1.01	(0.79- 1.30)
France	1.50	(1.25- 1.80)	1.23	(1.03- 1.46)	1.43	(1.23- 1.65)	1.21	(1.02- 1.44)
Italy	1.87	(1.70- 2.05)	1.59	(1.45- 1.74)	1.77	(1.41- 2.21)	1.52	(1.38- 1.66)
Spain	1.89	(1.49- 2.40)	1.57	(1.21- 2.04)	1.81	(1.43- 2.29)	1.52	(1.17- 1.97)
Portugal	2.53	(1.93- 3.32)	1.99	(1.52- 2.61)	2.03	(1.53- 2.69)	1.68	(1.39- 2.04)
Hungary	1.37	(1.13- 1.66)	1.29	(1.06- 1.56)	1.34	(1.17- 1.54)	1.27	(1.06- 1.54)
Czech Rep.	1.31	(0.96- 1.79)	1.08	(0.79- 1.46)	1.23	(1.11- 1.37)	1.00	(0.74- 1.34)
Lithuania	1.05	(0.88- 1.27)	0.97	(0.81- 1.16)	1.03	(0.91- 1.18)	0.97	(0.82- 1.16)
Latvia	1.28	(0.98- 1.67)	1.23	(0.95- 1.61)	1.16	(1.01- 1.34)	1.14	(0.90- 1.44)
Estonia	1.14	(0.88- 1.48)	0.94	(0.73- 1.20)	0.95	(0.86- 1.06)	0.93	(0.82- 1.05)
Total	*1.29*	*(1.24- 1.35)*	*1.12*	*(1.08- 1.17)*	*1.26*	*(1.21- 1.31)*	*1.11*	*(1.06- 1.15)*

Note. See notes of previous table.

Among women, inequalities in obesity were not of similar size as inequalities in hypertension, with the exception of Lithuania, Latvia, Hungary and Norway. However, even though the inequalities in obesity were much larger than those in hypertension, a clear relationship existed between international variations in the inequalities of these conditions (R^2 = 0.77; without Portugal: R^2 = 0.45). This relationship was visible predominantly in the Mediterranean countries.

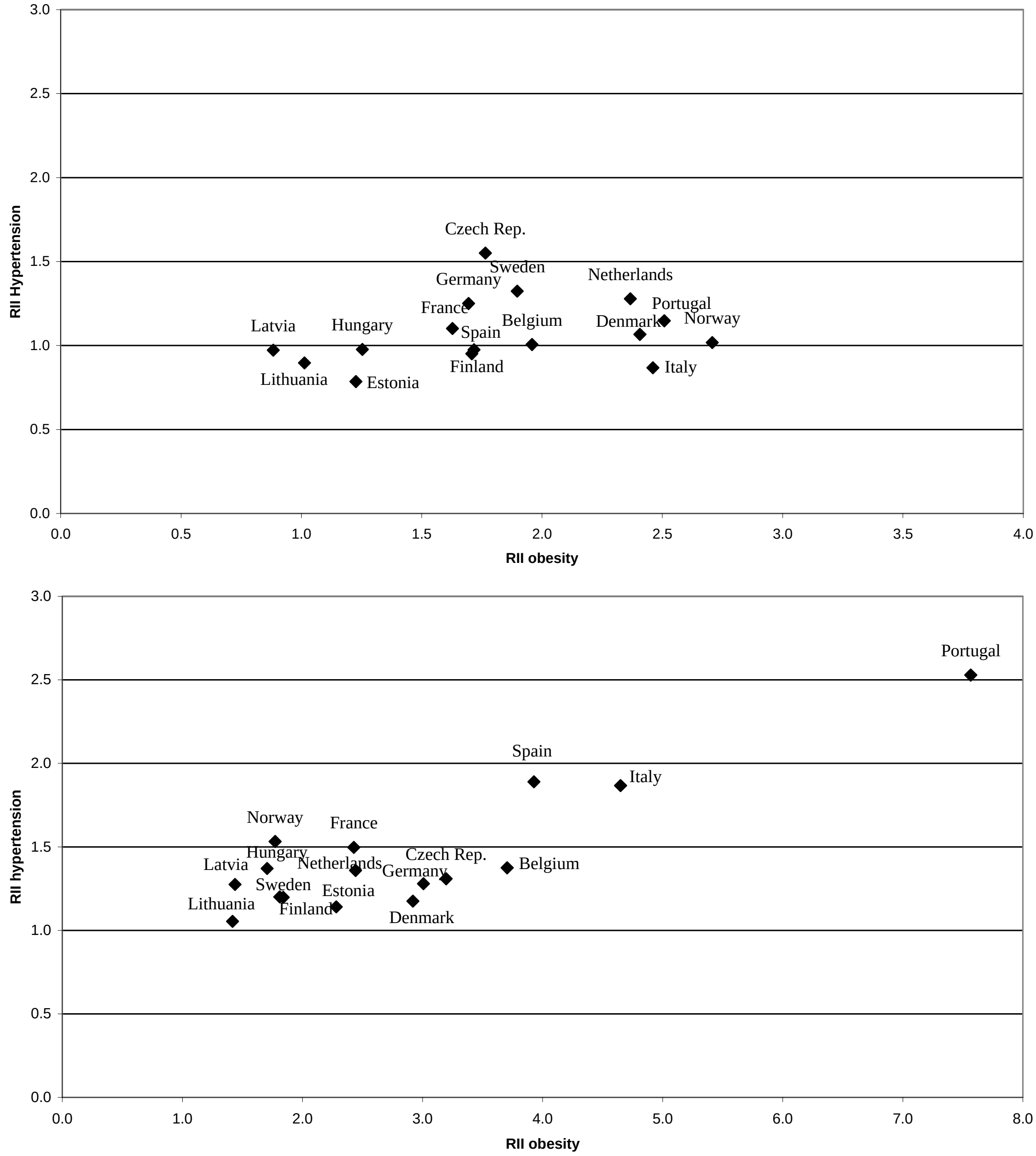
In addition, we conducted analyses in which we assessed the contribution of alcohol consumption to educational inequalities in the prevalence of hypertension (data not shown). The average daily self-reported alcohol consumption was measured as a variable with eight categories, with the values *‘None’*, *'Less than 1 glass/day'*, *'Between 1 and 2 glasses/day'*, … , *'6+ glasses/day*'. In none of the countries where this variable was available, we found consistent evidence for a clear contribution of alcohol consumption to the magnitude of the educational inequalities in the prevalence of hypertension.

DISCUSSION

Summary of the results

Across Europe, inverse educational gradients in hypertension (i.e. higher education, less hypertension) are common in women but not in men. Among women, a clear north-south gradient was present: inequalities in hypertension were largest in southern Europe and smallest in Baltic and Nordic countries. In men, generally no consistent inequality patterns emerged. Among women, obesity explains much of the inequalities in hypertension. Within most countries, control for BMI in multivariate analyses explained about one half of the inequalities in hypertension among women. In cross-national comparisons, the countries with the largest inequalities in hypertension were found to have the largest inequalities in female obesity as well.

Figure 2. The relationship between educational inequalities (RII) in hypertension (y-axis) and obesity (x-axis) across Europe for men (*above*) and women (*below*)



Note. The scale of the x-axis differs between the two graphs.

Evaluation of data and methods

Some limitations of the data used for the present paper must be acknowledged. Underreporting of hypertension is a problem. If respondents have been previously diagnosed with hypertension, they usually also report this as such. [24] An NHANES study indicated a sensitivity of 71 %, although the specificity was 90 %. [25] Educational level may be inversely related to underreporting in hypertension (lower educational level, more underreporting). [26] Furthermore, it has been found that the sensitivity of hypertension was almost twice as low in high-educated people. [27] However, other findings indicated that SEP was unrelated to the level of agreement between self-reports and medical records in hypertension. [24] In addition, large differences in the measurement of hypertension are likely to exist also between countries and surveys. Such differences may bias cross-national differences in the overall prevalence of hypertension. However, this bias could not strongly affect our analyses, as these focused on relative inequalities within countries.

Misreporting is also relevant for diabetes and BMI. For instance, about 35 % of all cases of diabetes are not diagnosed. [28] In diabetes, the level of agreement the level of agreement between self-reports and medical records may be greater in people of higher SEP [24] but this is not a consistent finding. [29] Other studies found that educational inequalities in underreporting of diabetes were small [30] or absent. [31]

Similarly, people with a high true BMI have a tendency to underreport their weight, while most people over-report their height, [32] leading to underestimations of BMI. Some studies found that people with a lower education overestimated their height more than their higher educated counterparts, leading to underestimations of inequalities in BMI. [33,34] In absolute terms, however, the bias may be modest. [35]

In short, the literature indicates that low-educated people may be more likely to underreport hypertension. This implies that the ‘true’ level of inequalities may be greater than found in this study. Second, self-report-based data of hypertension, BMI and diabetes contain many false-negatives but few false-positives. Thus, assuming that under-reporting of BMI and diabetes is more common in groups of lower SEP, we may have underestimated the relative contribution of these factors to inequalities in the prevalence of hypertension.

Comparison to previous studies

Other studies also found inverse relationships between educational level and hypertension prevalence among women but less so among men. [1,2,4] BMI generally accounted for 18 to 28 % of the (inverse) educational gradient in hypertension, [17,18] which was substantially lower than our findings, which indicated a proportion of around 50 %. In consistence with previous findings, [1,4] we found that the predictive value of BMI for inequalities in the prevalence of hypertension was generally larger among women. We identified no studies that investigated the contribution of educational inequalities in diabetes prevalence to hypertension prevalence. Our findings indicated that diabetes marginally contributes to inequalities in the prevalence of hypertension.

Our results indicate a clear north-south gradient among women. Inequalities in obesity were larger in southern European women. [19] This finding appears to conflict with other studies, which could not identify geographical patterns in educational inequalities in hypertension. [5] However, these conflicting results may be explained by the fact that men and women were not analyzed separately, which probably masks the important gender differences in the magnitude of inequalities in the prevalence of hypertension or related variables. [31,36]

Findings of studies on cardiovascular diseases appear to be partly in agreement with our results. Educational differences in stroke mortality were of similar magnitude in most European populations [6] and differences in mortality from ischemic heart disease (IHD) were larger in northern Europe. [6]Adjustment for blood pressure attenuated the effect of education on stroke mortality to a relatively larger extent in southern than in northern Europe. [6] Possibly, the high availability of fruits and vegetables [37] and the greater adherence to the (cardioprotective) Mediterranean diet among people of lower SEP [38] explains the small inequalities in IHD mortality in southern European countries, whereas the larger inequalities in the prevalence of hypertension may have prevented similarly small inequalities in stroke mortality.

Explanation and interpretation of results

SEP differences in nutrition and nutrition-related factors have been suggested to explain about half of the educational inequalities in hypertension. Low-educated people are characterized by a higher intake of sodium, a lower intake of potassium, a larger BMI and a higher alcohol consumption. [4] There is also evidence that psychosocial factors play a role in the pathogenesis for hypertension. [39] For instance, occupational (e.g., job strain) family (e.g., marital cohesion) and cultural factors (e.g., cultural differences in the role of women) have all been mentioned in this respect. [3] In addition, our results suggested that obesity is another important factor. [40]

Firstly, the inequalities in the prevalence of hypertension were larger and more pronounced among women than among men in most European countries. This is consistent with findings of BMI, which also shows larger inequalities in female obesity [7 19] and suggests that SEP impacts differentially on body weight for men and women. SEP differences in dieting behavior have been suggested as an explanation for the relatively large inequalities in the prevalence of overweight among women, and it is conceivable that this explanation also applies to hypertension. [7] A thinner body may be socially valued and materially viable to a greater extent for women of higher SEP, and these factors could help maintain SEP differences for women, for whom thinness continues to be promoted as an ideal of physical beauty. [7] All these factors should probably be viewed in relationship to broader, social and cultural factors.

Secondly, the inequalities in hypertension were clearly largest among Mediterranean women. BMI explained about 50 % of those inequalities. There are two possible reasons for the large inequalities in the prevalence of hypertension and obesity. [19] Both reasons should be viewed in light of the fact that the Mediterranean societies may be more ‘traditional’ [41] in terms of gender roles and related social policies. Firstly, Mediterranean women, especially those of lower SEP, may be more likely to assume traditional role patterns [42] and become full-time homemakers, who show higher levels of obesity. [43] Secondly, low-educated women who do succeed to combine work and family, may do so at high costs as family demands may have a greater impact on health in working women of lower SEP. [41] For example, other studies observed that hypertension and physical inactivity were 1.3 times (workers) and 1.7 times (housewives) more common in women of lower SEP. [41]

Not all variations by gender or between countries could be explained by BMI. For example, in Italy, after control for BMI, inequalities in hypertension prevalence were still large among women (RII = 1.52), while ‘reverse’ inequalities were observed among men (RII = 0.81). Gender contrasts have also been observed in other Italian studies. For example, one study found an inverse relationship between alcohol consumption and educational level among Italian men, which offers a possible explanations for the inverse patterns that we observed. Furthermore, a *positive* relationship was observed between alcohol consumption and educational level in women, which seems at odds with our findings. [44] Further research is needed to investigate which other factors may explain the Italian inequality patterns in the prevalence of hypertension.

Portugal was another “outlier” country. The largest inequalities in hypertension prevalence, also after control for BMI, were observed among Portuguese women (RII = 1.68). Portugal in general has a high salt intake diet, with salt intake reaching almost twice the recommended level. [45] Salt intake is strongly influenced by socioeconomic level and may partially explain the higher prevalence of hypertension in lower socioeconomic classes.[46] Therefore, high rates of salt intake among lower socioeconomic groups may have contributed to the pattern we observed, although this could not explain the fact that BMI-controlled inequalities were much smaller among men (RII = 1.04). Further research may investigate the role of broader factors, such as the exceptionally low levels of education of Portuguese women, and the large proportion of Portuguese men working in agriculture.

Implications; conclusion

In most European countries, obesity has a strong effect on inequalities in the prevalence of hypertension. The geographical inequality patterns in hypertension, obesity and diabetes more or less correspond. These inequalities might be reduced by making low-educated women a prime target of obesity prevention in Europe.

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Chapter 9

Social inequalities in the prevalence of self-assessed ill health *

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* A.E. Kunst, A.J.R. Roskam for the Eurothine consortium (2009). Overweight, smoking and educational differences in self assessed health in 13 European countries (final version).

ABSTRACT

Background. International overviews demonstrated large cross-national variations in the magnitude of inequalities in overweight and in smoking. The aim of this paper is to assess the extent to which countries differed also with regards to the contribution that smoking and especially overweight made to inequalities in general health.
Data and methods. Micro-level data were obtained from national health interview surveys of 13 countries from different parts of Europe. In each survey, data were available on respondents' educational level, self assessed health (SAH), body mass index (BMI) and smoking. The magnitude of educational inequalities in SAH, overweight and smoking was assessed by means of Relative Index of Inequalities. Multivariate regression analyses were applied to assess the extent to which the RII for SAH changed after controlling for BMI and smoking, respectively.
Results. In general, large inequalities in overweight prevalence translated into large contributions of overweight to inequalities in SAH. The contribution of overweight to educational inequalities in general health strongly differed between countries, being close to nil in some countries (especially in eastern Europe) to about 20 percent in France and Spain. As compared to overweight, smoking made larger contributions to educational differences in general health among men, but smaller contributions in the case of women. For men, the contribution of overweight to inequalities in SAH was larger in (mostly northern) countries where the contribution of smoking was large as well. For women, the association was less consistent, with France and Spain as main outliers.
Conclusions. The estimates presented in this paper support the view that overweight is an important factor for socioeconomic inequalities in health in many European countries, especially among women. The observed variability warns that estimates from individual countries cannot be readily generalized to other countries. However, there is much potential for mutual learning, and for the identification of contextual determinants.

INTRODUCTION

Studies from several European countries documented large inequalities in overweight (including moderate overweight and obesity) according to indicators of socioeconomic status such as educational level, occupational class and household income.[1 2] Many studies observed large inequalities in the prevalence of obesity, compared to smaller or even no inequalities for moderate overweight. [3] Whereas inequalities in overweight among women are a generalized phenomenon, inequalities among men have been observed mainly in populations at higher levels of socioeconomic development. [4 5]

A main question is to what extent socioeconomic inequalities in the prevalence of overweight contributed to the widely documented inequalities in disease, disability and death. If overweight were to be an important contributor to health inequalities, also as compared to other factors such as smoking, this would imply that policies aimed to reduce health inequalities should also address inequalities in overweight. A key challenge for overweight prevention measures would then be to improve their reach and effectiveness among lower socioeconomic groups.

Overweight has been found to contribute to an important extent to socioeconomic inequalities in the occurrence of specific diseases and conditions. For example, it has been estimated that about one third or one half of educational inequalities in the prevalence of diabetes mellitus can be attributed to the higher prevalence of overweight in lower socioeconomic groups. [6 7] Similarly, overweight has been found to the be most important single factor contributing to inequalities in hypertension prevalence.[8-10] Finally, a European study observed that inequalities in the incidence of heart disease could for about 10 percent be attributed to inequalities in the prevalence of overweight. [11]

Disease-specific studies do not tell how much overweight contributes to socioeconomic inequalities in general health outcomes such as length of life and health-related quality of life. With regards to inequalities in length of life, as measured by mortality, the contribution of overweight has been found to be modest. For example, the Dutch GLOBE study estimated that overweight contributed to less than 10 percent of educational inequalities in mortality among middle-aged men and women.[12] As recent studies recognized overweight to be disabling rather than a killing, the full impact of overweight on health inequalities might better be assessed using measures of health-related quality of life, such as disability measures or general health. For example, in another study based on the GLOBE data, overweight was found to contribute about 20 percent to educational inequalities in the prevalence of “poor” general health. [13 14]

It is highly uncertain to what extent the estimates from these single-country studies can be generalized towards other countries. The magnitude of socioeconomic inequalities in overweight does not only change over time, [15] but also varies between populations. [1]Within Europe, small or even no socioeconomic inequalities in overweight have been observed among men in eastern European countries, whereas exceptionally large inequalities were observed among women in the south. [2] However, to our knowledge, no study assessed to what extent European populations also differ with regards to the contribution that overweight makes to socioeconomic inequalities in general health.

The case of smoking and mortality illustrates the large variability that might be observed.[1 16] A European study used lung cancer mortality data to estimate that educational inequalities in life-time exposure to smoking contributed to about 30 percent of the educational inequalities in mortality among men in northern European countries. Similar contributions were estimated for men in southern European populations, with the exception of much smaller contribution for men in the Madrid region. For women, a sharp north-south gradient was observed, with contributions of about 20 percent in the north compared to cero or even inverse contributions of smoking to inequalities in mortality among women in the south.

This paper aims to present similar estimates for overweight in relationship to general health. Its main objective is to provide a first European overview of the contribution of overweight to socioeconomic inequalities in general health. The analysis covers 13 countries from different parts of Europe, including central eastern Europe. For each country, data were available from national interview surveys with nearly identical questions on respondents' educational level, general self assessed health (SAH), body mass index, and smoking. Data on smoking will be used to also estimate the contribution of smoking to educational inequalities in SAH in various countries.

The analysis consists of three steps. First, we will describe educational inequalities in smoking status and amount of cigarette smoking, and assess the contribution of smoking to educational inequalities in SAH. Second, we will describe inequalities in obesity and moderate overweight, and assess their additional contribution to inequalities in SAH. Finally, we will make comparisons across men and women in the 13 countries in order to assess whether large contributions of smoking tend to concur with large additional contributions of overweight.

DATA AND METHODS

We used micro-level data from national health interview surveys of 13 of the 19 countries included in the Eurothine project. A more elaborate description of this project can be found in Mackenbach et al, 2008. [1] These data were provided by national statistical offices. Finland, Estonia, Latvia and Lithuania were excluded because of differences in the survey question on self assessed health and the exclusion of persons older than 65 years from the Finbalt Health Monitor survey. Norway was excluded because of incomplete data on smoking status, while Portugal was excluded because of highly uneven educational distributions among women.

Table 1. Overview of surveys used in the study

Country	**Year(s)**	**Name of survey**	**Non-response rate (%)**	**Number of respondents**	
				Men	Women
Sweden	2000/2001	Swedish Survey of Living Conditions	23.9	5,702	5,786
Denmark	2000	Danish Health and Morbidity Survey	25.8	4,720	5,803
England	2001	Health Survey for England (HSE)	33.0	3,803	3,940
Ireland	1995/2002	Living in Ireland Panel Survey	18.0	4,706	4,863
Netherlands	2003/2004	General social survey (POLS)	41.7	5,376	5,609
Belgium	1997/2001	Health Interview Survey	41.5	6,146	6,223
Germany	1998	German National Health Examination and Interview Survey	38.6	2,627	2,766
France	2004	French Health, Health Care and Insurance Survey (ESPS)	30.0 *	5,831	6,050
Italy	1999/2000	Multipurpose Family Survey	13.4	54,437	56,096
Spain	2001	National Health Survey	15.0	6,568	6,675
Hungary	2000/2003	National Health Interview Survey Hungary	21.0	3,322	3,896
Czech Rep.	2002	Health Interview Survey	29.3	549	643
Slovak Rep.	2002	Health Monitor Survey	49.1	762	842

Note. * % non-response at level of households

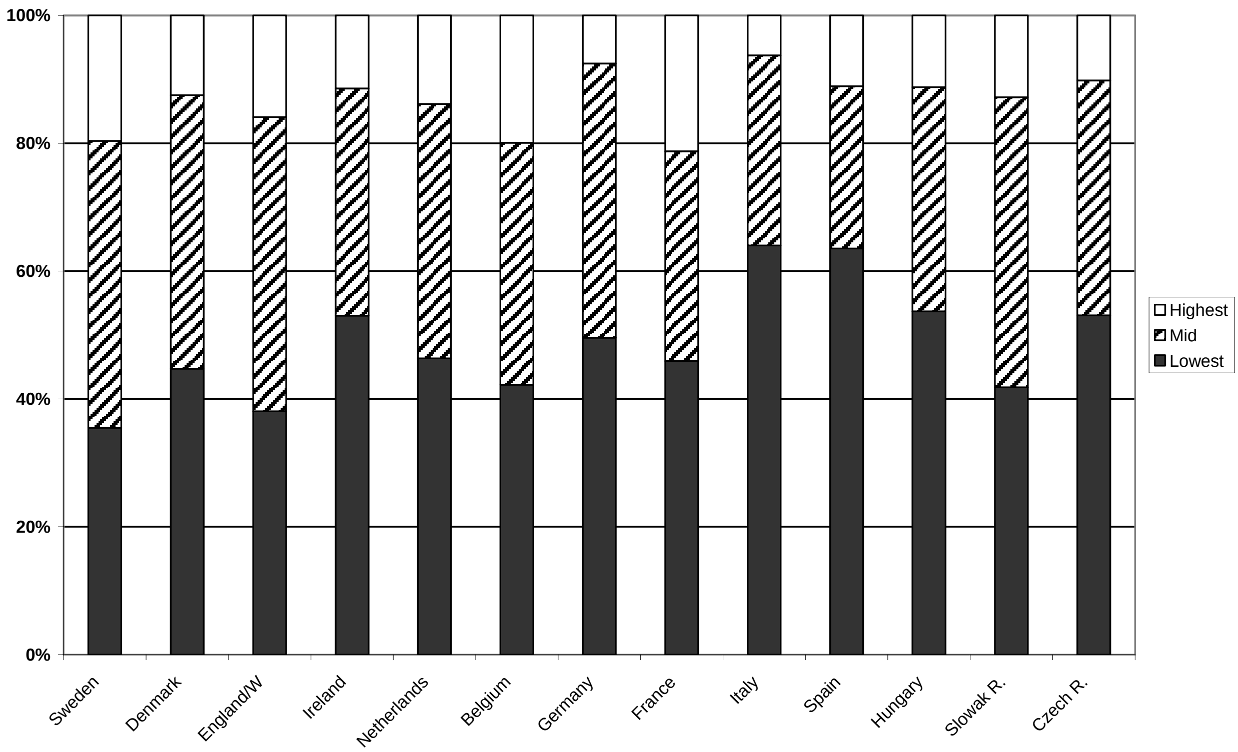
Table 1 shows study characteristics, non-response rates and number of respondents. Most surveys were conducted in or after the year 2000. Non-response rates were relatively low in Italy and Spain (about 15%) and high in the Slovak Republic (49%); rates in most other countries were between 20 and 35 %. The total number of respondents per sex was between 2,000 and 10,000 in most countries, with much larger numbers for Italy, and smaller numbers for the Czech and Slovak Republics.

Body mass index (BMI) was calculated from self-reported weight (in kilograms) divided by the square of self-reported height (in meters). For some analyses, BMI was divided into three categories of overweight status: (i) normal weight ($18 \leq BMI < 25$), (ii) moderately overweight ($25 \leq BMI < 30$) and (iii) obese ($BMI \geq 30$). Percentages of missing values for BMI were generally below 5 percent, but 10.8 percent in Spain.

Smoking status was self-reported and classified in our data files as 'current daily smoker', 'occasional smoker', 'former smoker' or 'never smoker'. In further analyses, 'occasional smokers' were combined with 'never smokers' instead of 'current daily smokers' because occasional smokers differ from current daily smokers in terms of socio-economic status and health consequences related to smoking.[17] Smoking was generally missing for less than 2 percent of the total sample, but for 6.2 percent in Belgium and for 19.9 percent in Slovak Republic.

For current smokers, additional information was obtained on the amount of cigarettes smoked. For most countries, this information was obtained through questions on the number of cigarettes smoked daily. In a few national surveys, smokers were asked whether or not they smoked more than 20 cigarettes per day.

Figure 1. Distribution of number of male and female respondents according to educational level



Educational level was chosen as a socioeconomic indicators because it was available in a comparable way for all selected countries. Educational level was measured as the highest level of education completed by the respondent. This level was initially classified according to national categories, which were subsequently reclassified into three levels of education ("lowest" is no, only primary or lower secondary, "mid" is upper secondary and post non-tertiary, "highest" is tertiary). These levels approximately corresponding with the following levels of the International Standard Classification of Education (ISCED)[18]: 0+1+2, 3+4, and 5+6. Figure 1 shows the distribution of the survey populations by educational level.

Measurement of self assessed health (SAH)

SAH was measured by a question such as “How would you describe your current state of health: very good, good, fair, poor or very poor?”. The answer categories “*very good”, “good”, “poor”* and “*very poor*” were applied to all selected surveys. For the middle category, the words “fair” or “average” were used. Because very few respondents report “very poor” health, this SAH state was combined with the “poor” state in all analyses. Percentages of missing values for self assessed health were generally below 3 percent, but 7.5 percent in Belgium and 15.8 percent in the Netherlands.

The SAH measure is usually analysed by using a dichotomy between for example “(very) good” and “less than good” health. In this paper, however, we applied a new method which takes into account all four SAH states separately, thus making full use of the available information. The new SAH measure was constructed by quantifying the four SAH states. For this, we measured the “relative burden of disease” that was associated with each SAH state. This approach is based on the finding that respondents’ answers to the question on SAH are mainly determined by the presence of diseases, especially diseases that are disabling.

Elsewhere we observed that the number of diseases reported by respondents increased exponentially when moving from the “very good” to “(very) poor” SAH states. In addition, in most surveys, the exponentiation coefficient was within a narrow range from 1.80 and 1.90, the average being 1.85. For all countries together, the exponentiation coefficient hardly varied by gender or by educational level (variations less than 0.05 units). This suggested that, within each country, relative differences between the four SAH states in terms of “relative burden of disease” were similar for each sex and each educational level.

For the current paper, the relative burden of disease of “very good” health was used as the reference, and set at 1.00. For other SAH states, we assumed an exponentiation coefficient of 1.85. This yielded estimates of the relative burden of disease for “good” of 1.85, for “fair” of 1.85^2 (= 3.42), and for “(very) poor” of 1.85^3 (= 6.33).

Regression analyses

We quantified the magnitude of educational inequalities in health outcomes by using the Relative Index of Inequality (RII) and its 95% confidence interval (CI). The RII can be compared between all countries, provided that a detailed and hierarchical classification of educational level is used in each country. [19 20] RII is a regression-based measure that takes into account all educational groups separately. It assesses the association between health outcomes 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.

When applied to overweight, the resulting measure can be interpreted as the risk of being overweight at the bottom end of the educational hierarchy as compared to that risk at very top of the educational hierarchy. When applied to the new measure of SAH, the resulting RII expresses the “burden of disease” value of the SAH measure at the bottom of the educational hierarchy as a ratio to the “burden of disease” value at the top. An RII above (below) 1.00 indicates a higher (lower) risk or “burden of disease” among those with lower socioeconomic position.

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 version 8.2 (SAS Institute, Cary, North Carolina, USA). [21]

The contribution of smoking and overweight to educational inequalities in SAH was assessed by a series of regression models with SAH as the dependent variable. In the first model, only age and education were included. In the second model, we added categorical variables on smoking status (current, former, never) and amount of smoking (more or less than 20 cigarettes a day). In the third model, we also added BMI as continuous variable. For all models, the association between SAH and educational level was assessed by means of the RII, based on the regression coefficient for education. The change in this RII in the second and third model was used to measure the contribution of overweight and smoking to educational inequalities in SAH.

RESULTS

Table 2 shows the magnitude of educational inequalities in smoking among men and women in the 15 countries. The prevalence of current smoking was strongly related to low educational level in

Table 2. Inequalities in smoking according to educational attainment

Sex; Region	Relative Index of Inequality (95% CI) †								
- Country	current smoker %			former smoker %			smoking > 20 cigarettes %		
Men									
North									
- Finland	2.00	(1.77-	2.26)	1.19	(1.07-	1.32)	2.48	(2.17-	2.83)
- Sweden	2.23	(1.74-	2.86)	1.15	(0.99-	1.32)	*		
- Denmark	1.84	(1.67-	2.03)	1.13	(0.98-	1.29)	1.29	(1.18-	1.40)
West									
- England/W	2.40	(2.07-	2.77)	1.18	(1.04-	1.33)	1.30	(1.04-	1.62)
- Netherlands	2.91	(2.54-	3.32)	1.30	(1.17-	1.44)	1.25	(0.98-	1.60)
- Belgium	2.44	(2.15-	2.77)	0.99	(0.88-	1.12)	0.72	(0.59-	0.88)
South									
- France	2.02	(1.69-	2.42)	1.08	(0.95-	1.24)	2.31	(1.67-	3.20)
- Italy	1.73	(1.63-	1.83)	1.10	(1.04-	1.16)	1.46	(1.39-	1.54)
- Spain	1.90	(1.69-	2.12)	1.15	(0.99-	1.34)	1.23	(1.10-	1.37)
East									
- Czech Rep.	5.40	(3.66-	7.99)	1.83	(1.30-	2.60)	0.66	(0.33-	1.33)
- Slovak Rep.	3.06	(1.89-	4.94)	1.34	(0.85-	2.11)	4.50	(1.85-	10.95)
- Hungary	1.12	(0.95-	1.33)	0.90	(0.69-	1.16)	1.24	(1.07-	1.44)
Women									
North									
- Finland	2.56	(2.18-	3.02)	1.21	(1.00-	1.48)	4.70	(3.43-	6.44)
- Sweden	2.01	(1.61-	2.51)	1.02	(0.81-	1.28)	-	-	-
- Denmark	1.95	(1.75-	2.18)	1.00	(0.83-	1.20)	1.41	(1.25-	1.59)
West									
- England/W	2.63	(2.29-	3.03)	1.12	(0.96-	1.29)	1.54	(1.19-	1.99)
- Netherlands	3.14	(2.69-	3.67)	1.00	(0.88-	1.13)	2.12	(1.61-	2.78)
- Belgium	2.09	(1.77-	2.47)	0.72	(0.61-	0.85)	0.65	(0.53-	0.79)
South									
- France	1.40	(1.14-	1.71)	0.57	(0.48-	0.69)	1.44	(0.95-	2.18)
- Italy	0.88	(0.82-	0.95)	0.46	(0.42-	0.50)	1.26	(1.12-	1.42)
- Spain	1.19	(1.03-	1.37)	0.42	(0.33-	0.52)	1.19	(0.99-	1.43)
East									
- Czech Rep.	3.53	(2.21-	5.63)	1.12	(0.69-	1.83)	2.91	(0.66-	12.83)
- Slovak Rep.	2.73	(1.30-	5.74)	0.69	(0.30-	1.56)	0.91	(0.72-	1.13)
- Hungary	0.97	(0.84-	1.12)	0.47	(0.34-	0.65)	1.83	(1.38-	2.41)

Note. * No data were available on the amount of smoking; † 95 % CI = 95 % Confidence interval

Table 3. Educational differences in self assessed health: the effect of controlling for smoking.

Sex; Region - Country	**Relative Index of Inequality** Control for age only	(95% CI) †	Control for age and smoking status	(% decrease)	Control for age, status and amount of smoking	(% decrease)
Men						
North						
- Finland	1.35	(1.28- 1.43)	1.26	(-25.3)	1.25	(-28.8)
- Sweden	1.35	(1.24- 1.46)	1.28	(-20.3)	*	
- Denmark	1.35	(1.26- 1.45)	1.28	(-18.5)	1.27	(-21.6)
West						
- England/W	1.51	(1.41- 1.62)	1.42	(-17.3)	1.42	(-17.7)
- Netherlands	1.33	(1.25- 1.42)	1.28	(-14.1)	1.27	(-17.6)
- Belgium	1.41	(1.32- 1.50)	1.37	(-10.0)	1.36	(-10.7)
South						
- France	1.28	(1.18- 1.39)	1.26	(-5.2)	1.25	(-7.7)
- Italy	1.27	(1.24- 1.30)	1.27	(-1.1)	1.27	(-1.7)
- Spain	1.28	(1.20- 1.37)	1.28	(-1.4)	1.28	(-1.6)
East						
- Czech Rep.	1.46	(1.23- 1.74)	1.42	(-7.9)	1.42	(-9.0)
- Slovak Rep.	1.49	(1.21- 1.85)	1.39	(-20.2)	1.42	(-15.3)
- Hungary	1.42	(1.32- 1.53)	1.42	(0.7)	1.40	(-5.5)
Women						
North						
- Finland	1.36	(1.28- 1.44)	1.32	(-12.2)	1.31	(-13.7)
- Sweden	1.33	(1.22- 1.44)	1.29	(-13.3)	*	
- Denmark	1.52	(1.42- 1.63)	1.45	(-13.2)	1.44	(-14.6)
West						
- England/W	1.59	(1.48- 1.70)	1.55	(-7.1)	1.54	(-8.8)
- Netherlands	1.32	(1.24- 1.40)	1.30	(-7.4)	1.29	(-9.6)
- Belgium	1.41	(1.32- 1.50)	1.39	(-5.5)	1.38	(-7.8)
South						
- France	1.34	(1.24- 1.45)	1.35	(2.6)	1.35	(1.9)
- Italy	1.25	(1.21- 1.28)	1.26	(2.0)	1.25	(1.9)
- Spain	1.33	(1.24- 1.42)	1.34	(2.5)	1.34	(2.1)
East						
- Czech Rep.	1.63	(1.40- 1.89)	1.63	(-0.2)	1.63	(-0.6)
- Slovak Rep.	1.64	(1.33- 2.02)	1.63	(-1.7)	1.61	(-4.4)
- Hungary	1.52	(1.43- 1.62)	1.52	(0.2)	1.53	(2.0)

Note. * No data were available on the amount of smoking; † 95 % CI = 95 % Confidence Interval

most populations. RII values higher than 2 were observed among men in most countries (except Hungary) and among women in most countries except Hungary and the southern European countries (France, Italy, and Spain).

Educational inequalities in the prevalence of former smoking were much weaker, with RII never exceeding the 1.40 value. Inverse gradients (RII values smaller than 1.00) were observed among women in Hungary and southern countries. Among current smokers, the average number of cigarettes smoked was associated with lower educational level. RII values higher than 1.00 were

Table 4. Inequalities in overweight according to educational attainment

Sex; Region - Country	Relative Index of Inequality (95% CI) †			
	Overweight (BMI ≥ 25)		Obesity (BMI ≥ 30)	
Men				
North				
- Finland	1.09	(1.03- 1.16)	1.51	(1.25- 1.84)
- Sweden	1.07	(0.95- 1.20)	1.41	(0.97- 2.04)
- Denmark	1.28	(1.19- 1.38)	2.21	(1.76- 2.77)
West				
- England/W	1.01	(0.94- 1.08)	1.59	(1.32- 1.91)
- Netherlands	1.48	(1.35- 1.63)	2.90	(2.21- 3.80)
- Belgium	1.22	(1.12- 1.33)	1.89	(1.49- 2.41)
South				
- France	1.31	(1.15- 1.49)	3.07	(2.14- 4.41)
- Italy	1.54	(1.48- 1.61)	2.99	(2.63- 3.40)
- Spain	1.23	(1.13- 1.33)	2.30	(1.72- 3.07)
East				
- Czech Rep.	0.89	(0.75- 1.05)	1.73	(0.92- 3.24)
- Slovak Rep.	0.84	(0.67- 1.05)	1.08	(0.53- 2.21)
- Hungary	0.92	(0.83- 1.01)	1.30	(1.01- 1.68)
Women				
North				
- Finland	1.41	(1.20- 1.65)	2.41	(1.66- 3.50)
- Sweden	1.53	(1.37- 1.71)	2.46	(1.92- 3.17)
- Denmark	1.36	(1.26- 1.47)	1.81	(1.54- 2.13)
West				
- England/W	0.84	(0.67- 1.06)	1.45	(0.88- 2.40)
- Netherlands	1.66	(1.48- 1.85)	2.45	(1.87- 3.21)
- Belgium	2.23	(1.98- 2.51)	4.32	(3.35- 5.58)
South				
- France	2.74	(2.29- 3.28)	4.67	(3.31- 6.60)
- Italy	3.74	(3.48- 4.03)	7.70	(6.48- 9.15)
- Spain	2.93	(2.47- 3.48)	7.07	(4.65- 10.74)
East				
- Czech Rep.	1.34	(1.09- 1.66)	4.03	(2.27- 7.16)
- Slovak Rep.	1.44	(1.16- 1.79)	2.52	(1.54- 4.11)
- Hungary	1.36	(1.22- 1.51)	2.10	(1.66- 2.65)

Note.† 95 % CI = 95 % Confidence interval; BMI = Body Mass Index (kg/m^2)

observed for men and women in most countries. Belgium is the only country for which an inverse association can be demonstrated with statistical significance, both for men and women.

Table 3 shows the extent to which inequalities in smoking can statistically explain inequalities in SAH in different countries. When control is made for age only, SAH was found to be consistently related to low educational level in each country. For example, for men in Sweden, the RII of 1.35 can be interpreted as a 35 percent higher burden of disease among men at the bottom end of the educational hierarchy compared to those at the top. A similar magnitude of inequalities in health was observed among men in most other countries, but larger inequalities (with RII exceeding the 1.45 value) was observed for Ireland, England, Czech Republic and Slovak Republic. Also for women, about equally large inequalities were observed in many countries, while larger inequalities (with RII larger than about 1.45) were observed for the same countries as for men, but also for Denmark and Hungary.

Table 5. Educational differences in self assessed health: the additional effect of controlling for overweight.

Sex; Region - Country	**Relative Index of Inequality** Control for age and smoking	(95% CI) *		Plus control for overweight	(% decrease)
Men					
North					
- Finland	1.25	(1.17-	1.33)	1.23	(-8.0)
- Sweden	1.28	(1.24-	1.46)	1.26	(-7.1)
- Denmark	1.27	(1.18-	1.37)	1.24	(-11.8)
West					
- England/W	1.42	(1.32-	1.52)	1.37	(-11.1)
- Netherlands	1.27	(1.19-	1.36)	1.24	(-12.7)
- Belgium	1.36	(1.27-	1.46)	1.34	(-5.5)
South					
- France	1.25	(1.16-	1.36)	1.24	(-5.7)
- Italy	1.27	(1.24-	1.30)	1.26	(-2.6)
- Spain	1.28	(1.20-	1.37)	1.28	(-1.6)
East					
- Czech Rep.	1.42	(1.18-	1.69)	1.42	(1.0)
- Slovak Rep.	1.42	(1.11-	1.81)	1.40	(-5.2)
- Hungary	1.40	(1.29-	1.52)	1.39	(-2.2)
Women					
North					
- Finland	1.31	(1.23-	1.39)	1.26	(-15.0)
- Sweden	1.29	(1.18-	1.40)	1.27	(-6.9)
- Denmark	1.44	(1.35-	1.55)	1.38	(-15.0)
West					
- England/W	1.54	(1.43-	1.65)	1.47	(-13.5)
- Netherlands	1.29	(1.21-	1.37)	1.24	(-15.7)
- Belgium	1.38	(1.29-	1.47)	1.32	(-14.8)
South					
- France	1.35	(1.25-	1.45)	1.27	(-22.0)
- Italy	1.25	(1.22-	1.29)	1.23	(-11.4)
- Spain	1.34	(1.25-	1.43)	1.28	(-18.3)
East					
- Czech Rep.	1.63	(1.40-	1.89)	1.60	(-4.3)
- Slovak Rep.	1.61	(1.30-	2.00)	1.60	(-2.4)
- Hungary	1.53	(1.42-	1.65)	1.50	(-6.4)

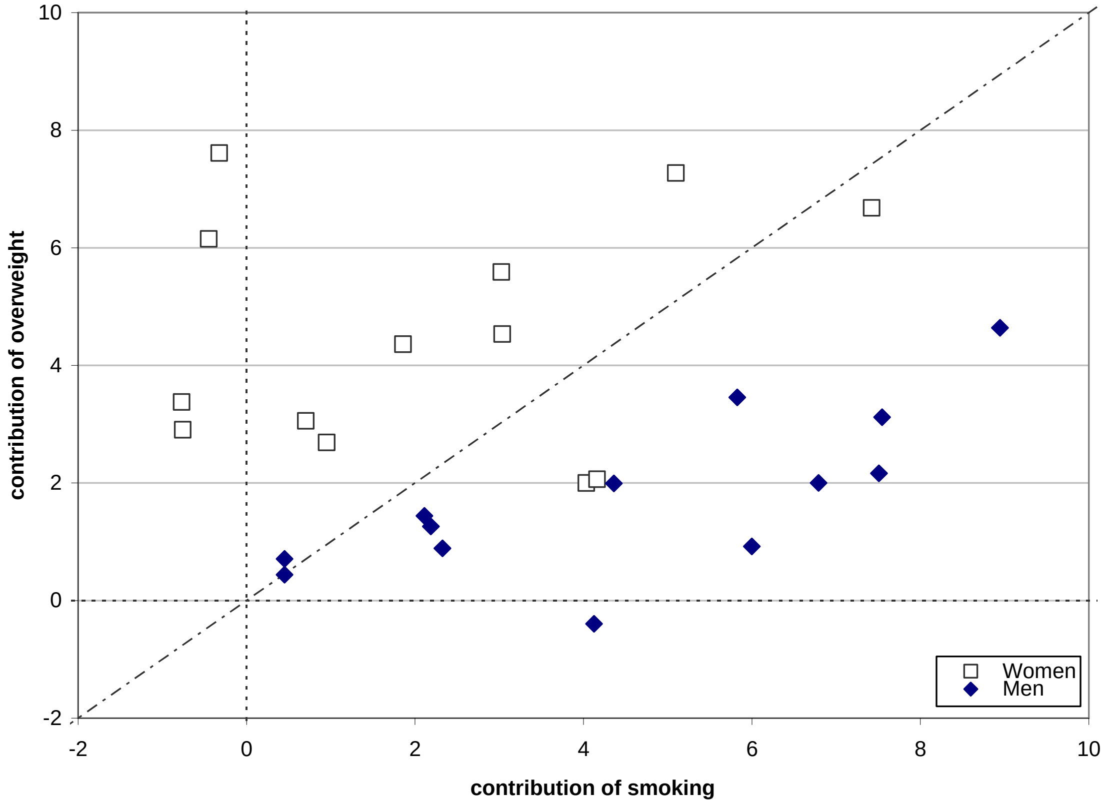
Note. * 95 % CI = 95 % Confidence Interval

Educational inequalities in SAH became smaller after control for smoking status and amount of smoking. The decline in the RII was largest (17 to 22 percent) for men in Sweden, Denmark, England and the Netherlands, and smallest (less than 8 percent) for men Hungary and southern countries. For women, the decline in RII was generally smaller than for men. A consistent north-south contrast is observed. The largest declines were observed for Denmark and Sweden (about 14 percent), followed by other northern countries (7 to 10 percent). In Hungary and southern countries, inequalities in SAH became larger (instead of smaller) after control for smoking. Thus, in the latter countries, smoking concealed inequalities in SAH instead of contributing to these inequalities.

Table 4 shows the estimates of magnitude of educational inequalities in moderate overweight and obesity. A few patterns consistently emerge from these estimates. First, in all populations, educational inequalities in obesity were substantially larger than inequalities in moderate overweight. Second, inequalities in overweight were larger among women than among men in most countries. Finally, among women, the largest inequalities were observed in France, Italy and Spain, whereas inequalities were smallest in the Ireland and the three eastern European countries.

Table 5 shows to what extent controlling for BMI decreased estimates of the educational inequalities in SAH after than smoking was already controlled for. In general, the contribution of BMI to health inequalities was larger among women than among men. Among men, control for BMI reduced the magnitude of health inequalities by about 10 percent in most northern countries and by less than 3 percent in Ireland, Italy, Spain, Hungary and the Czech Republic. Among women, the contribution of BMI was about 15 percent or more in most countries, up to about 20 percent in France and Spain. Relatively small contributions were observed for women in Sweden, Ireland, and the three eastern European countries.

Figure 2. Men and women in 13 countries plotted against the contributions of smoking status and overweight to educational inequalities in self assessed health.



Note. The contributions are expressed as the absolute decline in the value of RII (times 100) after control for smoking resp. additional control for body mass index.

In figure 2, men and women from the 13 countries are plotted against the contribution of smoking status (on the X-axis) and overweight (on the Y-axis) to inequalities in self assessed health. All male populations are (almost) in the lower right triangle, indicating larger contributions of smoking. In contrast, most female populations are (almost) in the upper left triangle, indicating larger contributions of overweight. However, women in Sweden and Ireland are positioned in the “male” triangle.

Among men, countries with a large contribution of smoking also tended to have a large contribution of overweight. Small contributions of overweight were observed in countries with small or intermediate contributions of smoking. Among women, a similar positive association between the two contributions was observed across most countries. However, for women in two “outlier” countries, France and Spain, the contribution of overweight was large whereas smoking did not contribute to inequalities in SAH.

DISCUSSION

Several international overviews showed that socioeconomic inequalities in smoking existed throughout Europe but that the magnitude of these inequalities strongly varied between different countries.[1 22 23] Similarly, more recent overviews demonstrated large cross-national variations in the magnitude of inequalities in moderate overweight and obesity. The present papers made a first attempt to assess the extent to which countries differed not only with regards to inequalities in smoking and overweight per se, but also with regards to the contribution that smoking and especially overweight made to inequalities in general health.

The contribution of overweight to educational inequalities in general health strongly differed between countries, being close to nil in some countries to about 20 percent in France and Spain. Larger contributions were observed for women than for men in nearly all countries. As compared to overweight, smoking made larger contributions to educational differences in general health among men, but smaller contributions in the case of women.

Evaluation of data problems

For this study, we utilized a data set that covered all European regions and that included comparable measurements of both educational level, self assessed health, body mass index and smoking. This data set was derived from micro data based on national interview surveys with large and nationally representative samples. Despite these advantages, the data set presented a series of limitations that might have affected the principal finding as summarized above.

The interview surveys available for different countries differed in a series of aspects such as sampling procedure, survey questionnaire, and non-response rates. In addition, the use of self reported data implies that cross-national comparability of data may be affected by cross-national differences in respondents’ tendencies to answer questions on general health.[24] The effect of these problems on our results is uncertain. They may have affected the international variations that we observed with regards to the magnitude of educational inequalities in SAH. Although about similar international variations were observed in comparative studies based on other data sources such as international surveys, we cannot exclude the possibility that part of the international variations is an artifact rather than reflecting true variations in the magnitude of health inequalities.

It is important to note that this paper did not aim to compare countries with regards to the magnitude of health inequalities per se, but that countries were compared with regards to the contribution that smoking and overweight made to health inequalities with each country individually. The key question is therefore how estimates of the contribution of overweight and smoking could have been biased. Three data problems need to be evaluated.

First, the measurement of body mass index and smoking was based on a set of relatively simple measures that were available to each of the countries. These measures may be imprecise and incomplete. Body mass index was self reported. Part of the respondents will have underreported their weight and/or over-reported their height, with the effect to underestimate their body mass index. [25] The degree of underestimation is related to low socioeconomic position according to some studies, [26] [27] although other studies found no or only small differences according to socioeconomic position. [28] [29] As a consequence of differential or non-differential bias in the measurement of body mass index, its contribution to educational inequalities in SAH is likely to be underestimated. For smoking, a similar argument applies. Comparable measures were available on smoking status and amount of cigarettes smoked, but not on smoking history. This incomplete measurement may have resulted in an underestimation of the contribution of smoking to inequalities in SAH. This effect might however be small, as a recent study on lung cancer incidence illustrated that most of the effect of smoking on inequalities in incidence could be captured by a simple measure of current smoking status.[30]

Second, due to the cross-sectional measurement of all variables, the causality of the observed associations is uncertain. The causality of associations between SAH with educational level (which we take as an general indicator reflecting socioeconomic position from early life through young adulthood) may be fairly undisputed, as education is established over the life course before most of the burden of disease appears. In contrast, the relationship between overweight and smoking on the one hand, and SAH on the other hand, may not only reflect an effect of the former on the latter, but also a reverse “health selection” effect. [31] For example, because of problems with general health, people may loose weight, quit smoking or reduce the number of cigarettes smoked. In as far as health selection effects added to our estimates of the contribution of overweight and smoking to health inequalities, this contribution would be overestimated in our cross-sectional analyses.

Third, the analysis could not include a series of factors that may have acted as confounders. Examples of such factors include other life styles (e.g. alcohol abuse, intake of specific nutrients), psychosocial factors (e.g. self control, exposure to stressors) and material factors (e.g. working and housing conditions). In as far as these factors are (a) correlated with both educational level and overweight, and (b) have independent effects on self assessed health, such factors may have acted as confounders in our analysis of the contribution of overweight to health inequalities. The same applies to smoking. Unfortunately, data on potential confounders were not available in a comparable way for all countries, and not even a part of these countries. Due to failure to control for potential confounders, our analysis may have overestimated or underestimated the independent contribution of overweight or smoking to health inequalities. Given the positive interrelationships between most risk factors for poor general health, overestimation is most likely to have occurred.

In conclusion, while imprecision in the measurement of overweight and smoking may have resulted in an underestimation of their contributions to health inequalities, other problems may have resulted in their overestimation. Therefore, the estimates presented in this paper should be taken as general approximations of the extent to which overweight and smoking contribute to inequalities in SAH. To this, we should add that the main objective of this paper was not to accurately estimate the contribution of overweight or smoking to health inequalities, but to assess variations across Europe in their contributions. The data problems discussed above are unlikely to explain the large variations between men and women, and between European countries, in the contributions that were observed for both overweight and smoking.

Explanations of key findings

As may be expected, large inequalities in overweight translated into large contributions to inequalities in SAH, and similar for smoking. However, this is not a one-to-one rule. A main deviation from this rule relates to men in France, Italy and Spain, where inequalities in overweight were relatively large, but the contribution of overweight to inequalities in SAH was relatively small. Further analyses suggested two explanations for the lack of an substantial effect of overweight on health inequalities. First, among men in the south, socioeconomic inequalities in overweight were large only in younger generations. These inequalities could not substantially contribute to the inequalities in SAH, as the latter were principally determined at the older ages (i.e. ages at which the burden of disease as measured in the SAH measure was much more prevalent). Secondly, the direct effect of moderate overweight and obesity on SAH was relatively small among men in southern countries as compared to northern men. This smaller effect might be related to a different epidemiological profiles of southern male populations, including their lower prevalence of heart disease – one of the main diseases through which overweight could affect general health.

For men, the contribution of overweight to inequalities in SAH was large only in countries where the contribution of smoking was large as well. Large contributions for both life risk factors were observed mainly in northern European countries. Although this correlation might just be a geographical coincidence, it might also reflect a common underlying factor particular to northern Europe. For example, northern European countries are most advanced in terms of modernization, individualization and the associated epidemiological transitions, including the nutrition transition and the smoking epidemic. Both epidemiological developments started among men from higher socioeconomic groups and then trickled down to lower groups. Diffusion of modern life styles towards lower socioeconomic strata may have been stimulated by societal changes such as improved education for all, expanded social welfare systems, and increased social mobility. Northern European countries were first in Europe to go through these transition processes, resulting in relatively wide and established social gradients in both overweight and smoking.

For women, we also observed a cross-national association between the contributions of overweight and smoking, respectively. However, for women, two “outlier” countries were main exceptions to this rule: France and Spain. In these two countries, smoking contributed much less to educational inequalities in SAH than would be expected given their large inequalities in overweight. Smoking even did not contribute anyhing to educational inequalities in SAH in France and Spain, nor did it in Italy and Germany. This lack of contribution reflected the delayed progress of the smoking epidemic among women in these central southern European countries. Among women in these countries, smoking was until recently associated with higher instead of lower education. This female pattern is likely to be related to a more traditional position of women in southern societies, as reflected by the low scores of these countries on female emancipation indices. A recent analysis suggested low emancipation rates to be associated with low smoking initiation rates among women, especially those with low education. [32] One might speculate whether the traditional social norms that discouraged low educated women from starting smoking, may have fostered life styles conducive towards high prevalence of overweight among the same women.

In the three central eastern countries, the contribution of both smoking and overweight to educational inequalities in SAH was relatively small. The joint contribution of the two factors was less than 10 percent in all cases except Slovak men (18 percent). This low contribution contrasts with the large educational inequalities in general health, and also the large inequalities in total mortality, that characterize eastern European countries. Even though overweight and smoking do contribute to some modest extent to these inequalities in health, the fact that health inequalities are so large in central eastern Europe, cannot be attributed to overweight or smoking. Other factors must have played a decisive role. For example, high rates of alcohol abuse among men in lower social classes have contributed to large socioeconomic inequalities in premature mortality. However, alcohol abuse is less likely to explain the large inequalities in general health that we observed for each of the three eastern countries, and especially so among women. Other potentially relevant factors include poverty and related material factors, psychosocial factors and possibly problems with access to high quality health care.

Implications
The estimates presented in this paper support the view that overweight is a potentially important factor for socioeconomic inequalities in health in many European countries. The effect of overweight is not limited to inequalities in the occurrence of specific diseases such as diabetes mellitus and hypertension, but extend to inequalities in health in general. Overweight is especially important to health inequalities among women, for whom our tentative estimates suggest a greater importance for overweight than for smoking. This would imply that for understanding and tackling health inequalities among women, it is important to assess the role of overweight and its proximate determinants, including obesogenic nutrition and physical activity.

The estimated contribution of overweight to health inequalities greatly varied between European populations. This variability warns that estimates from individual populations cannot be generalized to other countries. If extrapolations are to be made, due attention should be given to national differences in potentially relevant factors such as the level of socioeconomic development and the stage of the nutrition transition. Further comparative studies are needed to identify contextual factors that have a substantial impact on the magnitude of inequalities in overweight and, ultimately, on socioeconomic inequalities in general health.

Finally, our results have a bearing on possible future trends in health inequalities. The experiences from some European countries, especially those in the northern part of Europe, present scenarios to other countries. For example, if the nutrition transition in eastern European countries were to follow the same path as set by the northern European countries, overweight would increase its impact on health inequalities in the east – where inequalities are already large. Given the large variability between European countries that we observed, the potential for change in the future is considerable. It is therefore essential not only to reduce socioeconomic inequalities in overweight wherever they exist, but also to prevent the widening of such inequalities wherever they are yet small.

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Part V

Discussion and summary

DISCUSSION

Introduction

In this dissertation inequalities in overweight/obesity and related variables are studied in an international perspective, which offers an additional level of explanation (see also Chapter 1). Building on health outcomes from many countries, as opposed to two or three, better enables us to examine specific country-level characteristics to understand what shapes the magnitude of health inequalities across countries. [1] In short, international overviews allow the researcher to 'zoom out' to include national characteristics, which we use in an attempt to explain why the magnitude of socioeconomic inequalities in overweight/obesity and related diseases differ from country to country. [2]

The finding that groups of lower SEP carry most of the burden of overweight and obesity is certainly not new. [3,4] However, the studies presented here have several key advantages. One important advantage of this dissertation is that it includes more countries than most existing international overviews, [5-7] among which the Baltic and Eastern European countries. Second, we used data that were usually acquired in 2000 or even later. There is a need for up-to-date international overviews, as the prevalence of obesity has tripled in Europe during the past two decades, [8] which might have changed the inequality patterns. Third, we attempted to quantify the contribution of SEP inequalities in overweight/obesity to the risk of having diabetes or having hypertension and self- assessed health. One way we did this was by studying the relationship between inequalities in overweight/obesity vis-à-vis inequalities in diabetes and hypertension prevalence. This approach had never been followed before in an international context.

The first section of this final chapter gives an overview of the main results. Next, the effect of data problems regarding the validity of the results are discussed. This is followed by a paragraph in which we aim to interpret the results in their entirety, across all previous chapters. Finally, recommendations are made, both in terms of future research and in terms of health policies.

Main findings

Socioeconomic differences in overweight and obesity in Europe

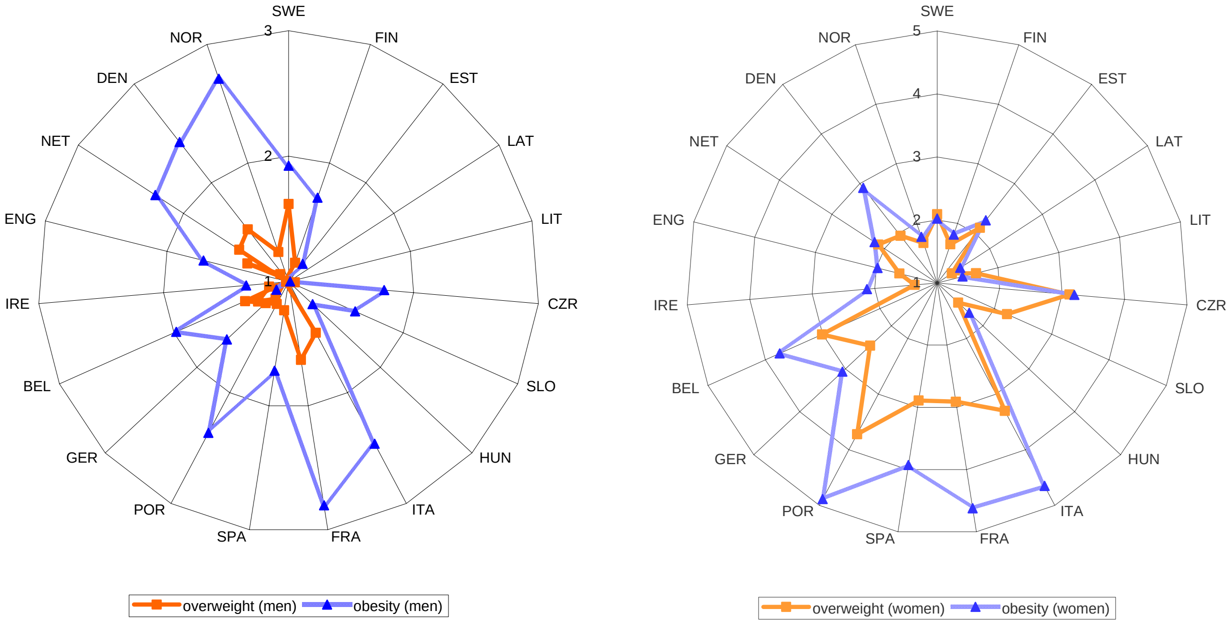
Our first objective was to describe the socioeconomic differences in overweight and obesity in Europe, and their possible relationship with general level of socioeconomic development. We found that inverse educational gradients in overweight (i.e. higher education, less overweight) are a generalized phenomenon among European men and even more so among women. Baltic and Eastern European men were the exceptions, with weak, positive associations between education and overweight. Educational inequalities in overweight were largest in southern Europe, but this applied only to women.

Second, we found some evidence for a weak relationship between level of socioeconomic development and inequalities in overweight. When level of socioeconomic development increased, overweight became increasingly more common among men of lower education, while the opposite was true for men of higher education. There was no clear association of level of socioeconomic development with inequalities in overweight among women.

Figure 1 summarizes the main results of Chapter 3 of this dissertation. A so-called spider chart is used to plot pan-European educational inequalities (RII) in overweight and obesity. The position of the countries in the 'web' roughly corresponds with their geographical position (e.g., Norway, Sweden, Finland in the north, Spain, France, Italy in the south). It is important to note that the scale of the axis starts with RII = 1. This means that positive gradients (more overweight/obesity among some high-educated Baltic men, or RII < 1) are not visible. The scale of the axis differs between the graphs.

Looking at the figure, it immediately becomes apparent that the inequalities in overweight and obesity were larger among women (which is not a new finding), but especially among Mediterranean women (a novel finding). Another striking observation are the small inequalities in overweight and obesity in the Baltic and the eastern European countries, Finland, England and Ireland, for both men and women.

Figure 1. Educational inequalities (RII, expressed as PRR) in overweight and obesity among men (*left*) and women (*right*).



Note. For Slovakian women, the RII of obesity lacked precision and was therefore omitted (RII = 5.85, 95%CI = 1.41-24.24). Abbreviations: FIN = Finland, SWE = Sweden, DEN = Denmark, IRE = Ireland, ENG = England, NET = Netherlands, GER = Germany, BEL = Belgium, FRA = France, ITA = Italy, SPA = Spain, POR = Portugal.

The relative predictive value of different socioeconomic indicators for overweight

In the second half of Part II (Chapter 4), we aimed to investigate which socioeconomic indicator was most strongly related to overweight/obesity: educational attainment, occupational status, or income level.

For both sexes, and in virtually all European countries, a low educational attainment was the strongest predictor of overweight. Occupational level generally was the second-most strongest predictor of overweight, although the relationship between overweight and occupational level was not always perfectly graded. The association between income level and overweight prevalence was generally weak, and sometimes inconsistent with the other SEP indicators (i.e., different directionality).

Socioeconomic differences in vegetable consumption and physical inactivity in Europe

In Part III of this dissertation, our first objective was to describe the magnitude of socioeconomic inequality in physical inactivity (leisure time physical activity, or LTPA) in European countries (Chapter 5). In all European countries, sedentary behavior was more common among low-educated people. Inequalities in LTPA were generally larger among women than among men. We observed marked differences in the level of inequality in LTPA across Europe.

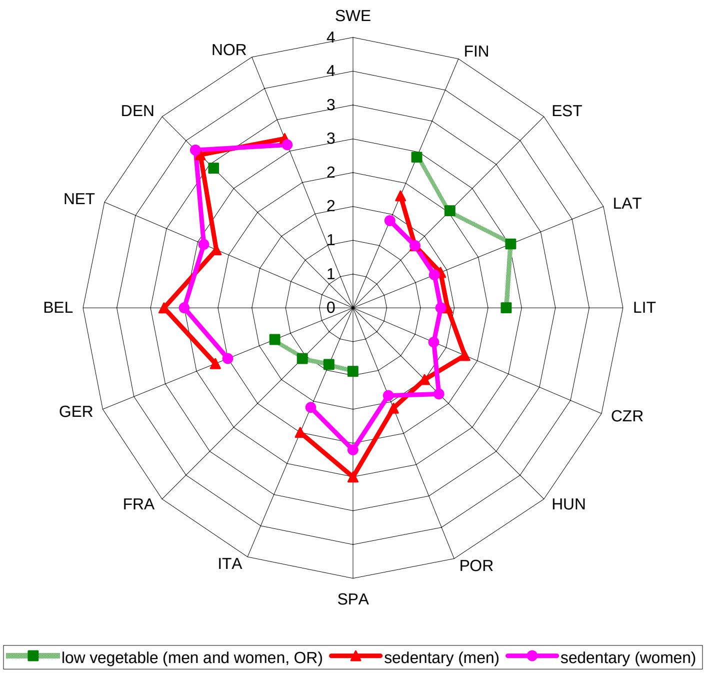
Among men, the inequalities in the prevalence of sedentary behavior were smallest in eastern Europe, the Baltic countries, Finland and Portugal and largest (in ascending order of magnitude of inequality) in Italy, Netherlands, Germany, Spain, Norway, Belgium, and Denmark. This pattern was roughly the same in women, with the smallest magnitude of inequalities found in the Baltic and the eastern European countries, as well as in Portugal and Germany. The largest magnitudes of inequalities in the prevalence of sedentary behavior among women were observed in (in ascending order) Finland, Hungary, Italy, Spain, Netherlands, Belgium, Norway, and Denmark.

As might be expected, the overall prevalence of sedentary prevalence was often more or less inversely related to the magnitude of inequalities in sedentary behavior. That is, the inequalities in the prevalence of sedentary behavior were small in countries where sedentary behavior was extremely common, and vice versa. For instance, a very high overall prevalence of but relatively small inequalities in the prevalence of sedentary behavior was observed in men from Portugal, Czech Republic and Estonia.

The second objective of Part III was to establish the magnitude of socioeconomic inequality in low vegetable consumption in European countries (Chapter 6). In all countries, educational level and vegetable consumption were related to SEP, but the direction and the strength of the association varied. In the Nordic and the Baltic countries, those with the highest educational level were more often daily users of vegetables, while in the Mediterranean countries, the lowest educational level group used vegetables more often than the other groups. Daily use of vegetables was more common in the non-manual than the manual occupational group in all the countries studied.

In addition, we found some evidence for a positive association between the availability/pricing of vegetables and the magnitude of the socioeconomic inequalities in vegetable consumption (higher availability/lower costs, less inequality). The Mediterranean countries, with high vegetable availability and affordability, differed from the other countries in that the SEP differences in low vegetable consumption were smaller or even opposite.

Figure 2. Educational inequalities (RII) in low vegetable consumption and sedentary behavior.



Note. Unlike all the other estimates presented here, the educational inequalities (RII) in low vegetable consumption are expressed as age- and sex-adjusted Odds Ratios (OR). The RIIs of sedentary behavior are expressed as age-adjusted Prevalence Rate Ratios (PRR).

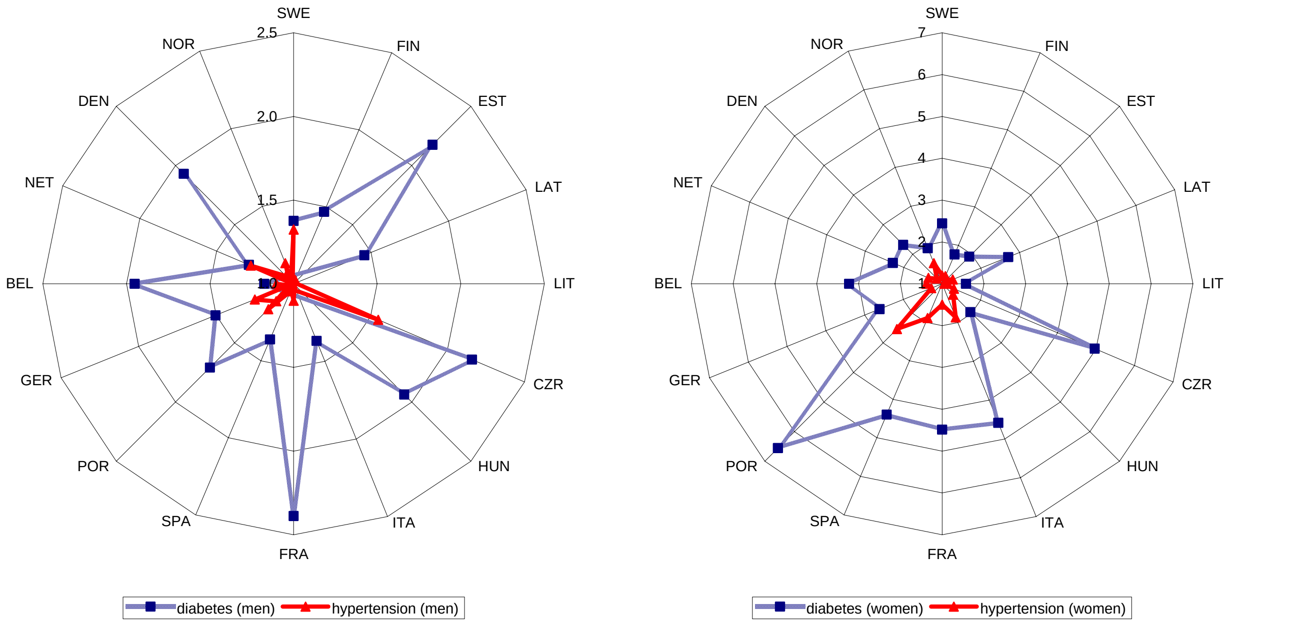
Figure 2 summarizes educational inequalities low vegetable consumption and sedentary behavior across Europe. In comparison with the other studies, relatively few countries were represented, and the vegetable consumption and the LTPA variables were of poorer quality. That said, it can be observed that the inequalities in low vegetable consumption were clearly smaller in southern Europe than elsewhere, and that the inequalities in sedentary behavior were relatively large in the Nordic (Denmark and Finland) and the Baltic countries.

Socioeconomic differences in diabetes, hypertension, and subjectively experienced level of health in Europe

The objectives of Chapter 7 were to describe the international patterns of inequalities in diabetes (specifically type 2 diabetes) and to investigate to what extent obesity inequalities could explain inequalities in diabetes prevalence in the different European countries. Inequalities in both diabetes and obesity were generally larger among women, especially Mediterranean women. Large inequalities in diabetes appeared to go in tandem with similarly large inequalities in obesity, and vice versa. In Europe at large, diabetes and obesity were each 1.5 times (men) and 2-3 times (women) more common among low-educated people.

Similarly, in Chapter 8 we aimed to describe international patterns in educational inequality in hypertension prevalence, also in relation to inequality in obesity. Inequalities in hypertension prevalence were of much smaller magnitude than e.g. those of overweight/obesity. Across Europe, inverse educational gradients in hypertension (i.e. higher education, less hypertension) were common among women but not among men. A clear north-south gradient was present among women: inequalities in hypertension were largest in southern Europe and smallest in Baltic and Nordic countries. Among men, generally no consistent inequality patterns emerged, but high-educated Baltic men were slightly more likely to be hypertensive. Among women in most countries, obesity was a strong predictor for inequalities in hypertension. In addition, countries with relatively large inequalities in hypertension also had large inequalities in obesity, and vice versa.

Figure 3. Educational inequalities (RII) in diabetes and hypertension among men (*left*) and women (*right*).



Note. For Norwegian men, the RII of diabetes lacked precision and was therefore omitted (RII = 3.46, 95%CI = 1.64-7.30)

Figure 3 is similar to Figures 1-2 and summarizes educational inequalities in diabetes and hypertension across Europe. It can be seen that the international pattern of inequalities in diabetes more or less mirrored the pattern of the inequalities in overweight/obesity (cf. Figure 1). This also applies to inequalities hypertension prevalence, but to a much smaller extent. If the inequalities in diabetes prevalence were to be described as a crisp-clear echo of obesity prevalence, then inequalities in hypertension prevalence were more like a distant echo of it.

The objective of Chapter 9 was to describe the international patterns of inequalities in subjectively experienced ill health. In particular, we aimed to quantify obesity's role in the level of inequalities in subjectively experienced ill health. After adjusting for smoking, control for BMI explained about 5 % of the residual inequalities among men, but 10 % of the residual inequalities among women. Among men, the geographical pattern of inequalities in SAH was similar to that of smoking; control for BMI explains a maximum of about 12% for Denmark, England and the Netherlands. Among women, the highest values are observed not only in Southern Europe (18-22 % in France and Spain), but also in Northern/Western Europe (15-17 % in Germany, Netherlands, Finland, and Denmark). International variations in the share of smoking and BMI partly reflected differences between European countries in staging or control of the tobacco and obesity epidemics.

Table 1. Inequality patterns of overweight/obesity and related variables in European countries

		MEN							WOMEN						
Region	Country	Overweight	Obesity	Sedentary	Vegetable	Diabetes	Hypertension	SAH	Overweight	Obesity	Sedentary	Vegetable	Diabetes	Hypertension	SAH
Nordic/Western															
	FIN	M	S	M	L	M	S*		S	S	M	L	S	S	
	SWE	L	L			S	L	M	M	M			M	S	S
	NOR	M	L	L		L	M	L	M	S	L		S	L	L
	DEN	L	L	L	L	M	M	M	M	M	L	L	M	S	M
	IRE	M	S						S	S					
	ENG	S	M						S	S					
	NET	L	L	M		S	L		M	M	L		M	M	
	BEL	L	M	L		L	M	M	L	L	L		M	M	M
	GER	M	M	L	M	M	L		M	M	S	M	M	M	
Mediterranean															
	FRA	L	L		S	L	M	S	L	M		S	L	L	S
	ITA	L	M	M	S*	S	S*	S	L	L	M	S*	L	L	S
	SPA	M	M	L	S*	S	M*	S	L	L	L	S*	L	L	S
	POR	M	M	S		M	L	L	L	L	M		L	L	L
Eastern/Baltic															
	SLO	S*	S	S					M	-	M				
	HUN	S*	S	M		M	M*	L	S	S	M		S	M	L
	CZR	M	L	M		L	L	M	L	L	M		L	M	L
	LIT	S*	S*	S	M	S*	S*		S	M	S	M	S	S	
	LAT	S*	S*	S	L	M	S*		S	S	S	L	M	M	
	EST	S*	M	S	M	L	S*		M	M	S	M	S	S	

Note.
- SML: between-country (i.e., column-wise) comparison. S, M, L = relatively Small, Medium, Large magnitude of inequalities as compared to the other countries (lower-middle-upper tertile of inequalities).
- Asterisk (*) = RII < 1; Blank cells = data unavailable; Hyphen (-) = data omitted (imprecise measure).
- Overweight = BMI ≥ 25 kg/m^2; Obesity = BMI ≥ 30 kg/m^2; Sedentary = sedentary behavior during leisure time; Vegetable = low vegetable consumption; SAH = self-assessed health; Country abbreviations: see Figure 1.

Table 1 above summarizes the main results of this dissertation. The letters SML indicate relatively Small, Medium, Large inequalities. SML is a ranking of the relative level of inequality as compared to most other countries. It indicates the top, middle and lower tertile of the relative, cross-national level of inequality. Asterisks indicate that the unfavorable overweight/obesity-related health indicator is more common among high-educated people (RII < 1).

Evaluation of data problems

As other authors previously remarked, [9] data problems may plague international comparisons such as those presented here. For the specific health indicators, these problems have been covered in the previous chapters. Below follow the most important possible data problems encountered in this dissertation: study design, confounding, availability/comparability of data, precision, external validity, construct validity, criterion validity.

Study design

Observational studies provide a 'snapshot' of the frequency of the disease or behavior in a particular population at a particular point in time. They are valuable, relatively low-cost, tools to describe population health and to identify key problems and their international variations. Observational studies allow the researcher to make individual-level and country-level observations. However, it has to be kept in mind that this tool is not the most suitable to make inferences on the causes of these variations, neither on the individual nor on the country level.

Cross-sectional study design - Individual-level observations are made in a cross-sectional study design. Within individuals, the relationship between different variables at a certain point in time can be the subject of investigation. However, since exposure and health status are measured at the same point in time, it may not always be possible to distinguish whether the exposure preceded or followed ill health. A good example of this 'directionality problem' is the question whether SEP is a cause or a consequence of overweight/obesity. This chicken-and-egg problem has already been discussed in Chapter 2. On the one hand, SEP might cause overweight/obesity, and on the other being overweight/obese might 'select' people into lower societal strata ('downward social mobility'). [10 11] Although causation and selection probably both apply, causation is thought to be of greater importance for the origination of overweight/obesity. [12]

The ECHP study (Chapter 4) is also relevant for the discussion of the directionality problem, as the potential for causation versus selection mechanisms may depend on the specific SEP indicator. Occupational and income level generally remain dynamic during adult life, thus leaving much possibility for an effect of overweight and obesity. Indeed, being overweight/obese has been linked to inequality in hiring, salary, promotion, and employment termination, [13-15] mainly through mechanisms of stigma and discrimination. Especially for women this appears to be a fairly consistent finding.[4 16]

Conversely, the selective effect of overweight/obesity on *educational* level is probably small. Educational level is established early in life, well before the onset of overweight/obesity, which typically occurs after childhood. [16 17] This may be true in the populations that made up the Eurothine data, but it may be changing in younger generations, where childhood obesity is more common.

One study demonstrated that individuals who had been obese during childhood (but not during adulthood) were not more likely to leave school before the age of 16. Women with persistent obesity through adulthood, on the other hand, were less likely to have paid work. [16] This suggests that selective mechanisms are more important in relation to occupational level and less important in relation to educational attainment. In other words, the prevalence of overweight/obesity may be a stronger determinant for occupational or income level than for educational level. We generally used educational level as a measure for SEP. Therefore, the role of the selective mechanisms in the SEP-

BMI relationship is probably relatively small. Nonetheless, even in the Eurothine data, it is plausible that indirect selection mechanisms in part explain the relationship between educational level and inequalities in the prevalence of overweight/obesity. For example, certain character traits, such as the ability to set long-term goals, may exert influence on both body weight and educational level.

Ecological study design - Country-level observations are made in a ecological study design. For instance, geographical characteristics can be used to define groups. Contextual determinants, such as national characteristics, may be construed as a type of epidemiological exposure. We compared inequalities in the prevalence of overweight and related variables in ‘exposed’ and ‘unexposed’ national populations. Aided by existing research, we tried to generate plausible hypotheses as to what national characteristics may have caused international inequality patterns. For example, we speculated that national welfare level (Gross Domestic Product per person) had some effect the magnitude of inequality in overweight/obesity in countries.

A potential pitfall of ecological studies is the ‘ecological fallacy’. [18] This phenomenon refers to the fact that individual-level and country-level observations sometimes appear to contradict each other, because the country averages ignore country variation. For example, the average BMI is higher in individuals from *wealthy countries*, but within these nations, the *wealthy individuals* tend to have a lower average BMI. [18] Likewise, in developing countries, an increase in the general welfare level may cause overweight/obesity to become more common in poor individuals [19] (cf. Chapter 3).

Aggregation bias arises when inferences are made from country-level (aggregate) data to individual-level relationships. However, we were cautious to avoid making such ‘cross-level inferences’. What we did do, was to make country-level inferences in order to assess the effects of contextual factors on inequalities in the prevalence of overweight/obesity and related variables.

Confounding

Confounding occurs when there is a mixing of effects between the exposure and the outcome of interest and a third factor (the ‘confounder’) that is associated with the exposure and independently affects the risk of the outcome.

Confounding is an important potential pitfall that applies to observational studies at both the individual and ecological level. It is conceivable that other, confounding factors than those which we identified are really behind the inequality patterns. When comparisons are made (be they on the individual or the group level), the health status of an exposed group (say, the prevalence of overweight/obesity) is compared to that of an unexposed group. If prevalence of diabetes/hypertension in the exposed group differs, this is seen as an indication that this is *caused by* the different level of exposure. However, when confounding factors have not been recognized, correlation can easily be mistaken for causation.

Would it be conceivable, for example, that the relationship between GDP and inequalities in the prevalence of overweight/obesity (Chapter 3), was biased by confounding? If GDP is not the proper independent variable to specify the model, specification bias occurs. Specification bias may be defined as confounding of the ‘group’ itself. Extraneous risk factors may be differentially distributed by group, or some property of the group itself. [20] For example, the level of social disorganization, rather than GDP could also be hypothesized to underlie the size of the inequality gap of the prevalence of overweight/obesity. Also, GDP per person is an average level (as opposed to, for example, a median level) of wealth. Therefore, it does not take into account the possibly unequal distribution of wealth. Such a scenario has been referred to as ‘non-homogenous grouping’. [20] One has to be fully cognizant of such possible alternative explanations.

Availability and comparability of data
Unavailability of data was one implication of the fact that pre-existing data were used in the Eurothine project. There were two problems regarding the availability of data. The first issue was about data availability per se, whereas the second issue was about the availability of comparable data.

Firstly, data were often not available for all countries, simply because the variable in question was never part of the original survey. Data for vegetable consumption were not available for Sweden, Czech Republic, Hungary, Slovakia, Portugal, Belgium and the Netherlands. Therefore, the international patterns on inequalities in vegetable consumption are incomplete, especially given the fact that data of most eastern European countries were not available. Most findings of this dissertation indicate important international variations in inequality patterns. It is difficult to extrapolate the results to those geographical regions for which data are lacking.

Secondly, international comparability of the available survey items sometimes caused problems. In Chapter 1 we already mentioned that the educational attainment variable poses a particular challenge in this respect. However, UNESCO devised the ISCED classification [21] to enhance international comparability, and we used the RII overcome any remaining problems. [22] Moreover, the educational distributions were validated against Eurostat data.

Comparability problems sometimes forced us simply not to utilize the variables of certain surveys. For instance, we also analyzed inequality patterns of cardiovascular diseases, which were measured as myocardial infarction, angina pectoris, heart failure, or simply as ‘heart disease’. The availability of each of those four variables differed from country to country. Etiology-wise (not to mention symptomatology-wise), this is a very diverse array of diseases, making comparability problematic. For instance, the term ‘heart disease’ is very broad in comparison to the other diseases. Also, people from lower SEP may be less familiar with the ‘medical’ names of the other conditions, which raises questions about the reliability of these questionnaire items. Not surprisingly, the results of the analyses on cardiovascular diseases were incoherent and inconsistent, and the cross-national (inequality) differences in the prevalence rates were unrealistically large. Therefore, we decided not to report these results at all.

In conclusion, we maximized the use of our data, but the information contained in it was sometimes too limited to be of practical use. We only reported the results of variables which we deemed to be of sufficient comparability to make international comparisons of relative prevalence, that is, of inequality. Use of the RII helped overcome comparability problems related to educational attainment. Nonetheless, some caution was warranted when interpreting the results. We tried to avoid mis- or over-interpretations by focusing on cross-national patterns that were most pronounced and stable.

Precision
Precision, also called reproducibility or repeatability, refers to the degree to which further measurements or calculations show the same or similar results.

Relatively small sample sizes sometimes posed problems in terms of statistical power. Small sample sizes may compromise the precision of statistical estimates. Especially for relatively rare phenomena, such as diabetes and hypertension, the number of cases was sometimes too small to yield accurate estimates of age-adjusted inequalities in prevalence rate ratios.

A more technical problem that we encountered is that large prevalence rate ratios (and wide confidence intervals) tend to cause non-convergence between model and data. In some cases, we were able to circumvent non-convergence problems by estimating prevalence rate ratios using the COPY Method, [23] but this was not always effective. For example, for Slovakia, for which only a small dataset was available, this approach did not work. Therefore, except for BMI, we did not report any of the results of this country. More generally, we have to be cognizant of the fact that the PRR estimates often lack precision. Therefore, in such cases it is precarious to draw solid, country-level conclusions.

External validity

External validity deals with the question to what extent sample-based conclusions can be applied to the population as a whole. Sample size and non-response bias are two factors that determine a study's generalizability.

Non-response bias also is a factor that affects the generalizability of a study. Random stratified sampling often had been used to acquire the data. However, non-response data were not available, which raises questions about the representativeness of the samples. Thus, we simply had to assume that the assumption of random non-response had been met – a non-testable assumption.

In addition, the sample may be not nationally representative if sample stratification does not equal the population stratification in terms of general demographic characteristics such as age, gender and regional distribution. To evaluate this non-response effect, we performed sensitivity analyses using data of Denmark, Ireland, Germany, and the Netherlands, which contained sampling weights. We applied the stratification weights using a bootstrap procedure. [24 25] Although the bootstrapped confidence intervals were slightly narrower than the unweighed confidence intervals, there were no important differences between regular and bootstrapped prevalence estimates. Apart from the smaller degree of precision, the unweighed estimates were remarkably similar. Therefore, we believe that, in terms of basic demographic characteristics, our samples represented the population.

However, there is more to a population than basic demographic variables. Aside from the fact that sampling had taken place in the non-institutionalized (i.e., healthier) population, morbidity may be a predictor of non-response. For example, it is conceivable that people who are overweight or obese may be less likely to participate in health surveys. If there is no SEP gradient in the morbidity-related non-response, however, the distorting effect on the inequality estimates is probably limited. Nonetheless, this was another reason for us to focus on relative prevalence of ill health, rather than on absolute prevalence.

Construct validity

A fourth issue was related to the construct validity of the measures in question. Construct validity deals with the question to the extent to which the survey question measures a particular theoretical construct.

Even if data were available for a reasonable number of countries, it could be that the specific indicator was less-than-optimal. One might, for instance, remark that waist-to-hip ratio (WHR) or waist circumference would have been a better measure for relative body weight than BMI. Or that vegetable consumption is a measure for nutrient intake, and at most a proxy for energy intake. Another valid remark might be that LTPA is an incomplete measure for energy expenditure, as only physical activity during leisure time is covered. This is probably true, but we simply had to cut our coat (dataset) according to our cloth (data).

An important issue in this respect deals with the question to what extent can BMI be used to validly measure overweight/obesity. BMI can not distinguish between fat mass and muscle mass, nor does it account for the wide variation in body fat distribution. In particular, excess fat in the abdominal regions is not always expressed as 'unhealthy' BMI values ('false negative' cases of overweight or obesity). On the other hand, a relatively large muscle mass may also lead to 'false positive' cases of overweight/obesity.

There is some evidence suggesting that WHR-SEP relationship is stronger than the BMI-SEP relationship. While the relationship between waist circumference and BMI was similar between high- and low-educated people, the hip circumference of low-educated people was smaller than as predicted from their BMI (OR = 1.87). [26] Thus, it follows that, compared to BMI, WHR (but not waist circumference alone) may be significantly more strongly related to SEP.

Notwithstanding these drawbacks, there is a solid correlation of BMI with morbidity, [27 28] as well as between BMI and other measures of relative body weight.[29] In addition, in some of our papers, we limited the age range to 45 years, as the validity of the 'standard' BMI classification may be less appropriate for people of higher age categories. [30-32] Therefore, we deem it highly unlikely that the use of a different measure for relative body weight would have led to radically different conclusions about the relationship between relative body mass and SEP, as well as the contribution of relative body mass to inequalities in overweight-related variables.

The same is not true for our measures of energy intake and expenditure. Vegetable consumption and LTPA are incomplete measures for total food consumption and physical activity. For instance, one study found that, after correction for work-related physical activity, the total amount of physical activity was independent of SEP. [33] Other studies found that vegetable and fruit consumption were related to SEP, but total energy intake was not. [34 35] Thus, neither the results of vegetable consumption, nor those of LTPA may be extrapolated to total energy intake and expenditure, respectively. Forthcoming international studies would therefore benefit from the use of better, more complete measures.

Criterion validity

Criterion validity deals with the question to what extent the survey responses are associated with the individual's actual behavior. Self-report bias has potentially affected the criterion validity of the studies presented here.

One kind of self-report bias is related to social desirability. This will render the data biased toward the desired characteristic, e.g. reporting a 'favorable' body weight or reporting higher vegetable consumption. For instance, people with a high true BMI have a tendency to underreport their weight [36], while most people over-report their height. [37 38] The differences between may be modest, however. For instance, one study found that the mean difference between self-reported and measured height was 0.6 cm for men and 0.79 cm for women. For weight, the corresponding difference was -0.74 kg for men and -1.64 kg for women. BMI was more underestimated in women (-0.85 kg/m^2) than in men (0.40 kg/m^2). [30] The World Health Organization concluded that data based on self-reported weight and height showed similar proportions as measured data. [39]

As long as there are no SEP differences in the level of self-report bias, the inequality estimates (i.e., the relative measures of inequality) will not be affected. However, there is some evidence that in fact SEP sometimes *is* a predictor for self-report bias. Low-educated people may be slightly more likely to underreport diabetes and hypertension prevalence, [30 40 41] although this finding is not consistently found. [42] Self-report-based SEP differences in obesity tend to be underestimated in women, and overestimated in men, although the differences may be small. [30] This implies that the 'true' magnitude of inequalities may be larger than found in this dissertation. All in all, the findings of existing studies indicate that the effect of SEP on self-report bias is quite modest. [30 43]

Another kind of self-report bias is related to the fact that some diseases often go undiagnosed. The literature indicates that self-report-based (as opposed to physician-diagnosed) overweight, diabetes and hypertension data contain many false-negatives but few false-positives. [41] Self-report-based prevalence rates represent an underestimation of the 'true' prevalence rates. Given their high specificity, they may be a better approximation of the minimal prevalence rate, that is, of the lower bound of prevalence estimate. For these reasons, we largely refrained from using *absolute* prevalence rates. Instead we focused on *relative* prevalence rates. Nonetheless, we acknowledge that that our prevalence estimates probably represent the tip of a 'clinical iceberg'.

The size of the clinical iceberg may differ from one nation to another, as the quality and accessibility of the healthcare system co-determines the likelihood of being diagnosed. Thus, cross-national patterns of educational differences in diabetes or hypertension prevalence may also be reflections the accessibility of the national healthcare systems, not only of the health status per se. This was another reason why we focused on relative differences rather than absolute differences.

The text above was a discussion about haves and have-nots, under- and overestimations, apples and pears, chickens and eggs. To what extent could all these different possible sources of distortion undermine our conclusions? We believe that the international inequality patterns are generally robust when (i) geographical patterns were coherent and stable over time, (ii) the focus is on relative measures of inequality (iii) the results coincide with previous studies using independent data sources. For instance, Eurothine and ECHP data show comparable inequality patterns with respect to the 'cluster' of Mediterranean countries (large inequalities in overweight/obesity among Mediterranean women). The results are less robust for LTPA as items differed markedly between countries.

Interpretation of the results

General picture

In this paragraph, three main findings are presented. Firstly, we will address the finding of the ECHP paper (Chapter 4) that educational attainment is clearly more strongly associated with the prevalence of overweight/obesity than the other two facets of SEP, occupational and income level. Importantly, this was demonstrated in men and women of virtually all European countries. Secondly, in the Baltic and eastern European countries, overweight/obesity and related diseases and behaviors were more common in men with a higher educational attainment. The inequalities among Baltic and Eastern European women were usually small too. Thirdly, the inequalities in overweight/obesity and related diseases were largest in Mediterranean women. This was not visible in similar-sized inequalities in sedentary behavior or subjectively experienced health, and even contradicted by the positive relationship between educational level and low vegetable consumption among Mediterranean women.

Why is educational attainment so strongly related to the prevalence of overweight/obesity?

Why, of all three SEP indicators, would educational attainment be so strongly related to overweight? The persistency and omnipresence of this pattern throughout Europe suggests that causes of inequalities in overweight/obesity are intimately linked with educational level. Cognitive factors moderate the relationship between educational level and BMI. For instance, intelligence was identified as one potential explanation for the correlation between education and BMI. [44] Other studies underline the associations between personality traits, educational level and obesity. [45] There is a strong link between health-related *knowledge* and cognitive *skills* vis-à-vis educational attainment. Borrowing terms from cognitive psychology, we will refer to these two concepts as declarative and procedural knowledge, respectively. [46]

Declarative knowledge is knowledge about facts and things, for instance knowledge about food facts. Health literacy may be defined as declarative knowledge in the context of health and is important for preventing overweight/obesity through appropriate life styles.[47] Lower SEP is associated with less health consciousness (thinking about things to do to keep healthy), which is in turn associated with unhealthy behavioral choices. [48] Health education contributes to a greater level of health literacy and is based on the communication of factual information on health risks. [49 50] Health education, and accessibility thereto, may play an important role in the origination of inequalities in overweight/obesity and related behaviors. [51]

The amount of attention for health promotion differs greatly between countries. Political and economical differences are at least in part responsible for international differences in the quality and accessibility of health education for all layers of society. [52] Thus, differences in the prevalence of overweight/obesity may in part be determined by individual-level knowledge gradients, which in turn may partially depend on country-level educational characteristics.

Procedural knowledge is knowledge about how to perform actions in life. Cognitive skills represent an individual's ability to efficiently cope with demands of the (social) environment. Control is a central tenet of physiological stress and stress coping. Lack of control is a major factor in the origination of obesity, [53] hypertension [54] and type 2 diabetes. [55 56] Stress has been implicated in the prevalence of obesity, [53] cardiovascular disease [57 58] and physical inactivity. [59] People of lower SEP have been shown to have higher stress levels, [60] and less perceived control. Therefore, differences in perceived stress load and physiological dynamics may well explain inequalities in overweight/obesity and related variables. Moreover, physiological imbalances that lead to obesity and diabetes can increase the vulnerability of an individual to stress and these may have a genetic component. [61]

Stress has been implicated in gene expression, including in situations that involve caloric intake. [62 63] In the Introduction (Chapter 1) we mentioned that genetic factors alone can not explain the rapid increase in the prevalence of overweight and obesity in the recent few decades. It is indeed true that genetic changes do not act on a time scale of a mere two or three decades. However, the underlying genetic code does not need to undergo any changes for genes to become (in)active. The field of epigenetics studies changes in gene expression by factors other than the underlying genetic code, for example by influences of the environment. So-called 'dormant genes' [64 65] have been recognized long ago, and one could speculate that 'thrifty' genes [66] are one example of dormant genes that have been 'waken up' by the obesogenic environment. [67]

In addition to endogenous factors, exogenous factors also determine health, perhaps by adding up to the total stress load. It has been suggested before that certain individuals may be more susceptible or more resilient to neighborhood influences, but research is largely lacking. [68]

One could hypothesize that the interaction between the environment and health outcome is differentially mediated by SEP indicator. More specifically, a higher educational level could be hypothesized to have a protective effect against a deprived environment, [69] while a lower educational level could represent a greater vulnerability. Indeed, one study demonstrated that environmental factors have a greater impact on low-educated people than on blue collar workers. [70]

Such findings warrant further research, especially given the fact that there is a large body of evidence that the environment per se is an important determinant of health.

One study found that, after controlling for education and known confounders, neighborhood deprivation level had an independent effect on the risk of being overweight, especially in women and older persons. In the highest educational group no association between neighborhood deprivation and the prevalence of overweight was found. [69] In deprived areas, LTPA was less common, but non-leisure time physical activity (e.g. going to work) was more common, independent of SEP. [71] Yet another study found that neighborhood problems were *not* related to diet or physical activity. [72]

There is also strong evidence to suggest that neighborhood conditions affect the prevalence of various health variables, independent of one's educational level. In a randomized controlled trial design (a rarity in epidemiological research), people were part of a housing mobility experiment. The 'experimental' group was offered vouchers to help them relocate from deprived to non-deprived areas. The 'control' group did not receive vouchers. Three years later, the deprived-to-non-deprived group showed lower levels of obesity (a 20 % reduction in the relative risk of being obese) and positive effects on exercise and nutrition, but equal levels of hypertension. [73] In addition, the experimental group showed less distress symptoms than persons who were not selected for relocation (the control group), independent of their educational level. [74]

In conclusion, compared to occupational class and income levels, educational attainment may be a better predictor of overweight because of the cognitive and behavioral determinants of overweight/obesity. More education and better cognitive skills may set in motion a protective chain of events that lead to a reduction in later life obesity risk. [75 76] On the one hand, the protection may be explained by SEP differences in health-related knowledge. Procedural knowledge may be a more important mechanism, however, as it helps protect individuals against stress-related bodily wear and tear. [54] Depending on an individual's resilience against stress, dormant genes may or may not become active. In addition, external factors, such as neighborhood factors, co-determine people's health, although the exact mechanisms remain largely unknown.

What explains the relatively small inequalities seen in the Baltic countries?
Among men from the Baltic countries and eastern Europe, small (and sometimes 'reverse') inequalities were visible in the prevalence of overweight/obesity, diabetes and hypertension. Women showed higher levels of inequality, especially in overweight and obesity. We will try to give explanations for these findings.

Firstly, we will zoom in to immediate risk factors for overweight/obesity. The SEP inequalities in the immediate risk factors (sedentary behavior and low vegetable consumption) and those in overweight/obesity prevalence were both small. Our findings corroborated the results of previous studies, which indicated that low vegetable consumption and sedentary behavior were only slightly more common among low-educated Baltic people. [77 78]

The overall prevalence rates of obesity and its immediate risk factors are not higher than in other European regions. For instance, the overall prevalence rates of obesity (around 10 %) [79] and sedentary behavior (around 50 %) [77] in the Baltic countries fall below or just within the European ranges. Within the European region, the overall prevalence of obesity varies between 13-23 % and the overall prevalence of sedentary behavior varies between 45-77 %. [8 39]

In summary, in the Baltic countries (and to a lesser extent also eastern Europe) SEP is not clearly related to the prevalence of obesity, nor to measures of energy intake and expenditure. At the same time, the overall prevalence of obesity does not differ greatly from that of other European countries.

Secondly, we will zoom out to material and psychosocial factors to further explain the relation (or lack therein) between SEP and the prevalence of overweight/obesity prevalence in the Baltic countries. [80]

The Baltic countries underwent a dramatic change since the collapse of state socialism. In terms of general socioeconomic development, these countries are lagging behind compared to western European countries. The economic reforms after the collapse of communism had pronounced effects on the material and psychosocial conditions, compromising the health of major parts of the population. Material deprivation is widespread and constitutes a strong link to ill health. [80 81] For instance, one study found that one third of Russians reported serious problems meeting their basic material needs. [81] Shortages of food and other daily needs, unfulfilling work, little or no reward for effort at work, low control over lifestyle, and feelings of disadvantage relative to western Europe have been common in former socialist countries. [80]

The social, political and economic transition and the increasing welfare level brought about an increased consumption of unhealthy foods. This phenomenon, which is called the 'nutrition transition', is associated with an increasing prevalence of overweight/obesity. [82] In low-income countries, chronic diseases such as overweight/obesity are more common among the socioeconomic elite, giving rise to the term 'diseases of affluence'. [3] However, depending on (among others) national welfare level, this pattern slowly shifts to a situation where the burden of disease mostly lies on the socioeconomically disadvantaged. [19] Low-to-middle income countries, such as the Baltic and eastern European countries, may be in an earlier phase of socioeconomic development (and the nutrition transition) than the 'western' countries, where clear negative gradients in the prevalence of overweight/obesity and related health variables are already present.

People of higher SEP are generally the first to adopt the novel, modern behaviors that come with an increase in general welfare level. [83] Likewise, high-educated Baltic people tend to choose modern foods, while those with a lower level of education consume more traditional foods. [84] However, the 'modernity' aspect may be a more important drive for food choice than the 'health' aspect. For instance, cheese consumption, which is perceived as a 'modern' nutritional habit, is more common among high-educated Baltic people. [85] Even if the correct health beliefs are present, this does not necessarily translate into a healthier pattern of behaviors. [86 87] Or, with an intended pun, it may be the modernity aspect that drives people; the health aspect is just gravy. The unhealthy, modern behaviors of the elite may therefore dampen the obesity gap.

Conversely, for people of lower SEP, the economic changes of the transition to market economy have reduced the availability of certain foods. [88] The newly introduced western foods are not available for the less privileged. One study found that up to almost half of the Latvian respondents depended partially or entirely on home-grown or raised foods. [88] This provides an important source of healthy foods for many people in the Baltic countries and is of particular benefit to the poor. It is believed that home production is one reason why the caloric intake of people living in countries undergoing economic transition is not compromised. [89 90] Even so, reduced intakes of nutrient-dense foods, especially among poor people, have been observed. The discordance in food quantity and food quality may be one explanation for contradicting results of inequalities in morbidity and mortality that were recently observed. [91]

Compared to other European countries, the gender differences in SEP inequalities in overweight/obesity and related variables were small in the Baltic countries. The legacy of state socialism constitutes an important factor that might explain these limited differences. During the socialist period, educational attainment and the labor market were equally accessible to men and women. For instance, labor force participation among women was considerably higher than in capitalist countries. [92]

In summary, in low-to-middle income countries such as the Baltic countries, nutrition transition and the socioeconomic transition may together give rise to a low-inequality situation. Poverty may still protect the lower SEP from engaging in the unhealthy behaviors owing to the nutrition transition.

What explains the large inequalities in Mediterranean women?

Women from the Mediterranean countries (Portugal, Spain, France, Italy) were characterized by high levels of inequality in overweight/obesity, diabetes and (to a much lesser extent) hypertension prevalence. On the contrary, small inequalities in vegetable consumption (with the lowest educational level group even using vegetables more often than the other groups) and low-to-medium-sized inequalities in the prevalence of sedentary behavior were visible.

Regarding energy intake, Spanish people of a lower SEP may have a *lower* intake of energy and nutrients. [93] Another Spanish study observed an association between lower educational level and adherence to the Mediterranean Diet, whereas educational level and obesity incidence were inversely related. Adherence to the Mediterranean Diet was associated with a reduced incidence of obesity [94] and is generally thought to have cardioprotective effects. [95 96] This is consistent with the small differences in vegetable consumption that we observed in southern Europe (Chapter 6).

Regarding physical activity, [97 98] the inequality pattern appeared to bear some resemblance (especially among men) to the inequality pattern of overweight/obesity. This appears to be corroborated by findings that sedentary behavior during leisure time was twice as common among Spanish women, but not men, of lower educational levels. [99] Compared to women of higher education physical inactivity during leisure time was 1.3 - 1.7 times more common in low-educated women (workers and housewives, respectively). [98] Similarly, women from non-manual occupational levels appeared to be more likely to be physically inactive during leisure time. [100] In contrast, a Spanish study found that LTPA (and dietary habits) did not seem to be affected by educational status in either gender. [101]

In conclusion, the inequalities in the immediate risk factors (physical inactivity, low vegetable use) did not seem to offer a convincing explanation for the observed inequality pattern of overweight/obesity and related diseases' although the evidence appears to be in favor of physical inactivity, especially in working women. Yet Mediterranean women spearheaded the European list of the inequalities in overweight/obesity and related diseases. We will use family-work interactions and cultural characteristics to try and explain this paradox. [102 103]

Firstly, we will zoom in to micro-level factors concerning the role of employment status and family demands in the relationship between SEP and ill health in general, and overweight/obesity in particular. [104] The interaction between family demands, employment status and SEP may together determine women's health. [98 105] On the one hand, being engaged in paid work may be beneficial for health, while on the other hand, combining work and family demands may be health-damaging and possibly obesity-promoting. These two possible mechanisms have been described as the 'role enhancement' and the 'role overload' hypothesis, respectively. [98]

Role enhancement refers to aspects of work that are beneficial for women's health, in particular for the relative body weight. It is widely recognized that paid employment has a beneficial effect on women's health. [106 107] For instance, the job environment can offer opportunities to build self-esteem, social support and experiences that enhance life satisfaction. [98] It is possible that working women, especially those of higher SEP, work in a social environment where the social norm emphasizes thinness and healthy food patterns. [4] A thinner body may be socially valued and materially viable to a greater extent for women of higher SEP, and these factors could help maintain SEP differences for women, for whom thinness continues to be promoted as an ideal of physical beauty. [108]

Role overload is another potential mechanism for explaining the SEP inequalities in overweight/obesity among women. As the term suggests, 'overload' involves physiological stress, which has been linked to overweight/obesity [58] and cardiovascular disease. [57] Depending on SEP, the combination of work and family demands may or may not cause adverse health effects. [109] For instance, among Spanish women it was observed that family demands had a higher impact on low-educated workers. Compared to high-educated working women, chronic diseases and health behaviors were more common among low-educated female workers. [98] Moreover, working more than forty hours was more common among low-SEP women, and was associated with a twofold odds of being hypertensive, or being sedentary during leisure time. [99] In full-time homemakers, however, the impact of family demands on health was not SEP-dependent. [98 100] Thus, when the total workload is high, combining jobs and family demands may be obesity-promoting, but the risk of 'role overload' appears to be particularly great for women of lower SEP.

Secondly, we will zoom out to macro-level explanations related to specific Mediterranean sociocultural factors. The Mediterranean countries have been called 'traditional societies'. [98] For example, the involvement of Mediterranean men in household tasks is generally low. [105] In addition, the Mediterranean 'male breadwinner model' is maintained in gender inequities in social policies. [110 111] For example, it is scarcely possible for women to do part-time work and child-support is less than generous. [112] Not surprisingly, the female employment rates [113] and the fertility rates [114-116] in the Mediterranean countries are lower than elsewhere in Europe. Also, the proportion of women working part time is 2-3 times lower in the Mediterranean countries (13 %) than in the Western/Nordic European region (31 %). [117 118]

Depending on SEP, the ‘traditional’ Mediterranean society differentially impacts women. The degree of incompatibility between work and family demands in Mediterranean countries is larger than anywhere else in Europe. Lower-educated women often conform to these more traditional role patterns, which makes them more likely to be full-time homemakers. [115] Women of higher education, on the other hand, are more modern and full-time labor participation in this group is therefore generally higher. [98]

In summary, low-educated women may be more likely to obey the traditional, family-oriented values that are embedded in the Mediterranean societies as ‘soft’ (e.g., expectancies) and ‘hard’ (e.g., child-support) factors. On the one hand, certain aspects of work, such as social factors, may be beneficial for women’s relative body weight (‘role enhancement’). On the other hand, the combination of family and work may have a negative impact on relative body weight or related variables (‘role overload’).

Labor participation is lower among low-educated Mediterranean women to begin with, but for those who work, role overload is more likely to be a problem, compared to high-educated working women. Characteristics of the ‘traditional’ Mediterranean culture may be behind these two factors, and may therefore explain the wide inequality gaps in the prevalence of overweight/obesity and related variables in these countries.

So, considering the available evidence, which immediate causal factor for overweight/obesity would be the ‘culprit’ of the large inequalities in Mediterranean women: physical inactivity or overnutrition? From the available evidence it appears that nutrition in Mediterranean countries show positive SEP inequalities, if anything, while physical inactivity is clearly more common among people of lower SEP. However, most research on nutrition concerns food quality. Good research on caloric intake (food quantity) is too scarce to give a definitive answer.

Rather than answering this ‘who dunnit’ question, it may be better to stress the *imbalance* between energy intake and expenditure. The deeper cause of overweight/obesity may lie in sociocultural factors, which eventually give rise to an imbalance in the input-output relationship between energy intake and expenditure.

Implications

Policy implications

Research findings such as those presented here could help to focus policies and interventions and provide a yardstick for success, because comparisons can be made with other countries. [119] Countries with relatively low levels of inequality may be used to demonstrate that inequalities can be smaller than they are in one’s own country, and to identify Good Practices (previously known as “Best Practices”). [120] In short: our findings raise awareness: [121] they uncover the previously unknown magnitude inequalities in obesity and related health variables.

The main implication of this dissertation is that interventions aimed at reducing overweight/obesity prevalence not only need to place special focus on women of a lower SEP, but also that an optimal intervention is probably not the same throughout Europe. The particular geographical region dictates the type and specificity of the intervention of choice; recipes for success of interventions are probably local recipes.

In the Baltic countries and Eastern Europe, the lower level of socioeconomic development of those countries may have a protective (equality-maintaining) effect. This region may not yet have reached a phase of full-blown ‘McDonaldization’, which means that there are still opportunities for prevention (rather than intervention) of SEP inequalities in overweight/obesity.

In Southern Europe, regulatory or legislative factors may have to be taken into consideration as factors that influence the magnitude of inequalities in the prevalence of overweight/obesity. More precisely, legislative factors that pursue gender equity in employment and family status need further study. The large inequalities in overweight/obesity in Mediterranean women indicate a more specific approach that specifically targets low-educated Mediterranean women.

A second important implication of this dissertation is that interventions aimed at reducing overweight/obesity prevalence are very likely to also diminish inequalities in the prevalence of diabetes, hypertension and subjectively experienced ill-health. Inequalities in the prevalence of overweight and obesity probably fuel, and widen, inequalities in a whole range of other diseases, of which diabetes and hypertension are just examples. All-cause mortality and self-assessed health are two other important measures, as they represent the cumulative effect of various (overweight-related) conditions.

A third implication relates to general welfare level or level of affluence. With regards to vegetable consumption, price and availability appeared to be potential tools to promote vegetable consumption in groups of lower SEP. With regards to LTPA, we concluded in Chapter 5 that interventions to promote physical activity in poorer populations may require different strategies from those targeted at more affluent countries. In poorer countries, these may entail the use of incentives or subsidies, or alternative motivational strategies that take away barriers that might discourage people from engaging in physical activity. Conversely, in more affluent countries, factors such as time and motivation, rather than financial aspects, may need more emphasis. [122]

A fourth implication relates to the individual knowledge levels. The results from the ECHP study suggest that the educational dimension of SEP is much more strongly related to overweight than the occupational or income dimensions. This is crucial for understanding inequalities in overweight and for developing strategies and interventions to prevent overweight in lower socioeconomic groups. [123] Causes of inequalities in overweight must primarily be thought of as inequalities in cognitive, attitudinal, and cultural factors that are best approximated by the level of education. People with a lower educational attainment should be a specific target group for the programs and policies that aim to prevent overweight. These groups may benefit from a focus on health literacy, aimed at increasing their understanding of and abilities to modifying behaviors with regards to diet and physical activity. [51]

A fifth implication is related to the predictive value of occupational level. The unique contribution of occupational level to the prevalence of inequalities in the prevalence of overweight and obesity was substantial, even though the relationship was less strong than for educational level. Educational and occupational level may have independent effects on BMI. The two indicators may express different mechanisms through which low social class is related to the prevalence of overweight/obesity.[124] Therefore, the workplace may also offer opportunities for prevention.

A sixth implication may be that it is probably better to stress the imbalance between energy intake and expenditure, rather than to focus on the immediate risk factors of overweight/obesity, physical inactivity and overconsumption. The deeper cause of inequalities in the prevalence of overweight/obesity may also need to be sought in ‘upstream factors’ such as sociocultural factors. Sociocultural factors (such as an increase in the general welfare level) may eventually give rise to an imbalance in the input-output relationship between energy intake and expenditure. Other important ‘upstream’ determinants include material and environmental factors, such as neighborhood conditions. [68]

Policies that aim to reducing socioeconomic inequalities among women may do so by addressing SEP characteristics at the individual level, and culture, norms, constraints and opportunities at the country level. [103] An expansion of investment in access to education (in particular by girls and women) to address the sharp international differences in health has been proposed before. [125] In addition, more generous possibilities for child support and more possibilities and flexibility in part-time work could be taken into consideration as possible intervention strategies to reduce inequalities in the prevalence of overweight/obesity in women from Mediterranean countries.

Future research

We will finalize by giving some suggestions for future research. The suggestions cover five broad themes, namely: data and methodological considerations, monitoring of inequality patterns, individual-level explanations for inequalities in overweight/obesity, country-level explanations for geographical patterns in inequalities in overweight/obesity, and the effects of overweight on disease outcomes.

Data matter(s) - Hitherto, making comparisons between countries is difficult, due to the use of different data collection methods, response rates, age ranges, years of collection, measures of socioeconomic position, and definitions of overweight and obesity. Better monitoring is therefore needed. [39] A robust monitoring system that covers similar age groups and includes various socioeconomic groups is urgently needed to assess the physical measures of a country's population. Improvements are certainly possible with regards to the availability and comparability of data, e.g. thanks to the increased harmonization of national surveys, and the availability of international surveys based on standardized questionnaires. Potential extensions include the availability of more valid measures, notably of relative body weight (in relation to ill health), caloric intake and physical activity.

Monitoring - Using cross-sectional designs, a significant body of descriptive research has been published in this area by now. [3 4] Repeated cross-sectional surveys enable inequality patterns to be monitored over time. Knowledge about trends in inequalities in the prevalence of overweight/obesity is important because it provides policy makers with an 'update' on the severity of the problem of inequalities in health. For example, one could assess whether the inequalities in the prevalence of overweight/obesity are still increasing, as was suggested about a decade ago. [7] This implies that SEP differentials in obesity-related diseases may also be increasing and this needs to be measured as well. [126]

Trend research is needed not only to gain a correct understanding of the progress of the obesity epidemic, but also to evaluate preventive initiatives that are progressively introduced. [36] For instance, countries with and without nationwide interventions aimed at reducing overweight/obesity could be compared before and after these interventions. What effect might the Dutch 'Covenant Overweight' have had on the magnitude of the inequalities in the prevalence of overweight/obesity? Or what would happen to the gargantuan Mediterranean obesity gap if a 'gender equity' bill were to be passed in one Mediterranean country, but not another? In short, trend research may be seen as a 'thermometer' for the state of affairs regarding the inequalities in the prevalence of overweight/obesity in countries.

Individual patterns – Using multivariate studies such as those presented here (e.g. in the chapter on inequalities in the prevalence of diabetes), a fine-grained profile of 'downstream' factors that possibly contribute to inequalities in the prevalence of overweight/obesity could be generated. Lifestyle variables, such as caloric intake and energy expenditure, are just a small part of these factors. Other variables may include, but are not limited to, social cognitive, personality, hereditary and prenatal factors. This may also be an implication of the ECHP paper (Chapter 4). A more fine-grained picture of what specific cognitive and attitudinal variables underlie the strong relationship between educational level and inequalities in the prevalence of overweight/obesity could be created.

Related to this, more insight is needed into the causal mechanisms that underlie inequalities in overweight and related health variables. The use of a longitudinal design allows for a better distinction between causation and correlation. For instance, data from international surveys offer exciting possibilities to analyze multi-wave data in an international perspective.

It is important that all factors be viewed in their entirety, not just as a few isolated variables. The deeper cause of overweight/obesity lies in an imbalance in the input-output relationship between energy intake and expenditure, caused by a complex interaction between 'downstream' and ‘upstream’ factors. [127] In this context, cognitive and attitudinal variables, such as the subjectively experienced level of control over one’s life, may constitute important ‘upstream’ individual determinants of overweight/obesity. [128]

Geographical patterns – Regarding ‘upstream’ factors, this dissertation has generated ecological hypotheses on cross-national inequality patterns in overweight/obesity and related variables. The country-level variables that we have put forward are ‘candidate’ explanatory factors that require more in-depth scrutiny. For instance, we operationalized national socioeconomic development as gross domestic product per person, but it would be desirable differentiate this concept into more fine-grained measures of wealth.

Similarly, we have suggested that gender inequity in labor participation may fuel the obesity gap in Mediterranean women. It would be fascinating to further pinpoint what specific sociocultural aspects are the most important drive behind the Mediterranean inequality patterns.

Finally, cultural factors may play role, such as dietary traditions and changes therein (e.g. the decreasing popularity of the traditional Mediterranean diet). In conclusion, to explain international patterns in inequalities in the prevalence of overweight/obesity, more detailed information on the role of sociocultural factors and other ecological variables in the origination of cross-national patterns in inequalities in overweight/obesity prevalence is needed.

Disease outcomes – In previous chapters (Chapter 7-8) we have demonstrated the close relationship between overweight/obesity and two chronic conditions, diabetes and hypertension. Other chronic diseases that are closely linked with the prevalence of overweight/obesity include cardiovascular disease (e.g. angina pectoris, myocardial infarction, congestive heart failure), stroke, osteoarthritis, gout – to mention just a few of a much longer list of diseases. For instance, close relationships have been observed between the prevalence of hypertension (and overweight/obesity) and stroke mortality, especially in southern Europe. [129] Therefore, more research on the international inequality patterns of these diseases is needed.

Moreover, with excess weight being related to such a range of major chronic diseases, SEP differences in obesity/overweight are contributing to broader SEP inequalities in health.[126] This is clearly illustrated in Chapter 9, where we found that BMI explains an average of 5 – 10 % of the educational inequalities in the prevalence of self-assessed poor health. Therefore, a further quantification is needed of the contribution of overweight/obesity to inequalities in the prevalence of other chronic diseases than those described in this dissertation. A host of research has already been conducted on inequalities in the prevalence of overweight and obesity. [3 4] Future studies may very well demonstrate that the prevalence of overweight and obesity is an important determinant of the magnitude of the social inequalities in the prevalence of a plethora of health conditions.

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APPENDIX – HARMONIZATION PROCEDURE OF USED VARIABLES

Educational level and its ranked equivalent [EDUCAT, EDURANK]

Definition
This variable measures the highest level of education that was completed by the respondent. Where appropriate, this level is completed by obtaining a diploma. When respondents are still attending school, this variable measures the level of school that is currently being attended. The ranked equivalent of this variable is called 'edurank'. Please refer to the description of 'sah_rank' for an explanation of the ranking procedure.

Categories and their meaning
1 = No or only primary education (ISCED 1)
2 = Lower secondary (ISCED 2)
3 = Upper secondary and post-secondary non-tertiary (ISCED 3+4)
4 = Tertiary education (ISCED 5+6)

Harmonisation procedure
The national categories of the educational level were harmonized on the basis of the International Standard Classification of Education (ISCED). The national codes were classified into four categories of the ISCED-scheme.

Recoding schemes
The following table shows for each country how the harmonised variable was constructed on the basis of the original variable. The codes in the middle column refer to the categories of the harmonised variable, as they are distinguished above.

Table 1. Recoding scheme of educational level

Country	**Harmonised variable (ISCED levels)**	**Original variable: national codes and explanations**
Norway	1	0= Pre primary or no education
	1	1= Primary education
	2	2= Second stage of primary
	3	3= 11-12 yrs
	3	4= 13 yrs
	3	5= 14 yrs
	4	6= 15-17 yrs
	4	7= 18-19 yrs
	4	8= 20 yrs
Sweden	1	0= no education
	1	1= primary
	2	2= lower secondary
	3	3= upper secondary
	3	4= post-secondary / non tertiary
	4	5= first stage tertiary
		6= second stage tertiary
Finland	1	0 - 8 yrs
	2	9 yrs

Country	**Harmonised variable (ISCED levels)**	**Original variable: national codes and explanations**
	3	10 -15 yrs
	4	16 yrs or more
Denmark	1	<10 years
	2	10 years
	3	11-12 years
	3	13-14 years
	4	>=15 years
Estonia	1	primary(1-6years)
	2	basic(7-9 years)
	2	primary or basic(1-9years)
	3	secondary(10-12 years)
	3	secondary-vocational(10-12 years)
	4	university(>13)
Lithuania	1	0 - 8 yrs
	2	9-11 yrs
	3	12 -15 yrs
	4	16 yrs or more
Latvia	1	0 - 6 yrs
	2	7-11 yrs
	3	12 -14 yrs
	4	15 yrs or more
Czech Rep	1	basic
	2	vocational training
	3	secondary
	4	tertiary
Slovakia	1	pre primary and primary
	2	lower secondary
	3	upper secondary
	4	post secondary and tertiary
Hungary ‘00	1	Pre primary education or no education
(before merging)	1	Primary or first stage of basic education
	2	Lower secondary
	3	Upper secondary
	4	First and second stage of tertiary
Hungary ‘03	1	Pre primary education or no education
(before merging)	1	Primary or first stage of basic education
	2	Lower secondary
	3	Upper secondary
	4	First stage of tertiary
	4	Second stage of tertiary
England	1	No qualification
	2	NVQ1/CSE other grade equiv
	3	NVQ2/GCE O Level equiv
	3	NVQ3/GCE A Level equiv
	4	Higher ed below degree
	4	NVQ4/NVQ5/Degree or equiv
Ireland	1	primary or none

Country	Harmonised variable (ISCED levels)	Original variable: national codes and explanations
	2	lower secondary
	3	upper secondary
	4	tertiary
Netherlands	1	Lager onderwijs
	2	Lbo
	2	Mavo, vwo-3
	3	Havo, vwo, mbo
	4	HBO,universiteit
Belgium	1	ISCED - level 0
	1	ISCED - level 1
	2	ISCED - level 2
	3	ISCED - level 3
	4	ISCED - level 5
	4	ISCED - level 6
Germany	1	Schule beendet ohne Abschluss oder noch keinen Schulabschluss
	2	Schule beendet ohne Abschluss oder noch keinen Schulabschluss
	3	Realschulabschluss (mittlere Reife) oder Abschluss Polytechnische Oberschule 10. Klasse oder anderen Schulabschluss
	3	Fachhochulreife oder Abitur
	4	Fachhochschule oder Ingenieurschule
	4	Universität oder Hochschule
France	1	Jamais scolarisé (Pre primary)
	1	Aucun diplome, autodidacte (Pre-primary)
	1	Etudes maternelles et primaries (jusqu' a 11-12 ans) (Primary)
	2	1º cycle (jusqu'a 15-16 ans) college, 1er cycle technique (Lower secondary)
	3	2º cycle (jusqu'a 18 ans) Lycee, 2º cycle technique (Upper secondary)
	3	Formation professionelle (Upper secondary)
	4	Etudes supérieures au baccalauréat (Post secondary)
Italy 1	1	ISCED level 0
	1	ISCED level 1
	2	ISCED level 2
	3	ISCED level 3
	4	ISCED level 5
	4	ISCED level 6
Italy 2	1	ISCED level 0
	1	ISCED level 1
	2	ISCED level 2
	3	ISCED level 3
	4	ISCED level 5
	4	ISCED level 6
Spain	1	pre primary education or no education at all
	1	primary education or first stage of basic education
	2	lower secondary or second stage of basic education
	3	upper secondary education
	3	non-tertiary education

Country	Harmonised variable (ISCED levels)	Original variable: national codes and explanations
	4	first stage of tertiary education
	4	second stage of tertiary education
Portugal	1	pre primary education or no education at all
	1	primary education or first stage of basic education
	2	lower secondary or second stage of basic education
	3	upper secondary education
	3	non-tertiary education
	4	first stage of tertiary education

Frequency distributions

The resulting population distribution according to ISCED level is given in the table below. The distribution is given for men and women together. The population distribution according to levels is given as % of the total population, excluding those with missing information on educational level. The % with missing education is given in the first row, as a % of the entire population.

Table 2. Frequency distribution of educational level variable, after recoding

Country	Missing (%)	Lowest	Second-lowest	Second-highest	Highest
Norway	2.9	0.2	17.3	56.6	25.9
Sweden	0.1	14.9	11.5	46.3	27.3
Finland	1.6	13.8	9.9	57.2	19.1
Denmark	2.2	20.2	6.2	54.8	18.8
Estonia	0.6	19.8	28.0	34.5	17.6
Lithuania	1.4	12.4	28.1	41.1	18.4
Latvia	1.1	24.3	20.0	34.6	21.1
Czech Rep	0.0	21.1	35.4	31.1	12.4
Slovakia	1.6	14.2	23.5	44.3	18.0
Hungary	0.3	32.3	25.3	29.0	13.4
England	5.7	30.0	5.8	37.1	27.0
Ireland	0.3	32.1	23.8	29.8	14.3
Netherlands	0.7	14.9	24.4	37.7	22.9
Belgium	3.6	20.3	20.7	30.0	29.0
Germany	2.8	2.9	40.1	43.1	13.9
France	2.3	17.0	36.7	18.9	27.4
Italy 1	2.2	33.8	29.7	30.1	6.4
Italy 2	0.0	31.0	30.2	31.7	7.0
Spain	0.2	37.9	29.2	19.7	13.2
Portugal	0.1	69.9	10.4	11.0	8.7

Educat_2 in ENG

We created a second Educat variable in the English data set [educat_2] wherein the original category NVQ2 is re-classified as lower secondary, instead of upper secondary as in the variable [educat]. The resulting population distribution according to [educat_2] is presented below. The large group which was first present in category 3 is now included in category 2.

Country	Lowest	Second-lowest	Second-highest	Highest	Lowest
England	5.7	30.0	30.4	12.6	27.0

Height/weight and Body Mass Index [HEIGHT, WEIGHT, BMI, BMICAT]

Definition
Height and weight of the respondent, measured in centimeters (cm) and kilograms (kg). BMI is defined as BMI = weight (kg) / [height (m)]^2. Variable 'bmicat' is the categorized version of BMI.

Categories and their meaning
Height, weight and BMI are continuous variables. The categories of variable 'bmicat' are:
1 = underweight [10 ≤ BMI < 18.5]
2 = normal [18.5 ≤ BMI < 25]
3 = overweight [25 ≤ BMI < 30]
4 = obese [30 ≤ BMI < 70]
-1 = missing or n/a [10 < BMI ≤ 70]

Recoding schemes
The following values were considered missing values: heights greater than 220cm or heights less than 100cm; weights below 30 and above 220 kg; BMIs less than 10 or greater than 70. Respondents were 16 years and older.

Country-specific notes
NET: height and weight were estimated on the basis of categorical items. Height: 22 4cm-categories between 10 and 210 cm. Weight: 25 categories between 3 and 125 kg. Estimation was done by averaging the poles of each category, e.g. 25-30 kg would result in an estimated value of 27.5kg.
CZR: Only BMI data (no height and weight) are available in the original dataset.
ITA: Neither of the variables was present for Italy part 2.

Table 3. Frequency distribution of BMI category variable, after recoding

Country	Missing	underweight	normal	overweight	obese
NOR	2.0	1.9	54.5	33.5	8.0
SWE	2.9	2.1	52.8	32.9	9.3
FIN	1.2	2.4	52.9	32.4	11.1
DEN	1.7	2.8	53.8	32.1	9.6
EST	1.2	3.7	53.0	28.2	13.9
LIT	1.5	2.0	48.8	32.8	14.9
LAT	2.4	3.7	52.7	27.7	13.5
CZR	0.6	2.7	46.0	36.0	14.7
SLO	4.3	4.2	46.6	31.2	13.8
ENG	3.1	1.5	36.3	37.3	21.8
IRE part 2	2.0	2.5	51.5	34.0	10.0
NET	2.1	2.4	53.5	31.9	10.1
BEL	2.9	3.8	52.1	30.0	11.3
ITA part 1	0.0	3.8	54.7	32.3	9.1
SPA	10.8	2.2	43.6	32.3	11.0
POR	5.4	2.2	45.5	34.8	12.1
GER	0.7	1.3	34.0	46.7	15.1
HUN	1.5	3.4	43.4	33.0	18.7
FRA[*)]	28.1	3.1	41.2	19.9	7.7

Table 4. Frequency distribution of height variable, after recoding

Country	Missing	100-119cm	120-139cm	140-159cm	160-179cm	180-199cm	200+ cm
NOR	0.5	0.0	0.0	5.5	66.2	27.7	0.0
SWE	1.5	0.0	0.0	7.8	66.1	24.5	0.1
FIN	0.7	0.0	0.0	9.1	70.6	19.5	0.1
DEN	0.6	0.0	0.0	6.5	67.6	25.2	0.2
EST	0.7	0.0	0.0	8.4	70.7	20.2	0.0
LIT	0.9	0.0	0.1	9.2	72.9	16.8	0.1
LAT	1.2	0.0	0.0	9.0	71.7	17.9	0.1
SLO	3.9	0.0	0.1	8.2	68.5	19.3	0.1
ENG	1.1	0.0	0.1	24.2	64.1	10.5	0.0
IRE part 2	0.8	0.0	0.1	14.3	68.0	16.8	0.1
NET	0.7	0.1	0.0	3.7	59.3	35.6	0.6
BEL	1.7	0.0	0.1	13.4	69.0	15.7	0.1
ITA part 1	0.0	0.0	0.1	15.2	74.2	10.5	0.0
SPA	8.4	0.0	0.1	18.5	63.8	9.1	0.0
POR	4.0	0.0	0.1	28.7	62.3	4.9	0.0
GER	0.6	0.0	0.0	15.9	69.3	14.2	0.0
HUN pt1-2	1.1	0.0	0.1	16.6	70.1	12.2	0.0
FRA*)	27.3	0.0	11.0	51.6	10.0	0.0	27.3

Table 5. Frequency distribution of weight variable, after recoding

Country	Missing	30-49kg	50-69kg	70-89kg	90-109kg	110-129kg	130+ kg
NOR	1.9	1.2	35.9	45.5	13.7	1.5	0.2
SWE	2.7	1.6	36.7	44.8	12.6	1.5	0.1
FIN	1.2	2.0	40.8	42.0	12.1	1.7	0.2
DEN	1.5	1.9	36.7	45.1	12.7	1.8	0.3
EST	1.0	2.0	41.9	40.7	11.6	2.6	0.3
LIT	1.3	1.5	36.3	45.7	13.2	1.6	0.4
LAT	2.1	2.3	39.4	42.3	11.9	1.6	0.4
SLO	3.9	2.9	36.8	40.9	13.7	1.3	0.4
ENG	3.0	2.8	37.2	41.0	13.2	2.4	0.4
IRE part 2	2.0	2.1	48.8	39.2	7.1	0.9	0.0
NET	1.7	0.6	29.3	49.1	16.9	2.4	0.0
BEL	1.7	3.7	42.9	40.1	10.2	1.1	0.2
ITA part 1	0.0	4.0	46.7	41.8	6.9	0.5	0.0
SPA	5.9	2.9	42.3	41.1	7.0	0.8	0.0
POR	5.2	3.6	46.9	38.9	5.1	0.4	0.0
GER	0.7	1.3	34.0	46.7	15.1	2.0	0.3
HUN pt1-2	0.8	3.5	38.7	41.0	13.8	1.9	0.3
FRA	27.7	3.2	34.5	27.6	6.0	0.7	0.2

Vegetable consumption – General

Definition
This group of variables aims to measure the amount of vegetables that the respondent consumes on a regular basis in a specified period of time.

Recoding procedure
We made the various variables measuring vegetable consumption as comparable as possible, by constructing a series of new variable that together measured *what* was eaten *how often*. A dichotomy of fresh versus non-fresh vegetables could be made, the latter being frozen, boiled or preserved vegetables. The variable for non-fresh variable consumption is discussed in the next section.

For the selected variables, the original items usually regarded a weekly frequency of vegetable consumption or, similarly, the number of days in a week that vegetables were consumed. As the various response categories tended to overlap between countries, the four new categories below could be created.

Harmonisation procedure
The group of vegetable variables aims to represent the frequency with which vegetables are consumed. In the datasets a distinction is often made between *fresh* [veg_f] and *non-fresh* [veg_o] vegetables, the latter usually being boiled, frozen or preserved vegetables. These two variables were combined into a *composite* variable on total vegetable consumption [vegtot]. The procedure used to combine the two variables is discussed in detail under 'vegtot'.

Fresh vegetable consumption [VEG_F]

Definition
This variable aims to measure the weekly amount of fresh vegetables that the respondent consumes on a regular basis.

Categories and their meaning
1 = Almost daily or more
2 = Three or more times per week
3 = Once or twice per week
4 = Never or almost never
-1 = Missing

Recoding procedure
See under heading 'Vegetable consumption – General'.

Harmonisation procedure
See under heading 'Vegetable consumption – General'.

Table 6. Description of source variables for the fresh vegetable variable the original surveys:

Country	Description of fruit item	Original categories [between brackets: the new values of the variable*)]	Remark
DEN	How often do you generally eat salad/raw food?	6 Everyday/several times a day (1) 5 Almost everyday (2) 4 A few times a week (3) 3 Once a week (3) 2 Less then once a week (4) 1 Never/very rarely (4)	
EST, LIT, FIN, LAT, SK	How often during the last week have you consumed fresh vegetables?	4 on 6-7 days (1) 3 on 3-5 days (2) 2 on 1-2 days (3) 1 never (4)	
ITA**)	How often do you consume the following food groups? *[See below]* **)	1 More then once a day (1) 2 Once a day (1) 3 Sometime in a week (2) 4 Less then once a week (4) 5 Never (4)	*Note that the third category could not be created*
SPA	Do you consume vegetables daily, three or more times per week, once or twice per week, least once per week, never?	1 Daily (1) 2 Three or more times per week (2) 3 Once or twice per week (3) 4 less than once per week (4) 5 Never (4)	
GER	During the last 12 months, how often did you eat fresh or uncooked vegetables?	1= more than once a day (1) 2= daily resp. nearly daily (1) 3= several times in the week (2) 4= about ounce a week (3) 5= 2 or 3 times per month (3) 6= once a month or less (4) 7= (nearly) never (4)	
HUN #1	How often did you eat <u>fresh fruits</u> or raw vegetables in the last four weeks?	1=More than once a day (1) 2=Several times a week, but not every day (2) 3=At least once a week (3) 4=At least once a month (4) 5=Less than once a week (4) 6=Never (4)	*Note that this item includes fresh fruits!*

Note. *) Meaning of the parenthesized numbers: 1=Almost daily or more; 2=Three or more times per week; 3=Once or twice per week; 4=Never or almost never

**) ITA: Two Italian items 'veg_leav' and 'veg_fru' were combined to create composite variable 'veg_f'. These two items included following types of vegetables.

-Item 1 [veg_leav]: Raw or cooked leaves vegetables (spinach, vegetable salad, chicory, cabbage, cauliflower).

-Item 2 [veg_fru]: Tomato (except preserve), aubergine, pepper, fennel, courgette, artichoke, carrot, pumpkin, cauliflower, green peas and other fresh pulses.

The composite 'veg_f' variable for Italy is then created according to the following scheme:

if (veg_leav = 1 or veg_fru = 1) veg_f = 1.
if (veg_leav = 2 and veg_fru = 2) veg_f = 1.
if (veg_leav = 2 or veg_fru = 2) veg_f = 2.
if (veg_leav = 4 or veg_fru = 4) veg_f = 4.

Frequency distributions

Table 7. Frequency distribution of fresh vegetable consumption variable, after recoding

Country	Fresh vegetable consumption				
	Missing	Almost daily or more	Three or more times per week	Once or twice per week	Never or almost never
FIN	36.2	23.7	20.6	14.9	4.5
DEN	0.4	12.2	24.6	41.9	20.9
EST part 1	4.0	19.8	33.1	23.8	19.2
EST part 2	9.1	11.8	33.3	24.8	20.9
LIT	38.2	11.6	17.7	22.8	9.7
LAT	11.4	23.1	25.8	29.6	10.2
SLO	6.9	24.3	31.7	28.3	8.8
ITA part 2	2.8	34.0	50.2	-*)	13.0
SPA	0.6	32.0	36.5	23.2	7.6
GER	2.6	34.8	42.8	16.6	2.6
HUN part 1	0.0	27.9	45.6	16.2	0.0

Note. *) ITA: category ‘once or twice per week’ does not exist.

Non-fresh vegetable consumption [VEG_O]

Definition
This variable aims to measure the weekly amount of non-fresh vegetables that the respondent consumes on a regular basis. Non-fresh vegetables are defined as boiled, frozen or preserved vegetables.

Categories and their meaning
1 = Almost daily or more
2 = Three or more times per week
3 = Once or twice per week
4 = Never or almost never
-1 = Missing

Recoding procedure
See under heading ‘Vegetable consumption – General’.

Harmonisation procedure
See under heading ‘Vegetable consumption – General’.

Country-specific notes

Table 8. Description of source variables for the non-fresh vegetable variable the original surveys:

Country	**Description of fruit item**	**Original categories** [between brackets: the new values of the variable[*)]]
DEN	How often do you generally eat cooked vegetables?	6 Everyday/several times a day (1) 5 Almost everyday (1) 4 A few times a week (2) 3 Once a week (3) 2 Less then once a week (4) 1 Never/very rarely (4)
LIT, FIN, LAT	How often during the *last week* have you consumed boiled vegetables	4 6-7 times (1) 3 3-5 times (2) 2 1-2 times (3)
SLO	How often during the *last week* have you consumed frozen, cooked, canned vegetables?	1 never (4)
GER[**)]	During the last 12 months, how often did you eat conserved/cooked vegatables?	1= more than once a day 2= daily resp. nearly daily 3= several times in the week 4= about ounce a week 5= 2 or 3 times per month 6= once a month or less 7= (nearly) never

Note.

[*)] Meaning of the parenthesized numbers: 1=Almost daily or more; 2=Three or more times per week; 3=Once or twice per week; 4=Never or almost never

[**)] GER: Variable veg_o was created by combining two variables that measured the consumption of cooked (vegcook) and conserved (vegcon) vegetables. This was done according to the following scheme:
if (vegcon = 1 or vegcook = 1) or (vegcon = 2 and vegcook = 2) veg_o = 1.
if (vegcon = 2 or vegcook = 2) or (vegcon = 3 and vegcook = 3) veg_o = 2.
if (vegcon = 3 or vegcook = 3) or (vegcon = 4 or vegcook = 4) or (vegcon = 5 and vegcook = 5) veg_o = 3.
if (vegcon = 5 or vegcook = 5) or (vegcon = 6 or vegcook = 6) or (vegcon = 7 and vegcook = 7) veg_o = 4.

Frequency distributions

Table 9. Frequency distribution of non-fresh vegetable consumption variable, after recoding

Country	**Non-fresh (boiled, preserved, frozen) vegetable consumption**				
	Missing	Almost daily or more	Three or more times per week	Once or twice per week	Never or almost never
FIN	37.5	5.6	15.4	26.9	14.6
DEN	0.3	12.7	32.2	43.9	10.9
LIT	40.7	5.7	16.4	24.7	12.6
LAT	20.3	4.5	11.0	29.8	34.4
SLO	10.1	4.9	15.2	41.4	28.3
GER	2.6	0.3	5.4	41.9	49.8

Total vegetable consumption [VEGTOT]

Definition
This variable aims to measure the total weekly amount of vegetables (i.e., both fresh and non-fresh) that the respondent consumes on a regular basis.

Categories and their meaning
1 = Almost daily or more
2 = Three or more times per week
3 = Once or twice per week
4 = Never or almost never
-1 = Missing

Harmonisation procedure
The two newly created variables 'veg_f' and 'veg_o' (see previous two sections) were combined into a 'composite' variable [vegtot]. This procedure took place according to the following derivation scheme:

if (veg_f = 1 or veg_o = 1) vegtot = 1.
if (veg_f = 2 and veg_o = 2) vegtot = 1.
if (veg_f = 2 or veg_o = 2) vegtot = 2.
if ((veg_f = 2 and veg_o = 3) or (veg_f = 3 and veg_o = 2)) vegtot = 2.
if (veg_f = 3 and veg_o = 3) vegtot = 2.
if (veg_f = 3 and veg_o = 4) or (veg_f = 4 and veg_o = 3) vegtot = 3.
if (veg_f = 4 and veg_o = 4) vegtot = 4.

This means that, in order for variable 'vegtot' to exist, its 'ingredients' veg_f and veg_o must also exist. The abovementioned 'merging scheme' does not apply to the French variable. In this data set, a variable measuring total vegetable consumption was already present.

Frequency distributions

Table 10. Frequency distribution of fresh and non-fresh vegetable consumption variable, after recoding

Country	**Fresh and non-fresh vegetable consumption**				
	Missing	Almost daily or more	Three or more times per week	Once or twice per week	Never or almost never
FIN	36.7	27.4	59.0	9.3	4.3
DEN	0.3	15.1	66.8	13.0	5.0
LIT	39.3	18.5	63.1	14.5	4.0
LAT	16.0	24.5	51.1	17.5	6.9
SLO	9.1	23.0	58.4	14.8	3.8
GER	2.7	33.4	56.8	7.8	2.1
FRA	31.7	60.7	14.9	0.4	24.1

Note. Prevalences are percentages of valid *N*.

FRA: The French harmonized variable 'vegtot' was created using a continuous variable for weekly vegetable consumption. The categorization scheme is identical to that described under 'fruitwk'. The measurement unit that was employed for the vegetables variable (i.e., *number* of vegetables) may have yielded artifactual results. A valid item for vegetable consumption ought to use a weight unit instead.

Respondents who reported to eat more than 49 vegetables a week were categorized as ‘missing’. Respondents who reported to eat between and including 8 and 49 vegetables per week were categorized as ‘1 daily or almost daily’. Respondents who reported to eat between and including 1 and 5 vegetables per week were categorized as ‘2 at least once a week’. Respondents who reported to eat no (zero) vegetables were categorized as ‘3 Never or almost never’. Formulated alternatively: if (vegets gt 49) vegtot = -1.
if (vegets ge 8 and vegets le 49) vegtot = 1.
if (vegets ge 1 and vegets lt 8) vegtot = 2.
if (vegets = 0) vegtot = 3.

Leisure Time Physical Activity [LTPACORE, LTPASUP]

Definition
This variable measures the total amount physical activity done by the respondent on regular basis during leisure time. It includes both regular sport training (jogging, spinning, body building, team game trainings, etc) as well as physically intensive leisure time activities such as leisure biking, gardening, walking, etc. In this variable information on the regularity of LTPA may also be included.

Harmonization procedure
Two leisure time physical activity variables were constructed:
-Leisure time physical activity, *core variable* [LPTACORE] measures the weekly frequency of leisure time physical activity (as defined above)
-Leisure time physical activity, *supplementary variable* [LTPASUP] measures the respondent’s life style in terms of physical activity. Difference with variable ‘ltpacore’ is, that for variable ‘ltpasup’ the concept of ‘physical activity’ is preferably measured as the combination of (a) intensity and (b) frequency of physical activity.

Categories and their meaning
The new response categories of variable ‘LTPACORE’ are:
1 = daily
2 = 4–6 times a week
3 = 2–3 times a week
4 = once a week
5 = less than once a week
-1 = Missing

The new response categories of variable ‘LTPASUP’ are:
1= highly active (frequent*) high-level intensity)
2 = moderate active (infrequent high-level activity, or frequent**) median-level+) activity)
3 = lightly active (infrequent**) median-level activity)
4 = sedentary (low-level activity dominates life style)
-1=Missing

* “frequent” = at least about 5+ times/days or 4+ hours a week
** “infrequent” = at least 1 time/day or 30 minutes a week
\+ “median-level” = makes mildly sweet or a bit breathtaking

Recoding schemes

-The categories ‘I cannot exercise because of damage or illness’ have been recoded to ‘Very inactive or sedentary’ for the variable LTPASUP, because the pattern of physical activity of this group of respondents is approximated as being ‘sedentary’.

-The missing categories of both variables include the rather heterogeneous items of ‘don’t know’ ‘missing’ ‘no answer’, ‘refused’ and the like.

Country-specific notes

Table 11. Description of source variables for the LTPA variables the original surveys:

Country	Description	Original categories	New codes Core*	New codes Sup**	Remark
FIN, LIT, LAT, EST, SLO	How often do you do physical exercise at leisure lasting at least 30 min. and making you at least mildly short of breath and perspire?	1 = daily	(1)	(1)	Category ‘less than once a week’ includes e.g. respondents with disabi-lities.
		2 = 4–6 times a week	(2)	(1)	
		3 = 2–3 times a week	(3)	(2)	
		4 = once a week	(4)	(3)	
		5 = 2–3 times a month	(5)	(4)	
		6 = a few times a year or less	(5)	(4)	
		7 = I cannot exercise because of damage or illness	(5)	(4)	
NET	How many hours a week do you spend (bicycling, wandering, gardening, doing odd jobs)? *(See also below)*	7 days/week	(1)	(2)	New category **1** can not be discerned for variable LTPASUP
		6 days/week	(2)	(2)	
		5 days/week	(2)	(2)	
		4 days/week	(2)	(3)	
		3 days/week	(3)	(3)	
		2 days/week	(3)	(3)	
		1 days/week	(4)	(3)	
		0 days/week	(5)	(4)	
CZR	Recreational sports: number of days per week	7 days/week	(1)	(2)	New category **1** can not be discerned for variable LTPASUP
		6 days/week	(2)	(2)	
		5 days/week	(2)	(2)	
		4 days/week	(2)	(3)	
		3 days/week	(3)	(3)	
		2 days/week	(3)	(3)	
		1 days/week	(4)	(3)	
		0 days/week	(5)	(4)	
HUN #1	How often did you do physical work or sport activities for at least 10 minutes (that cause significant sweating or increase heart rate) during the past 12 months?	1=At least once a day	(1)	(1)	New category **2** can not be discerned for variable LTPACORE
		2=Several times a week, but not every day	(3)	(2)	
		3=At least once a week	(4)	(3)	
		4=At least once a month	(5)	(4)	
		5=Less frequently	(5)	(4)	
		6=Never	(5)	(4)	

Note. *) The new codes of variable LTPACORE are: 1 = daily; 2 = 4–6 times a week; 3 = 2–3 times a week; 4 = once a week; 5 = less than once a week. **) LTPASUP: 1= highly active (frequent high-level intensity); 2 = moderate active (infrequent high-level activity, or frequent median-level activity); 3 = lightly active (infrequent median-level activity); 4 = sedentary (low-level activity dominates life style)

The Dutch data had four variables that were together suitable for the creation of variable ‘ltpacore’. These variables were: ‘wandering’, ‘bicycling’, ‘gardening’, and ‘doing odd jobs’. All four variables were measured in the number of days per week that this activity was done, and therefore ranged from 0 to 7. The composite variable was created by taking the highest number of days per week that was spent on any of the four activities. The average was then rounded and recoded according to the categories of ‘ltpacore’ (see also above). Variable ‘ltpsup’ was subsequently created using ‘ltpacore’ as input. The recoding scheme is shown above and is identical to that of CZR.

LTPACORE category 1 of the Hungarian data can be interpreted as ‘4 times per week or more’. In the original coding, the distinction between the new categories 1 and 2 could not be made. The omission of category 2 is, therefore, arbitrary to some degree. Category 1 could also have been omitted instead.

LTPACORE - Frequency distributions

Table 12. Frequency distribution of fresh and LTPACORE variable, after recoding

Country	**LTPACORE - leisure time physical activity*)**					
	Missing	daily	4–6 times a week	2–3 times a week	once a week	less than once a week
FIN	35.2	12.2	16.4	33.5	16.4	21.6
EST	3.0	7.4	5.1	18.2	12.8	56.6
LIT	7.2	15.6	8.0	16.9	13.7	45.8
LAT	4.4	12.9	5.4	15.9	12.3	53.5
CZR	3.2	9.3	3.1	14.8	6.5	66.3
SLO	10.4	6.3	6.1	17.5	17.1	53.1
NET	15.5	15.9	23.1	25.3	19.7	16.0
HUN# 1	1.2	36.7	-	19.8	6.4	37.0

Note. *) Percentages are proportions of valid *N*. Hyphenated cells indicate absence of categories.

Table 13. Description of source variables for the LTPASUP variable the original surveys:

Country	**Description**	**Original categories****)	**Remark**
NOR	How many hours a week do you perform LTPA that make you sweat/ out of breath?	4 3 hrs or more (2) 3 1-2 hours (3) 2 less than 1 hr (3) 1 none (4)	New category **1** can not be discerned
DEN	If we look back on the past year, what would you say best describes your spare time activities?	1=Heavy training and competitive sports regularly and several times a week (1) 2=Exercise or heavy gardening at least 4 hours a week (2) 3=Walk, bike or other easy exercise at least 4 hours a week (2) 4=Read, watch TV or other sedentary occupation (4)	New category **3** can not be discerned

Table 13. (cont.)

Country	Description	Original categories[**)]	Remark
BEL	What describes best your leisure time activities during the last year?	1 Hard training and/or sport for more than 4 hours a week (1) 2 Sport for less than 4 hours a week and/or light activities (2) 3 Sedentary activities (4)	New category **3** can not be discerned
SPA	Subjects were asked about the type of physical exercise done in their free time; in the case of unemployed or retired persons, exercise at any time was considered.	4= Intense physical activity several times per week (1) 3= Regular leisure activity several times per month (running, swimming, team plays, etc) (2) 2= Some occasional leisure activity as leisure biking, gardening, walking (3) 1=Completely sedentary (reading, watching television, …) (4)	
ITA#1 [***)]	In the last 12 months have you continuously done during leisure time one or more physical activities which required intensive training (agonistic and not agonistic sports, gym, etc…)?	2=Yes, more than 4 hours in a week *(see below)* 3=Yes, 4 hours in a week *(see below)* 4=Yes, less than 4 hours in a week *(see below)* 1=No *(see below)*	
POR	Do you practice any regular activity (run, ride bicycle or other) enough to make you feel tired at least once a week?	1= sport training (1) 2= physically intensive leisure time activities (2) 3= sedentary activities (4)	New category **3** can not be discerned
GER	How often are you practising <u>*sport*</u> activities?	1= regularly, more than 4 hours per week (1) 2= regularly, 2-4 hours per week (2) 3= regularly, 1-2 hours per week (3) 4= less than 1 hour per week (3) 5= no sport activities (4)	*Sports* activities during *last 3 months*

Note.

[*)] Countries in the previous table of 'LTPACORE' are also available for variable 'LTPASUP'.

[**)] The new variable codes are parenthesized. The new codes of variable LTPASUP are: 1= highly active (frequent high-level intensity); 2 = moderate active (infrequent high-level activity, or frequent median-level activity); 3 = lightly active (infrequent median-level activity); 4 = sedentary (low-level activity dominates life style)

[***)] ITA: The Italian dataset contained a series a three items that were suitable for the creation of variable LTPASUP:

-In the last 12 months have you continuously done during leisure time one or more physical activities which required intensive training (agonistic and not agonistic sports, gym, etc…)? [Variable name=ACTINT]

-(If not) In the last 12 months have you regularly done during leisure time one or more physical activities until sweating a bit (jogging, biking, gardening, etc…)? [Variable name=ACTREG]; -(If not) Do you usually do a soft physical activity (walking for at least one kilometer, climbing stairs, etc…)? [Variable name=ACTSOFT]

-All three items had the following response categories: 1 No; 2 Yes, more then 4 hours in a week; 3 Yes, 4 hours in a week; 4 Yes, less then 4 hours in a week.

For the *Italian data*, variable LTPASUP was created as follows:

Table 14. Coding scheme for LTPA variable in Italian data set.

Old variables and coding	**New variable LTPASUP and coding**
actint =2 or 3	→ ltpasup = 1
actint =4	→ ltpasup = 2
actreg=2 or 3	→ ltpasup = 2
actreg=4	→ ltpasup = 3
actsoft=2 or 3	→ ltpasup = 3
[all other cases]	→ ltpasup = 4

LTPASUP - Frequency distributions

Table 15. Frequency distribution of LTPASUP variable, after recoding

Country	**LTPA - Supplementary variable[*)]**				
	Missing	highly active	moderately active	lightly active	sedentary
NOR	0.3	-	30.7	38.2	31.1
FIN	35.2	28.6	33.5	16.4	21.6
DEN	1.0	4.5	78.9	-	16.6
EST	3.0	12.4	18.2	12.8	56.6
LIT	11.1	24.6	28.0	29.6	17.8
LAT	4.4	18.4	15.9	12.3	53.5
CZR	0.5	-	12.1	23.4	64.6
SLO	12.6	12.7	17.9	17.5	51.9
NET	15.5	-	32.3	51.6	16.0
BEL	7.7	16.1	48.2	-	35.8
ITA#1	0.0	9.0	19.3	29.7	41.9
SPA	0.6	5.7	8.7	39.7	45.9
POR	2.7	2.0	25.0	-	73.1
GER	2.7	7.1	11.0	33.3	45.8
HUN #1	1.2	19.6	6.3	36.6	36.3

Chronic diseases

General

This set of variables is based on a series of questions on the prevalence of chronic diseases (e.g. cancer, diabetes mellitus, hypertension, arthritis and headache/migraine). The original files usually have one variable for each of the chronic diseases covered in the surveys. In the recoded file, we included a series of variables that measure whether or not the respondent reports to *currently* have a chronic disease (but see the remark on diseases with a sudden onset below!), with one variable separately for each disease. An overview of the diseases included in this study, as well as the names used in the data files, is shown for each country in the table below. Country-specific information is discussed for each disease in separate paragraphs.

Categories and their meaning

The two main response categories are: 1 ‘currently present (yes)’ and 2 ‘currently absent (no)’. The missing category codes for the rather heterogeneous items of ‘don’t know’ ‘missing’ ‘no answer’ and ‘refused’.

General harmonization procedure

A large and sometimes heterogeneous amount of items about chronic diseases were available. Answers were either tricho- or dichotomous: ‘1 Yes, currently’, ‘2 No, never’, ‘3 No, but I had in the past’. Binary questions were yes/no questions. Trichotomous questions were generally dichotomised such that only respondents who *currently* have the disease are coded ‘yes’. Exceptions to this are diseases with a sudden onset. In the cases of epilepsy, myocardial infarct, and heart failure response categories ‘have now’ and ‘have had’ and similar pairs are recoded to ‘yes’.

Questions sometimes differ in their reference period: e.g. did you ever have disease X vs. did you have disease X in the past 2 months. Our aim was to let the reference periods be as comparable as possible. In the documentation of each disease, a ‘recall period’ is given (if available). The general syntaxis of the items is: “Did you have [disease] during the last [recall period]?” Unfortunately, information on the recall period is not available in many cases. In those cases where this information is available, the recall period is usually one year.

Diabetes [DIABETES]

Definition

This variable aims to measure whether the respondent currently has diabetes, type I or type II. The presence of this disease is measured (if available) in a specified recall period (e.g. 12 months).

Country-specific notes

Table 16. Description of source variables for diabetes variable the original surveys:

Country	Disease description	Original categories	Recall period
NOR	Diabetes	1 Have now, 2 Have had, 3 Have never had	[None given]
SWE	Diabetes mellitus (ICD9)	[See note in introduction of this chapter]	[None given]
FIN	Diabetes	1 Yes 2 No	Last year
DEN	Diabetes	1 Yes 2 No	[None given]
EST	Elevated blood sugar, diabetes	1 Yes 2 No	Last year
LIT	Diabetes		
LAT	Diabetes		
CZR	Diabetes	1 Yes 2 No	Last 12 months
SLO	High blood sugar (diabetes)	1 Yes 2 No	[None given]
NET	Diabetes	1 Yes 2 No	Last 12 months
BEL	Diabetes mellitus	1 Yes 2 No	Last 12 months
ITA	Diabetes	1 Yes 2 No, never 3 No, but I had in the past	[None given]
SPA	Diabetes	1 Yes 2 No	[None given]
POR	Diabetes	1 Yes 2 No	[None given]
GER	Diabetes with or without insuline dependency	1= yes 2= no 3= I do not know	Ever
HUN	Diabetes	1 Yes 2 No	[None given]
FRA	Diabetes	1 Yes 2 No	Currently

Note. German data had two diabetes variables for diabetes. If the respondent scores ‘no’ on both of the variables, the newly created variable acquires value ‘2 no’. If the respondent scores ‘yes’ on either of the two variables, the newly created variable acquires value ‘1 yes’.

Frequency distributions

Table 17. Frequency distribution diabetes variable, after recoding

Country	Indicator	
	Miss.	Prev.
BEL	1.09	3.8
CZR	.00	7.2
DEN	.09	2.7
EST	4.64	4.2
FIN	.00	2.5
FRA	25.40	4.3
GER	4.11	5.4
HUN	.27	7.5
ITA1	.00	4.5
LAT	.00	1.6
LIT	15.85	1.8
NET	15.54	4.0
NOR	.09	3.4
POR	.11	6.3
SLO	5.10	3.9
SPA	.00	5.4
SWE	.00	2.9

Hypertension [HYPERTEN]

Definition

This variable aims to measure whether the respondent currently has hypertension, which may be defined as elevated blood pressure persistently exceeding 130/90mm Hg. This condition should currently be present. The presence of this disease is measured (if available) in a specified recall period (e.g. 12 months).

Country-specific notes

Table 18. Description of source variables for the hypertension variable the original surveys

Country	Disease description	Original categories	Recall period
NOR	High blood pressure	1 Have now, 2 Have had, 3 Have never had	[None given]
SWE	Hypertensive disease (ICD9)	[See note in introduction of this chapter]	[None given]
FIN	elevated blood pressure	1 Yes 2 No	
DEN	High blood pressure	1 Yes 2 No	[None given]
EST	Elevated blood pressure, hypertension	Diagnosed or treated by a doctor during the Last year?	Last year
LIT	Elevated blood pressure	1 Yes 2 No	
LAT	Elevated blood pressure		
CZR	High blood pressure (hypertension)	1 Yes 2 No	Last 12 months
SLO	High blood pressure (hypertension)	1 Yes 2 No	[None given]
NET	High blood pressure	1 Yes 2 No	Last 12 months
BEL	Hypertension	1 Yes 2 No	Last 12 months

Country	Disease description	Original categories	Recall period
ITA	Hypertension	1 Yes 2 No, never 3 No, but I had in the past	[None given]
SPA	Hypertension	1 Yes 2 No	[None given]
POR	High tension	1 Yes 2 No	[None given]
GER	Hypertension	1= yes 2= no 3= I do not know	Ever
HUN	Hypertension	1 Yes 2 No	[None given]
FRA	High blood pressure	1 Yes 2 No	Currently

Frequency distributions

Table 19. Frequency distribution of the hypertension variable, after recoding

Country	Indicator	
	Miss.	Prev.
BEL	.63	13.9
CZR	.00	20.3
DEN	.09	8.7
EST	4.66	18.5
FIN	.00	12.2
FRA	.00	.0
GER	7.66	23.7
HUN	47.78	30.6
ITA1	.00	14.2
LAT	.00	10.4
LIT	13.79	21.1
NET	15.36	13.2
NOR	.15	10.7
POR	.26	20.3
SLO	5.10	20.8
SPA	.00	14.4

Self-Assessed General Health and its ranked equivalent [SAH, SAH_RANK]

Definition
This health indicator refers to the general assessment of health that is rated according to answer categories such as “Very good, good, fair, poor or very poor" or “Excellent, very good, good, fair, poor”. The variable SAH gives the answer of the respondent according to these five response categories. The variable SAH_rank positions the respondent on a “health” hierarchy ranging from 0 (the healthiest persons) to 1 (the least healthy person). In *countries with multiple years or file parts*, sah_rank (and also edurank), the ranking is sometimes calculated for each part. These countries should be analysed accordingly (e.g. Relative Index of Inequality must be calculated for each file part separately).

Categories and their meaning
In all countries, 5 answer categories are distinguished, with 1 representing the healthiest category (e.g. “ very good”). The precise answer categories vary between countries. See table below for a list of categories. The variable SAH_rank is measured on a continuous scale ranging from 0 to 1. Remaining categories signified ‘don’t know’ or ‘missing’ or ‘not applicable’. These were recoded to system missing.

Harmonisation procedure

The original coding of variable SAH was retained for each country. Variations in answer categories were not adjusted for.

In order to create a variable that is more directly compared between countries, we created the variable SAH_rank. This variable was calculated on the basis of the cumulative relative frequencies (cumpct) of the valid cases.

- First category: ranking variable = cumpct / 2.
- Other categories: ranking variable = cumpct minus the preceding cumpct, divided by two, plus the preceding cumpct. Or formulated alternatively:

  ranking variable = ((cumpct - lag (cumpct,1))/ 2) + lag (cumpct,1).

  This yields stepwise increasing categories with values between and including 0 and 1.

Country-specific notes

Table 20. Description of source variables for SAH variable the original surveys

Country	**Original survey item**
NOR	How do you assess your own health to be in general?
SWE:	How do you consider your general health?
FIN, LIT, LAT, EST	How would you assess your present state of health?
DEN	How do you rate your present state of health in general?
CZR	How is your health in general?
SLO	How would you assess your present state of health?
ENG	How is your health in general? Would you say it was …
IRE:	In general, how good would you say your health is? Would you say it is……
NET	What do you think, in general, about your health?
BEL	How is your health in general?
ITA	How is in general your health status?
SPA	In the last twelve months, would your state of health had been …
POR	How do you classify your health status?
GER	How would you describe your health status in general?
HUN	How do you think your health has been in general during the past 12 months?
FRA	How is your general state of health?

Table 21. SAH categories by country

NOR	SWE	EST, LET, LIT, FIN	DEN	CZR
1 = Very good	1 = Very good	*1 = Good*	1 = Really good	1 = Really good
2 = Good	*2 = Good*	2 = Reasonably good	*2 = Good*	*2 = Good*
3 = Neither good nor bad	3 = Something in between	3 = Average	3 = Fair	3 = Fair
4 = Bad	4 = Bad	4 = Rather poor	4 = Bad	4 = Bad
5 = Very bad	5 = Very bad	5 = Poor	5 = Very bad	5 = Very bad
SLO	**ENG**	**IRL**	**NET**	**BEL**
1 = Good	1 = Very Good	1 = Very Good	1 = Outstanding	1 = Very good
2 = Reasonably good	*2 = Good*	*2 = Good*	2 = Very good	*2 = Good*
3 = Average	3 = Fair	3 = Fair	3 = Good	3 = Fair
4 = Rather poor	4 = Bad	4 = Bad	4 = Moderate	4 = Bad
5 = Poor	5 = Very Bad	5 = Very Bad	5 = Bad	5 = Very bad
ITA, FRA	**SPA**	**POR**	**GER**	**HUN**
1 = Very good	1 = Very good	1 = Very good	1 = Excellent	1 = Very good
2 = Good	*2 = Good*	*2 = Good*	2 = Very good	*2 = Good*
3 = Fair, Average	3 = Not very good, fair	3 = Fair	*3 = Good*	3 = Fair
4 = Poor	4 = Bad	4 = Poor	4 = Less than good	4 = Bad
5 = Very poor	5 = Very bad	5 = Very poor	5 = Bad	5 = Very bad

Frequency distributions

Frequency distributions based on the aforementioned questions are shown in the table below.

Table 22. Frequency distribution of SAH variable, after recoding

Country	Missing	[positive/healthy]		:::::::::::::::::::		[negative/unhealthy]
BEL	7.5	24.0	50.3	21.2	3.8	0.7
CZR	0.0	18.5	43.7	28.4	8.1	1.3
DEN	0.1	35.2	42.6	16.1	4.6	1.6
ENG	0.0	33.0	41.1	18.8	5.4	1.7
EST	1.1	15.1	26.5	47.5	8.1	2.9
FIN	0.5	35.3	32.9	24.5	6.2	1.1
FRA	25.5	21.0	54.2	21.1	3.1	0.5
GER	2.2	3.0	16.8	62.7	15.7	1.8
HUN	0.1	8.2	34.7	39.5	14.3	3.3
IRE	0.2	45.9	35.4	15.4	2.5	0.7
ITA1	0.0	12.3	42.3	37.0	6.8	1.7
LAT	0.5	19.1	22.3	46.4	8.6	3.6
LIT	1.0	22.1	17.9	50.7	5.0	4.4
NET	15.8	18.9	26.7	42.6	10.1	1.7
NOR	0.1	33.8	47.2	12.9	5.1	1.0
POR	42.7	2.7	28.4	43.0	20.5	5.4
SLO	3.3	35.0	32.5	21.7	6.9	3.9
SPA	0.3	15.1	55.2	22.5	5.6	1.6
SWE	0.1	35.2	39.6	18.8	5.0	1.4

Smoking Status [SMOKSTAT]

Definition
The variable Smokstat describes the current smoking status of the respondent.

Categories and their meaning
1 = current regular smoker
2 = current occasional smoker
3 = ex smoker
4 = never smoker

Distinguished categories and survey questions
The following table shows for each country which survey questions were used to construct the variable Smokstat. The middle column specifies which categories are distinguished in the harmonized files per country. The last column gives the smoking-related survey questions that were used to distinguish these categories.

Table 23. Description of source variables for smoking status variable the original surveys

Country	Distinguished categories in harmonized files	Categories based on the following questions
Norway	1 2 4	Do you smoke sometimes? If yes, do you smoke every day?
Sweden	1 3 4	Do you smoke daily? Have you previously smoked daily for any period of your life?
Finland	1 2 3 4	Have you ever smoked? Have you ever smoked regularly/daily Have you ever smoked at least 100 times? Have you ever smoked regularly/daily
Denmark	1 2 3 4	Do you smoke? If no, have you been a smoker?
Estonia	1 2 4	Have you ever smoked in your life?
Lithuania	1 2 3 4	Have you ever smoked? Have you ever smoked regularly/daily Have you ever smoked at least 100 times? Have you ever smoked regularly/daily
Latvia	1 2 3 4	Have you ever smoked? Have you ever smoked regularly/daily Have you ever smoked at least 100 times? Have you ever smoked regularly/daily
Czech Rep	1 3 4	Do you smoke? Did you smoke?
Slovakia	1 2 3 4	Do you smoke in present time? Have you ever smoked in your life?
Hungary ‘00/’03	1 2 3 4	Do you currently smoke any tobacco products such as cigarettes, cigars or pipes
England	1 3 4	Have you ever smoked a cigarette, a cigar or a pipe? Do you smoke cigarettes at all nowadays?

Country	Distinguished categories in harmonized files	Categories based on the following questions
Ireland	1 2 3 4	Do you smoke, occasionally or daily? Did you ever smoke?
Netherlands	1 2 3 4	Do you smoke? Do you smoke every day? Did you ever smoke?
Belgium	1 2 3 4	Do you smoke? (every day / now or then) Did you ever smoke?
Germany	1 3 4	Have you smoked in the past or do you smoke at present
France	1 3 4	Do you usually smoke? Did you ever smoke?
Italy 1	1 3 4	Do you smoke? Yes/ I did / No
Spain	1 2 3 4	Do you smoke?
Portugal	1 2 3 4	Did you smoke on the last two weeks? How long ago did you stop smoking?

Frequency distributions

The resulting population distribution according to smoking status is given in the table below. The distribution is given for men and women together. The population distribution according to levels is given as % of the total population, excluding those with missing information on smoking status. The % missing is given in the second column, as a % of the entire population.

Table 24. Frequency distribution of smoking status variable, after recoding

Country	NA	Missing (%)	Current regular	Occasional	Ex	Never
Norway		0.2	27.2	10.7		62.1
Sweden		1.4	18.8		29.6	51.6
Finland		2.0	24.0	6.6	18.8	50.6
Denmark		0.2	34.3	2.8	23.5	39.3
Estonia		5.0	39.6		18.1	42.2
Lithuania		4.2	27.7	6.9	8.6	56.7
Latvia		79.5	30.9	6.0	10.7	52.4
Czech Rep		0.0	24.1	6.0	20.8	49.1
Slovakia		19.9	22.5	10.0	17.6	49.9
Hungary		0.2	30.0	3.0	19.0	48.0
England		1.4	25.4		32.1	42.5
Ireland		57.1	24.4	4.7	17.1	53.8
Netherlands		0.1	25.3	5.4	33.7	35.6
Belgium		6.2	25.0	4.6	28.8	41.6
Germany		2.3	26.6		21.3	52.1
France		27.4	23.8		26.5	49.7
Italy 1		0.0	24.4		19.7	55.9
Italy 2	X					
Spain		0.2	31.3	2.8	16.4	49.4
Portugal		0.1	18.3	2.4	13.6	65.6

Note. NA = Not available

Country specific notes

Ireland: The Irish dataset consists of two years (1995 and 2001) of the same survey. In 1995 the survey did not include any questions on smoking. The number of missings is therefore very high for the merged Irish data set.

Latvia: The Latvian dataset consists of for years (1998 2000 2002 and 2004) of the same survey. Only the latest survey (of 2004) included information on smoking. The number of missing values is therefore very high for the merged Latvian data set.

SUMMARY

It has been known for long that disease and death are unequally distributed over the population. This also applies to overweight and severe overweight (obesity). In most western countries, overweight and obesity nowadays are more common among people of lower socioeconomic positions. The socioeconomic differences are largest and most clear in women. For instance, in the Netherlands low-educated women are approximately 2-3 times more likely to be overweight than high-educated women. Which groups are affected most (*who*), how is that possible (*how*), is this true in all European countries (*where*), and has this always been the case (*when*)? In this dissertation all four questions, but especially the first two, are addressed.

The studies that are described in this dissertation, aim to compare European countries concerning the magnitude of socioeconomic differences in overweight and several related factors. Earlier studies demonstrated that the magnitude of health inequalities importantly varies between countries. The question is why. In fact, the added value of the international overviews presented here lies in the fact that we try to give a better answer to the *how* question by answering the *where* question.

That is, there are national characteristics (think of the general welfare level, or culturally determined dietary patterns) that could influence the magnitude of the socioeconomic differences in the prevalence of overweight. If one would study the data of only one country, such ‘contextual factors’ would never come to light, simply because there would be no way to ‘benchmark’ the results. This immediately gives rise to the second advantage of international comparisons: they provide policy makers with information needed to evaluate on the degree of the social inequality in a certain country. In other words, international overviews provide a yardstick for judging the magnitude of the health inequalities in single countries, in this case overweight-related inequalities. Thus, it may be possible that we could learn something from both countries where the inequalities are large, and there where they are small. Both from a scientific-theoretical and from a policy-practical viewpoint, international overviews may tell us whether research findings can be generalized from one country to another.

Most of the results from this dissertation are based on the Eurothine project. This is a large European research project on socioeconomic differences in health and healthcare utilization. The study into overweight/obesity and related factors was therefore only part of a larger whole. Although mortality data were also collected as a part of the Eurothine project, this dissertation describes only results based on morbidity data.

These morbidity data have usually been obtained around the year 2000 using health surveys. The data concerned pre-existing self-report data which were measured at a certain moment in time. The Eurothine data are comprised of data of a total of 19 different countries from all corners of Europe:

- Scandinavia: Finland, Sweden, Norway, Denmark
- Baltic states: Estonia, Latvia, Lithuania
- Eastern Europe: Slovakia, Czech Republic Hungary
- Western Europe: Netherlands, Belgium, Germany, United Kingdom, Ireland
- Mediterranean countries: France, Italy, Spain, Portugal

This long and varied list of countries reflects a great advantage of the Eurothine project. Never before, an international study into health inequalities was performed using such a diverse gamut of countries, among which the Baltic countries.

In addition to overweight and obesity, this dissertation also reports on social inequalities in risk factors for overweight and obesity (physical inactivity, low vegetable consumption) as well as obesity-related adverse health outcomes (diabetes, hypertension and self-assessed/subjective ill

health). We used educational level as an indicator of socioeconomic position because all datasets contained data on level of education.

Part II of this dissertation (Chapter 3) European describes the international patterns of socioeconomic differences in self-reported level of overweight and obesity. In addition, we evaluated the possibility that a link exists between the general welfare level of countries and the magnitude of the inequalities in overweight and obesity. The *where* question was therefore answered with a description of the current state of affairs on the socioeconomic differences in the prevalence of overweight and obesity. The link with general welfare level therefore gives a (partial) answer to the *how* question.

In the majority of the European countries overweight and obesity were more common among low-educated people. Nevertheless there were large international differences in the magnitude of the inequalities. Without any exception, this phenomenon was much more clearly and more extreme in women. Whichever European country is taken into consideration, overweight and obesity are at least twice as common (a factor 2) in low-educated women. A second, new finding is that the size of the 'obesity gap' varied importantly across Europe: in Mediterranean women it amounted to a factor 5.5, whereas in Baltic women it was a factor 2.5. In addition, at least among men, general welfare level seemed to be correlated with the size of the obesity gap. In terms of overweight risk, an increase in the overall level of wealth seemed to have an unfavorable impact on low-educated men, whereas high-educated men appeared to benefit from an increase in the overall level of wealth.

In the second chapter of Part II (Chapter 4) an attempt was made to, at least in part, answer the *who* question. The term 'socioeconomic position' has many facets, such as educational level, occupational class and income level. One cannot say that one of those facets is a 'better' measure of socioeconomic position than the others. It concerns qualitatively different dimensions. However, we are able to examine for which socioeconomic dimension the relationship with overweight and obesity is strongest and most clear. This was possible because we could also use another European data set, the European Community Household Panel (ECHP). The ECHP contained data concerning educational level, occupational class and income level. An important additional advantage with respect to existing research was that occupational class in the dataset was measured according to the 'European Socioeconomic Classification (ESeC)', a new international measure.

From this study it became clear that the link between level of education and overweight was much stronger, compared to the other two indicators. This was true in virtually all European countries. That means that there is 'something' about educational level (and not about the other two indicators), or something that is intimately linked to educational level, that may comprise a deeper cause of the differences in the prevalence of overweight. In Chapter 4, we speculate about a possible role for cognitive factors such as intelligence.

In Part III of this dissertation (Chapter 5-6) we discuss international patterns in inequalities in two risk factors for overweight and obesity: physical activity and vegetable consumption. Physical activity and energy intake are the most direct risk factors for overweight and obesity. This is often referred to as the 'Input-Output' relationship, between energy intake and physical activity, respectively. Each in itself Chapter 5 and 6 therefore give an answer to the *where* question, but together they also represent a possible answer to the *how* question.

Physical activity was measured by a question concerning physical activity during leisure time. Nearly everywhere in Europe physical *in*activity ('sedentary behavior') was more common in low-educated people. The educational differences within the Mediterranean and eastern European countries were relatively small. The small inequalities in sedentary behavior in the Mediterranean countries did not correspond to the large inequalities in overweight and obesity. In addition, relatively large inequalities in sedentary behavior were found in the Scandinavian countries.

The discrepancy between the inequalities in physical activity and overweight/obesity naturally gives rise to the question if the 'Input' side represents a possible explanation for the inequalities in the prevalence of overweight and obesity. Although it is at most an indirect measure for caloric intake, we have tried to answer this question by studying the inequality patterns of low vegetable consumption. In all European countries, a relation between vegetable consumption and level of education existed, but the strength and the direction of this link varied between countries. In the Scandinavian and the Baltic countries, vegetable consumption was higher under high-educated people. In the Mediterranean countries, on the other hand, low-educated people consumed more vegetables. The latter may be explained by the fact that vegetables are relatively cheap (and as a result for more people affordable) in Mediterranean countries.

After the discussion of risk factors, Part IV (Chapters 7 through 9) discusses the European inequality patterns of two important overweight-related conditions: diabetes and hypertension. Chapter 9 describes the inequality patterns of general health. All the three chapters are based on Eurothine data. We wanted to know the size of the socioeconomic differences in the prevalence of diabetes, hypertension and subjectively experienced ill health. In addition, we evaluated to what extent obesity could explain inequalities in diabetes, hypertension and subjectively experienced ill health.

The socioeconomic differences in the prevalence of diabetes and hypertension were larger in women, especially in Mediterranean women. The differences were smallest in the Baltic countries. The socioeconomic differences in the prevalence of hypertension were very small, but were clearly larger in the Mediterranean countries.

An important *how* question was to what extent inequalities in overweight and obesity could explain inequalities in the prevalence of diabetes and hypertension. The socioeconomic inequalities in the prevalence of diabetes appeared to closely coincide with those in overweight and obesity. Large inequalities in diabetes or hypertension appeared to coincide with similarly large inequalities in obesity, and vice versa. In Europe at large, body mass index explained about 30 % of the inequalities in diabetes en 50 % of the inequalities in hypertension.

In Chapters 7 and 8 the link between inequalities and in overweight/obesity and two diagnosis-specific health measures have been described. In Chapter 9, international inequality patterns in general health, as subjectively experienced by respondents, are described (*where* question). The 'score' on self-assessed health (SAH) was calculated using a novel method. This new method used all available questionnaire information, whereas the existing method used only one part of the available information. SAH is mainly determined by the number of 'objective' conditions that are present in a person. This given was used to enhance the international comparability of the SAH variable.

Everywhere in Europe, SAH was relatively poor among low-educated people, but the differences were largest in Eastern Europe, Great Britain and Portugal. The differences were relatively small in the Mediterranean countries (except Portugal) and in Scandinavia, but were nevertheless still considerable. The latter is surprising, because the Scandinavian countries advocate the principle of complete mutual equality ('egalitarism'). Nevertheless, we found no convincing evidence that these egalitarian regimes are associated with systematically smaller inequalities in subjectively experienced poor health.

Moreover, it was assessed to what extent overweight/obesity and smoking contributed to educational differences in subjectively experienced health (*how* question). On average, body weight (BMI) explained 5 % (men) to 10 % (women) of the educational differences in subjectively experienced poor health. BMI explained the largest percentage of the educational inequalities in subjectively experienced poor health in French (22%) and Spanish (18%) women. Smoking, on the other hand, accounted for a larger proportion of the inequalities in subjectively experienced poor health in men (10%) than in women (4%).

In Part V (Chapter 10) the impact of remaining data problems on the validity of the results is discussed. Next, an overview is given of the most important results. Comparability problems, differential response bias, and 'confounding' are the most important elements which may have led to unjustified conclusions.

The international comparability of indicators was not always satisfactory. The original surveys differed in varying degrees, from nuances to substantial differences. In addition, surveys were not completed, perhaps relatively often by low-educated people. Another possibility is that the answers may give 'idealized' picture of the real situation. Here, too, some evidence exists that low-educated people may have a greater tendency to give such socially desirable answers.

We used survey data that had been acquired by measuring people of different socioeconomic positions at one point in time. This is called a cross-sectional design because it produces a 'cross section' of the population. Group differences (for example between low- and high-educated people) in the prevalence of overweight can arise by a true difference in the level of exposure. However, one can never exclude the possibility that another factor, which has not been taken into consideration, is the actual underlying cause ('confounding'). In summary, a definitive answer to the *how* question cannot be given using only cross-sectional data.

Also in Chapter 10, possible explanations are given for the three main findings of this dissertation:

- A very strong relationship between educational level and the prevalence of overweight/obesity, in comparison with two other commonly used aspects of SEP, income and occupational level;
- Small inequalities in the prevalence of overweight/obesity and related conditions in Baltic/Eastern-European countries;
- Large inequalities in the prevalence of overweight/obesity and related conditions in Mediterranean countries, especially among women.

The strong association between level of education and the prevalence of overweight, in comparison with occupational and income level was so omnipresent in Europe that the term international 'pattern' hardly seemed appropriate. We speculated that, compared with income and occupational level, educational level may a better measure for all kinds of day-to-day knowledge and cognitive skills. Low-educated people may, in general, have less knowledge about things that are (un)healthy and may therefore be more likely to become obese and to get overweight-related conditions. In addition, low-educated people may be more sensitive to mental stress. Mental stress has been associated with the prevalence of overweight. How this works exactly at the biological level is not entirely clear. What is known, however, is that mental stress makes some people move less or eat more. Another possibility is that mental stress might influence the speed of metabolism.

A possible explanation for the pattern of small inequalities in the Baltic and Eastern-European countries is given in terms of an increase of the general welfare level. An increase in general welfare level initially leads to an increase in the consumption of unhealthy foodstuffs. However, this phenomenon does not take place simultaneously in all layers of the population. Modern behaviors (such as eating cheese) are first adopted by the higher socioeconomic positions ('early adopters'). A possible explanation for the small health inequalities in this region is that modern, but unhealthy behaviors among high-educated people are more or less in balance with the traditional, healthier behaviors among low-educated people.

The Mediterranean countries have been described as 'traditional cultures'. This means that the expectations and possibilities for men and women differ considerably. Men are generally still seen as the 'breadwinner', especially in families of lower SEP. Women primarily run the household and are also responsible for raising the children. Low-educated women tend to become fulltime homemakers, although some do manage combine work and motherhood. Previous research has shown that both scenarios are associated with an increased prevalence of overweight and obesity. On the one hand, a working life means that thinness is emphasized, for example by social feedback. This mechanism, which is known as the ‘enhancement hypothesis’, applies especially to women. On the other hand, combining work and family may be more likely to be health-damaging in low-educated women compared to high-educated women. This mechanism is known as the ‘overload hypothesis’.

Finally, some policy and research implications are made. With regard to policies, the most important implication is that interventions in obesity must especially target low-educated people, particularly low-educated women. Moreover, the strong geographical variations in the magnitude of the inequalities indicate that prevention activities must be regionalized. Next, it has become clear that fighting inequalities in the prevalence of overweight will probably also lead to a reduction in the prevalence of diabetes and hypertension. Furthermore, in the Baltic and Eastern-European countries, it seems advisable to consider if general welfare may be construed as an intervention instrument. Fourth, the Mediterranean countries may be regarded a counterexample in terms of inequalities in overweight/obesity among women. In southern Europe, it is advisable to examine the possible role of rules and regulations that pursue gender equity on the magnitude of inequalities in the prevalence of overweight and obesity. A fifth implication is that it seems useful to keep improving knowledge about healthy and unhealthy behaviors. Therefore, the accessibility (for people of lower SEP) and quality of the educational system must be guaranteed.

In terms of research implications, longitudinal studies should be conducted to examine the temporal course of the inequalities in the prevalence of overweight. Furthermore, cross-sectional research could be improved by using more fine-grained measures. Measures regarding individual measurement levels could be refined by further pinpointing what kind of ‘cognitive factors’ are really behind the strong association between educational level and the prevalence of overweight and obesity. Similarly, availability of more refined national characteristics would further pinpoint the exact underlying mechanisms that are behind the geographical inequality patterns. Finally, the international inequality patterns of other overweight-related health conditions, such as heart conditions, stroke and osteoarthritis, could also be studied. In conjunction with this, the contribution of overweight/obesity to socio-economic inequalities in the prevalence of these conditions must also be quantified.

SAMENVATTING

Het is al lang bekend dat ziekte en sterfte niet gelijk is verdeeld over de bevolking. Dit geldt ook voor overgewicht en ernstig overgewicht (obesitas). Tegenwoordig zijn overgewicht en obesitas in de meeste Westerse landen algemener onder mensen van lagere sociaal-economische klassen. Bij vrouwen zijn de sociaal-economische verschillen het grootst en het duidelijkst. Zo zijn in Nederland laagopgeleide vrouwen ongeveer twee tot drie maal vaker te dik dan hoogopgeleide vrouwen. Wie worden hierdoor het meeste getroffen (*wie*), hoe kan dat (*hoe*), is dit overal zo (*waar*), en is dit altijd al zo geweest (*wanneer*)? In dit proefschrift komen al deze vier vragen, maar met name de eerste twee, aan de orde.

Het onderzoek dat in dit proefschrift wordt beschreven, heeft tot doel Europese landen te vergelijken met betrekking tot de omvang van sociaal-economische verschillen in overgewicht en diverse gerelateerde factoren. Uit eerdere onderzoeken is al gebleken dat de mate van de gezondheidsverschillen sterk varieert tussen landen. De vraag is hoe dat komt. In feite bestaat de meerwaarde van deze internationale overzichten eruit, dat wij proberen een beter antwoord op de *hoe*-vraag te geven door de *waar*-vraag te beantwoorden.

Dat wil zeggen: er bestaan nationale karakteristieken (denk aan het algemeen welvaartsniveau, of cultureel bepaalde voedingspatronen) die invloed kunnen hebben op de grootte van de sociaal-economische verschillen in overgewicht. Als men de gegevens van slechts één land zou bestuderen, zouden dergelijke ‘contextuele’ factoren nooit aan het licht komen, simpelweg omdat er dan geen vergelijkingsmateriaal is. Dat brengt ook meteen het tweede voordeel van internationale vergelijkingen naar voren: beleidsmakers verkrijgen zo namelijk informatie die nodig is voor het beoordelen van de grootte van de sociaal-economische ongelijkheid in het betreffende land. Met andere woorden, internationale overzichten voorzien in een maatstaf voor het beoordelen van de ernst van de gezondheidsongelijkheden in afzonderlijke landen, in dit geval die ongelijkheden die met overgewicht te maken hebben. Zo kan men wellicht lering trekken uit zowel de landen waar de ongelijkheden groot zijn, als daar waar ze juist klein zijn. Zowel vanuit wetenschappelijk-theoretisch als uit beleidsmatig-praktisch oogpunt maken internationale overzichten dus duidelijk of onderzoeksbevindingen gegeneraliseerd mogen worden naar andere landen.

De meeste resultaten uit dit proefschrift zijn voort gekomen uit het Eurothine project. Dit is een groot Europees onderzoeksproject over sociaal-economische verschillen in gezondheid en zorggebruik. Het onderzoek naar overgewicht en gerelateerde factoren was dus slechts een onderdeel van een groter geheel. Hoewel in het Eurothine project ook sterftegegevens (mortaliteit) werden verzameld, is in dit proefschrift uitsluitend gebruik gemaakt van gegevens over ziekte (morbiditeit).

Deze morbiditeitsdata zijn allemaal rond het jaar 2000 verkregen aan de hand van vragenlijsten. Het ging dus om bestaande gegevens die op één bepaald moment door de mensen verstrekt waren. In totaal waren 19 verschillende Europese landen uit alle windrichtingen vertegenwoordigd:

- Scandinavië: Finland, Zweden, Noorwegen, Denemarken
- Baltische staten: Estland, Letland, Litouwen
- Oost-Europa: Slowakije, Tsjechië, Hongarije
- West-Europa: Nederland, België, Duitsland, Engeland, Ierland
- Mediterrane landen: Frankrijk, Italië, Spanje, Portugal

Deze lange en gevarieerde lijst van landen geeft een groot pluspunt weer van het Eurothine project weer. Nog nooit eerder werd er een internationaal onderzoek naar gezondheidsverschillen verricht met een dergelijk rijk geschakeerd pallet aan landen, waaronder de Baltische staten.

Naast overgewicht en obesitas zijn in dit proefschrift nog de volgende indicatoren bestudeerd: risicofactoren (fysieke activiteit, groente consumptie) en gezondheidsuitkomsten, (diabetes, hypertensie en zelf-ervaren/subjectieve gezondheid). Omdat alle gegevenssets een vraag over opleidingsniveau bevatten, is voor deze indicator voor sociaal-economische klasse gekozen.

Deel II van dit proefschrift (Hoofdstuk 3) beschrijft Europese variaties in de omvang en patronen in sociaal-economische verschillen in zelf-gerapporteerd overgewicht en obesitas. Ook werd gekeken of er een verband bestaat tussen het welvaartsniveau van landen en de grootte van de ongelijkheden in overgewicht en obesitas. De *waar*-vraag werd dus beantwoord met een beschrijving van de huidige stand van zaken omtrent de sociaal-economische verschillen in overgewicht en obesitas. Het verband met welvaartsniveau geeft een (deel-)antwoord op de *hoe*-vraag.

In verreweg de meeste landen in Europa bleken overgewicht en obesitas vaker voor te komen onder laagopgeleiden. Toch waren er grote verschillen te zien. Ten eerste was dit fenomeen zonder uitzondering veel duidelijker en extremer bij vrouwen. Waar men ook kijkt in Europa, overgewicht en obesitas zijn vaak minimaal tweemaal (dus een factor 2 of meer) zo algemeen onder laagopgeleide vrouwen. Een tweede, nieuwe, bevinding was dat dit sterk varieerde: bij Mediterrane vrouwen ging het om een factor 5.5, terwijl het bij Baltische vrouwen om een factor 2.5 ging. Daarnaast leek welvaartsniveau (bij mannen althans) samen te hangen met de grootte van de overgewichtskloof. Een toename in algemeen welvaartsniveau leek in termen van overgewichtsrisico ongunstig te zijn voor laagopgeleide mannen, terwijl voor hoogopgeleide mannen het tegengestelde leek te gelden.

In het tweede hoofdstuk van Deel II (Hoofdstuk 4) werd een poging gedaan om gedeeltelijk antwoord op de *wie*-vraag te geven. Het begrip ‘sociaal-economische klasse’ heeft veel facetten, zoals opleidings- beroeps- en inkomensniveau. Men kan niet zeggen dat één van die facetten een ‘betere’ maat is voor sociaal-economische klasse dan de andere. Het gaat om kwalitatief verschillende dimensies. Wél kan men onderzoeken voor welke dimensie de samenhang met overgewicht en obesitas het sterkst en het duidelijkst is. Dit was mogelijk omdat wij ook de beschikking hadden over een andere Europese gegevensset, namelijk die van de European Community Household Panel (ECHP). De ECHP bevatte gegevens over opleidings- en beroeps- en inkomensniveau. Een groot bijkomend voordeel ten opzichte van bestaand onderzoek was dat beroepsniveau in deze dataset werd bepaald met de ‘European Socioeconomic Classification’ (ESeC), een nieuwe internationale maat.

Uit dit onderzoek bleek, dat in nagenoeg alle Europese landen het verband tussen opleidingsniveau en overgewicht veel sterker was dan voor de andere twee indicatoren. Beroepsniveau hing duidelijk minder sterk samen met overgewicht, terwijl het voor inkomensniveau het verband met overgewicht in veel landen vrijwel afwezig of zelfs omgekeerd was. Dat betekent dat er ‘iets’ is aan opleiding (en niet aan de andere twee indicatoren), of iets wat heel sterk met opleiding verband houdt, dat wellicht een dieper liggende oorzaak van de overgewichtsverschillen vormt. In Hoofdstuk 4 speculeren we over een rol voor cognitieve factoren zoals intelligentie.

In Deel III van dit proefschrift (Hoofdstuk 5-6) komen internationale patronen in ongelijkheden in twee risicofactoren voor overgewicht en obesitas aan de orde: fysieke activiteit en groenteconsumptie. Fysieke activiteit en energie-inname zijn de meest directe risicofactoren voor overgewicht en obesitas. In de literatuur heeft men het vaak over een ‘Input-Output relatie’, voor respectievelijk energie-inname en fysieke activiteit. Ieder op zich geven Hoofdstuk 5 en 6 dus een antwoord op de *waar*-vraag, maar samen vormen ze ook een mogelijk antwoord op de *hoe*-vraag.

Fysieke activiteit kwam in de vragenlijsten terug als een vraag over fysieke activiteit in de vrije tijd. Vrijwel overal in Europa was fysieke *in*activiteit (‘sedentair gedrag’) algemener onder laagopgeleide mensen. De opleidingsverschillen in de Mediterrane en Oost-Europese landen waren verhoudingsgewijs klein. De kleine ongelijkheden in sedentair gedrag in de Mediterrane landen kwamen dus niet overeen met de grote ongelijkheden in overgewicht/obesitas. Daarnaast werden relatief grote ongelijkheden in sedentair gedrag gevonden in de Scandinavische landen.

De discrepantie tussen de ongelijkheden in fysieke activiteit en overgewicht/obesitas doet natuurlijk de vraag rijzen of wellicht de ‘Input’ zijde een mogelijke verklaring vormt voor de ongelijkheden. Hoewel het hooguit een indirecte maat voor calorie-inname is, hebben wij geprobeerd deze vraag te beantwoorden door de ongelijkheidspatronen van groenteconsumptie te bestuderen. In alle Europese landen bestond een relatie tussen groenteconsumptie en opleidingsniveau, maar de sterkte én de richting van dit verband varieerde tussen landen. In de Scandinavische en de Baltische landen was de groenteconsumptie hoger onder hoogopgeleide mensen. In de Mediterrane landen daarentegen consumeerden laagopgeleide mensen juist meer groenten. Dit laatste wordt wellicht verklaard door het feit dat groenten in de Mediterrane relatief goedkoop zijn (en daardoor voor meer mensen betaalbaar).

Na de bespreking van risicofactoren worden in Deel IV (Hoofdstuk 7-9) de Europese ongelijkheidspatronen van drie overgewichtsgerelateerde negatieve gezondheidsuitkomsten besproken: diabetes, hypertensie en zelf-ervaren slechte gezondheid. Ook hier werd gebruikt gemaakt van gegevens van de Eurothine dataset. Voor zowel diabetes en hypertensie gold, dat de sociaal-economische verschillen in het vóórkomen ervan groter waren bij vrouwen, en dan vooral bij Mediterrane vrouwen. Bij Baltische mensen waren de verschillen het kleinst. De sociaal-economische verschillen in hypertensie prevalentie waren overigens maar zeer klein, maar waren in Zuid-Europa net iets minder klein.

Een belangrijke *hoe*-vraag was in hoeverre ongelijkheden in overgewicht en obesitas de ongelijkheden in diabetes en hypertensie konden verklaren. De sociaal-economische ongelijkheden van diabetes bleken zeer goed te overeen te komen met die van overgewicht en obesitas. Grote ongelijkheden in de prevalentie van diabetes, hypertensie of zelf-ervaren gezondheid gingen samen met ongelijkheden van soortgelijke omvang in overgewicht en obesitas. In Europa als geheel verklaarde lichaamsgewicht zo’n 30 % van de ongelijkheden in diabetes en zo’n 50 % van de ongelijkheden in hypertensie.

In Hoofdstuk 7 en 8 is het verband tussen ongelijkheden en in overgewicht/obesitas en twee diagnose-specifieke gezondheidsmaten beschreven. In Hoofdstuk 9 worden internationale ongelijkheidspatronen in subjectief ervaren gezondheid (SAH) beschreven (*waar*-vraag). Hierbij werd de ‘score’ op de SAH berekend op een nieuwe manier. Deze nieuwe methode gebruikte alle beschikbare vragenlijst-informatie, terwijl de bestaande methode slechts een deel gebruikte. De SAH wordt met name bepaald door het aantal ‘objectieve’ ziekten dat men heeft. Dit gegeven werd gebruikt om de SAH gegevens nauwkeuriger en beter internationaal vergelijkbaar te maken.

Overal in Europa was de SAH minder goed onder laagopgeleide mensen, maar de verschillen waren het grootst in Oost-Europa, Groot-Brittannië en Portugal. De verschillen waren relatief klein in de Mediterrane landen (behalve Portugal) en in Scandinavië, maar waren toch nog aanzienlijk. Dit laatste is verrassend, want de Scandinavische landen gaan prat op het principe van algehele onderlinge gelijkheid (‘egalitarisme’). Toch vonden wij geen overtuigend bewijs deze egalitaristische regimes hun vruchten afwerpen in termen van systematisch kleinere ongelijkheden in slecht ervaren gezondheid.

Daarnaast werd beoordeeld in hoeverre overgewicht/obesitas en roken bijdroegen aan opleidingsverschillen in de subjectief ervaren gezondheid (*hoe*-vraag). Lichaamsgewicht (BMI) verklaarde bij mannen 5 % en bij vrouwen 10 % van de opleidingsongelijkheden in subjectieve gezondheid. Bij Franse (22 %) en Spaanse (18 %) vrouwen verklaarde BMI het grootste percentage van de opleidingsongelijkheden in subjectieve gezondheid. Roken was daarentegen voor mannen (10 %) een grotere verklarende factor voor ongelijkheden in subjectieve gezondheid dan voor vrouwen (4 %) .

In Deel V (Hoofdstuk 10) wordt het effect van resterende dataproblemen op de validiteit van de resultaten besproken. Daarna wordt een overzicht gegeven van de belangrijkste resultaten. Vergelijkbaarheidsproblemen ten aanzien van gegevens, differentiële response bias en ‘confounding’ worden genoemd als de belangrijkste gegevenseigenschappen die mogelijk hebben geleid tot ongerechtvaardigde conclusies.

De internationale vergelijkbaarheid van indicatoren was niet altijd even goed. De oorspronkelijke enquêtes verschilden soms in nuances, en soms in grote mate van elkaar. In andere gevallen werden vragenlijsten niet ingevuld, misschien zelfs vooral door laagopgeleiden. Een andere mogelijkheid is dat de antwoorden soms een te rooskleurig beeld van de werkelijke situatie gaven. Ook hier bestaat er enige evidentie dat de neiging hiertoe onder laagopgeleiden net iets groter is.

De gebruikte gegevens zijn op één moment afgenomen met steekproeven van mensen van verschillende sociaal-economische klassen. Dit heet een cross-sectioneel design omdat het als het ware een dwarsdoorsnede van de populatie oplevert. Groepsverschillen (bijvoorbeeld tussen laag- en hoogopgeleiden) in het vóórkomen van overgewicht kunnen ontstaan door een werkelijk verschil in blootstelling. Echter, het kan nooit worden uitgesloten dat er bij één van beide groepen nog een achterliggende oorzaak is die helemaal niet in beschouwing is genomen (‘confounding’). Samengevat: de *hoe*-vraag kan met behulp van cross-sectionele gegevens nooit definitief worden beantwoord.

Eveneens in Hoofdstuk 10 worden mogelijke verklaringen gegeven voor de drie bevindingen van dit proefschrift:

- Een zeer sterke relatie van onderwijsniveau met het vóórkomen van overgewicht, in vergelijking met twee andere veel gebruikte aspecten van SEP, inkomens- en beroepsniveau.
- Kleine ongelijkheden in overgewicht/obesitas en aanverwante ziekten in Baltische/Oost-Europese landen;
- Grote ongelijkheden in overgewicht/obesitas en aanverwante ziekten in Mediterrane landen, vooral onder vrouwen.

Bij de zeer sterke associatie van opleidingsniveau met het vóórkomen van overgewicht, in vergelijking met inkomens- en beroepsniveau was er strikt genomen geen sprake van een internationaal patroon. Dit fenomeen was namelijk zó algemeen dat het de aanduiding ‘patroon’ niet meer waardig was. Wij speculeren dat opleidingsniveau (in vergelijking met inkomens- en beroepsniveau) waarschijnlijk een betere maat is voor allerlei kennis en cognitieve vaardigheden die men in het dagelijks leven moet hebben. Laagopgeleide mensen hebben gemiddeld genomen wellicht minder kennis van dingen die (on)gezond voor hen zijn, wat kan leiden tot een grotere kans op overgewicht of verwante ziekten. Daarnaast zijn laagopgeleide mensen wellicht gevoeliger voor mentale stress. Mentale stress is geassocieerd met het vóórkomen van overgewicht. Hoe dit biologisch gezien precies werkt is nog niet helemaal duidelijk. Vast staat, dat stress er bij sommige mensen voor zorgt dat ze zich minder gaan bewegen, of dat ze meer gaan eten, of dat ze hun energie-voorraad minder snel opgebruiken.

Een mogelijke verklaring voor het patroon van geringe ongelijkheden in de Baltische en Oost-Europese landen wordt gegeven in termen van een toename van het algemene welvaartsniveau. Een toename in algemeen welvaartsniveau leidt in eerste instantie ook tot een toename in de consumptie van ongezond voedsel. Echter, dit fenomeen vind niet tegelijkertijd in alle lagen van de bevolking plaats. Moderne gedragingen (zoals het eten van kaas) worden het eerst aangenomen door de hogere sociaal-economische klassen (‘early adopters’). Wellicht moet de verklaring voor de geringe gezondheidsverschillen in deze regio er in gezocht worden, dat moderne, maar ongezonde gedragingen onder hoogopgeleiden min of meer in balans zijn met de traditionele, gezondere gedragingen onder laagopgeleiden.

De zeer grote ongelijkheden in overgewicht en gerelateerde ziekten onder Mediterrane vrouwen moet volgens ons de verklaring gezocht worden in genderongelijkheden en conflicten tussen moderne en traditionele socioculturele factoren. De Mediterrane landen staan bekend als ‘traditionele culturen’. Dit betekent de verwachtingen en mogelijkheden voor mannen en vrouwen aanzienlijk van elkaar verschillen. De man is er doorgaans nog de kostwinner, vooral bij gezinnen van lagere SEP. De vrouw runt in zo’n geval het huishouden en is ook verantwoordelijk voor het opvoeden van de kinderen. Laagopgeleide vrouwen worden in de praktijk vaak full-time huisvrouw, hoewel sommigen moederschap en werk weten te combineren. Uit eerder onderzoek is gebleken dat beide scenario’s samenhangen met een verhoogde kans op overgewicht en obesitas. Aan de ene kant wordt dunheid in een werkzaam bestaan benadruk en in stand gehouden, bijvoorbeeld door sociale feedback. Dit mechanisme staat bekend als de ‘enhancement hypothesis’. Aan de andere kant heeft onderzoek uitgewezen dat met name bij laagopgeleide moeders de combinatie tussen werk en opvoeding zwaar valt. Dit mechanisme staat bekend als de ‘overload hypothesis’.

Tot slot volgen enkele beleids- en onderzoeksimplicaties. Qua beleid is de belangrijkste implicatie dat obesitas-interventies zich vooral moeten richten op laagopgeleiden, en dan vooral laagopgeleide vrouwen. Daarnaast wordt uit de sterke variaties in de ongelijkheden duidelijk dat de aanpak geregionaliseerd moet worden. Ook is duidelijk geworden dat het bestrijden van ongelijkheden in overgewicht waarschijnlijk ook zal leiden tot een reductie in het vóórkomen van diabetes en hypertensie. Verder lijkt het verstandig om te kijken of welvaartsniveau in de Baltische en Oost-Europese kan worden opgevat als interventie-instrument. Ten vierde kunnen de Mediterrane landen in termen van ongelijkheden in overgewicht/obesitas onder vrouwen worden opgevat als een goed voorbeeld van hoe het *niet* moet. Hier verdient het aanbeveling om nader te onderzoeken of wet- en regelgeving die gericht is op gender-gelijkheid een afname van de ongelijkheden in overgewicht en obesitas te weeg kan brengen. Een vijfde implicatie is dat het nuttig lijkt te blijven hameren op kennis over wat gezond is en wat niet. Dit betekent dat de toegankelijkheid (voor mensen van lagere SEP) en de kwaliteit van het onderwijs moet worden gewaarborgd.

Qua onderzoek zouden longitudinale studies kunnen worden uitgevoerd om het verloop van de ongelijkheden in overgewicht als functie van de tijd te bestuderen. Cross-sectioneel onderzoek zou nog verrijkt kunnen worden door gebruik te maken van gedetailleerdere maten. Maten die betrekking hebben op individuele meetniveaus zouden verfijnd worden door beter uit te zoeken wat voor ‘cognitieve factoren’ er nu achter die sterke associatie van tussen opleidingsniveau en het vóórkomen van overgewicht zitten. Maten die betrekking hebben op geografische patronen kunnen verbeterd worden door verdere verfijning van de nationale karakteristieken die in verband lijken te staan met de grootte van de overgewichtskloof. Tenslotte moet voor meer overgewichtsgerelateerde aandoeningen -zoals hartziekten, beroertes en osteoarthritis- worden vastgesteld wat de internationale ongelijkheidspatronen zijn. In samenhang hiermee moet worden vastgesteld hoeveel overgewicht/obesitas nu eigenlijk bijdragen aan de ongelijkheden aan het vóórkomen van al deze ziekten.

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CURRICULUM VITAE

The author was born in Zwolle, the Netherlands on November 28, 1974. He completed secondary school at the Carolus Clusius College in Zwolle before he started, in 1994, his studies in Psychology at the University of Groningen (RUG). He graduated in the fields of Experimental Psychology and Neuro-/Biopsychology.

After his graduation he continued working as a researcher in the field of Human Factors engineering, first for RUG and later for Delft University of Technology. He was involved in traffic safety research, e.g. the role of driver fatigue on driving performance. About two years later, he became a researcher for the Health Survey Victims Enschede Fireworks Disaster (GGVE) at the Institute for Psychotrauma in Zaltbommel.

Yet another two years later he did research at the Erasmus Medical Center (EMC) in Rotterdam, where he participated in the Eurothine project on socioeconomic inequalities in health. Responsibilities included data cleaning and management, analysis and write-up of activities relating to the Eurothine project. He also created and maintained the project website (www.eurothine.org; more than 6600 visitors from 60+ different countries, as of March 2009) and co-organized several project meetings.

Close to two years later he decided to work for Statistics Netherlands (CBS) as a researcher in the field of health and healthcare consumption. There he was involved, among others, in exploratory statistical research on medical-surgical procedures on the basis of data from the Diagnosis Treatment Combination (DBC), and the matching of perinatal health data with municipal record data using probabilistic (“fuzzy”) linkage techniques. Meanwhile, he kept working part time at EMC to finalize his dissertation. Below is a complete list of publications and reports that he authored or co-authored during the time that he worked at Erasmus Medical Center:

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17. Roskam AJR, Kunst AE, et al. European overview of inequalities in hypertension and the role of obesity. *(submitted)* 2009.
18. Roskam AJR, Kunst AE, Van Oyen H, Demarest S, Klumbiene J, Regidor E, et al. Comparative appraisal of inequalities in overweight and obesity across Europe. *(submitted)* 2009.

PHD PORTFOLIO

Summary of PhD training and teaching activities

Name PhD student: *Albert-Jan Roskam*	PhD period: *15 July 2005 – 14 May 2009*
Erasmus MC Department: *Public Health (MGZ)*	Promotor(s): *Prof.dr. J.P. Mackenbach*
Research School: *Medical Societal Determinants of Public Health (MMDV)*	Supervisor: *Dr. A.E. Kunst*

1. PhD training

	Year	Workload (Hours/ECTS)
General academic skills		
- Biomedical English Writing and Communication	2007	40 / 1.4
Research skills		
- Statistics: Inequality measures, measures of relative risk,	2005, 2006	40 / 1.4
bootstrapping, regression methods, probabilistic data linkage	2005	40 / 1.4
- Methodology: Public Health & Healthcare (Mackenbach & Van der Maas, Eds. 2004)	2005-2008	40 / 1.4
- Programming languages: SPSS, SAS, SQL, Python, HTML	2005-2008	320 / 11.4
In-depth courses (e.g. Research school, Medical Training)		
- Effective and relaxed speaking in front of groups: learning to do	2006	15 / 0.5
presentations' (Schouten & Nelissen)	2007	8 / 0.3
- Writing scientific articles (Dept. of Public Health)	2007	8 / 0.3
- Introductory course in SAS (Dept. of Public Health)	2007	15 / 0.5
- Introductory course in S-Plus (Dept. of Public Health)	2007	15 / 0.5
- History of epidemiologic ideas (Queens University & NIHES Summer school)	2007	40 / 1.4
- Public Health in a changing global context (WHO & NIHES Summer school)	2008	40 / 1.4
- Reading and writing medical papers (NIHES Summer school)	2008	24 / 0.9
- Clarity and accessibility in written and spoken language (Lectric/CBS)	2008	8 / 0.3
- 'Boom der Statistiek' Methodology & Statistics (CBS)	2008	40 / 1.4
Presentations		
- Cross-national patterns of social inequalities in overweight/obesity: Eurothine Steering committee, Edinburgh; European Congress of Epidemiology, Utrecht	2005, 2006	40 / 1.4
- Social inequalities in diabetes in Europe, Eurothine Steering committee: Barcelona	2006	20 0.7
- Social inequalities in heart diseases in Europe, Eurothine Steering committee: Barcelona	2006	20 / 0.7
- Cross-national patterns of social inequalities in overweight/obesity and related variables, NIHES summer school: Rotterdam	2007	8 / 0.3
International conferences		
- European Congress of Epidemiology, Utrecht	2006	20 / 0.7

Name PhD student: *Albert-Jan Roskam* Erasmus MC Department: *Public Health (MGZ)* Research School: *Medical Societal Determinants of Public Health (MMDV)*	PhD period: *15 July 2005 – 14 May 2009* Promotor(s): *Prof.dr. J.P. Mackenbach* Supervisor: *Dr. A.E. Kunst*		
Seminars and workshops			
- Eurothine Steering committee, Edinburgh		2005	120 / 4/3
- Eurothine Steering committee, Barcelona		2006	240 / 8.6
- Eurothine Steering committee, Rotterdam (organization)		2006	400 / 14.3
Other			
- Design and maintenance of Eurothine project website		2005-2007	210 / 7.5
- Database management of Eurothine survey data		2005-2007	360 / 12.9
- Creation and dissemination of Eurothine e-mail news letters		2005-2007	25 / 0.9
2. Teaching activities			
Supervising practicals and excursions			
- Taught project members how to calculate dedicated inequality measures in SPSS and SAS		2005-2008	40 / 1.4

Note. ECTS = European Credit Transfer System; 1 ECTS equals a study workload of approximately 28 hours

About this thesis. It has been known for long that disease and death are unequally distributed over the population. People of lower socioeconomic positions tend to carry a disproportionate amount of the burden of mortality and morbidity. Overweight and obesity are no exception to this. In this dissertation we start by describing how large the socioeconomic differences in overweight and obesity currently are in Europe. Related to this, we investigate to what extent these inequalities vary from country to country. We try to explain the international inequality patterns by looking at country- and individual-level factors. We also evaluate to what extent the socioeconomic differences in the prevalence of immediate risk factors (low vegetable consumption, physical inactivity) mirror the inequality patterns of overweight and obesity. In addition, we investigate the possible role of inequalities in the prevalence of overweight and obesity in socioeconomic differences in the prevalence of diabetes, hypertension and subjectively experienced ill health. The findings suggest that inequalities in the prevalence of overweight and related variables show important cross-national patterns. Furthermore, the results of the studies strongly indicate that inequalities in the prevalence of overweight and obesity importantly contribute to socioeconomic inequalities in related diseases, although obesity's role strongly differs from country to country. We conclude by discussing potential ways through which inequalities in overweight and obesity and related diseases might be reduced. In terms of intervention and prevention strategies, the stark international inequality differences may dictate localized solutions. In addition, improving general nutrition-related knowledge may offer a common factor that contributes to the reduction of inequalities in the prevalence of overweight and obesity throughout Europe.

About the author. Albert-Jan Roskam (1974) studied Experimental Psychology and Neuro- & Biopsychology at the University of Groningen. He had various research jobs before he landed the position at Erasmus Medical Center that led to this dissertation.