Risk factors
and public health
in Denmark
Summary report

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Preface

This publication is an English summary of a report, which presents a comprehensive, broad description and analysis of the impact of selected risk factors for public health in Denmark.

We are operating with a broad definition of the concept of risk factor as a factor that is causally related with health status. The individual factors that are related to disease, functional limitation or death may occur at various levels in a larger causal network from biological factors like e.g. blood pressure, lifestyle factors like smoking, to social factors like educational level.

19 risk factors and 18 measures for health and economic consequences were selected. The selection was made by the National Board of Health in co-operation with the National Institute of Public Health (NIPH) on the basis of importance, public interest and availability of data. The results are based on new analyses of data from NIPH's Danish Health and Morbidity Survey 2000, the National Patient Register, the National Health Insurance Register, and the Cause of Death Register together with existing knowledge from scientific literature. The selected risk factors comprise lifestyle and biological and social conditions, and the Summary Report illustrates the impact of the risk factors on life expectancy, expected lifetime without long-standing illness, admissions to hospital, and costs to society.

This publication addresses itself to everyone engaged in disease prevention and health promotion and who needs comprehensive documentation of the impact of the most predominant risk factors for the overall health status and costs to society.

The analyses were made by Senior Researcher Knud Juel and Senior Researcher Henrik Brønnum-Hansen, the National Institute of Public Health, and Director Jan Sørensen, Centre for Applied Health Services Research and Technology Assessment, University of Southern Denmark. The publication was written by Knud Juel, Henrik Brønnum-Hansen, and Jan Sørensen with a few contributions from others. The English translation was made by Programme Secretary Vibeke Rosendal.

The project was planned in co-operation with the National Centre for Health Promotion and Disease Prevention, the Danish National Board of Health, who financed the work. We would like to thank all the persons involved and the contributors for their constructive efforts.

Copenhagen, December 2007
Finn Kamper-Jørgensen
Director

Contents

Condensed Summary

- A wide range of measures relating to mortality, morbidity and economic consequences have been calculated for up to 19 behavioural, biological and social risk factors. It is the first attempt in Denmark to present an overall description of the impact of such risk factors for public health. The analyses contribute to the planning of disease prevention and health-promoting efforts. The risk factors were chosen on the basis of data availability, importance, and public interest.

- Behavioural factors such as smoking, physical inactivity and unhealthy diet have important consequences for the health of both men and women, while the impact of alcohol and drug abuse are especially seen among men, and the impact of unsafe sex especially among women.

- Biological risk factors such as obesity and hypertension have important health consequences for both men and women.

- For persons engaged in active employment, occupational diseases and problems related to psychosocial factors at work are more frequent among men. With regard to injuries, it is in particularly traffic accidents among young men and falls among elderly women that dominate.

- There is evidence of a greater number of premature deaths and earlier onset of disease among persons with a low educational level.

- The causes of many diseases are complex and multifactorial. In order to relate health and economic consequences to risk factors, it is necessary to make a number of assumptions. Nevertheless, the calculations can give a deeper insight into the influence of a number of factors for the health status of the population. This information can be useful for planning purposes at both national and regional levels, as well as at municipal level.

- The degree of significance or the rank order of the various risk factors depends on the choice of measure of health consequences. Furthermore, the behavioural and biological factors are influenced by living conditions, for instance educational level and working conditions, which again are influenced by the way society is organised. The rank ordering procedure has not taken into account the interdependence of causes, nor that the factors are at different levels in a causal network. For example, a comparison of the significance of smoking and lower educational

level requires careful interpretation, as the impact of a lower educational level is partly mediated by differences in smoking habits. In a similar way, comparisons between physical inactivity, obesity and unhealthy diet require careful interpretation.

- Despite the methodological uncertainties, it is clear that smoking, educational level, alcohol consumption, physical inactivity, unhealthy diet and obesity play a major role for most measures of health and economic consequences. For specific health measures, for instance visits to emergency departments, accidents play an important role.

- Prevalence rates of many of the risk factors have changed dramatically within the past 50 years and it is likely that the rank ordering of the risk factors will change over the next decades.

Summary Report

Deaths and morbidity are routinely classified according to the disease or the accident that caused them. This is useful for planning in the health care system, but for disease prevention or health promotion it would often be more useful to classify according to the risk factors that contributed to the onset of disease.

It is a complex matter to describe the causes of poor health, and the suggested risk factors comprise only selected elements in a larger causal network.

Previous estimates of the influence of risk factors on the health of the population are most frequently illustrated by mortality.

In recent years, indicators have been developed that combine morbidity and mortality. These make it possible to compare the burden of various diseases, lethal as well as non-lethal, and can also illustrate the burden distributed on risk factors.

This study has three aims:

• to quantify the impact of important risk factors on the health of the population in Denmark expressed by relevant public health measures
• to assess the costs to society of these risk factors
• to assess the impact of a given risk reduction for selected risk factors

The project is based on a broad model for determinants of health, where health and disease are seen as a result of a number of mutually dependent causes.

As seen from the figure, the factors that influence the health of the population may lie more or less close to the single individual.
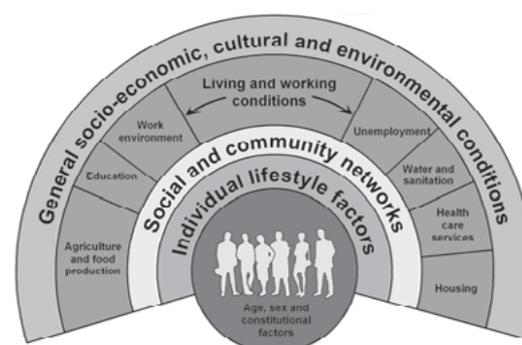
Source: Dahlgren and Whitehead, 1991

The factors cannot be viewed in isolation, but should be understood as mutually dependent. Thus, the lifestyle of a person depends both on factors close to the individual and on factors related to living conditions, for example educational level and working environment, which again are influenced by the way society is organised.

The concept of risk factor covers a factor or a condition, which in some way increases the risk of disease, functional limitation or death. The risk factor may be directly caus-

ally related with the health status, disease or death, or – as illustrated in the model – it may be a question of risk factors that occur in a chain of causal factors where the relationship is more indirect in relation to morbidity and death.

In the present study, risk factors are chosen at different levels in the model, and the importance of the chosen risk factors for the health of the population is quantified by a number of measures for health and economic consequences. Because of limitations in the knowledge and data it is, however, only a very small part of the total causal network which can form part of the analyses. Generally, better data are available for factors that lie closer to the individual and have a direct causal relationship with disease, than for factors which in the model lie further from the individual, and where the relationship is more indirect. The risk factors included in the analyses, therefore, comprise the health habits, social relationships, educational level and working life of the single individual, while it has not been possible to include factors that relate predominantly to the social level.

The study puts figures on the burden in Denmark of selected risk factors for a large number of measures for health and economic consequences.

The following risk factors are illustrated in the report: Smoking, alcohol, drug abuse, physical inactivity, overweight, unhealthy diet, unsafe sex, high blood pressure, risks related to working environment (accidents at work, occupational disease, psychosocial factors at work), passive smoking, home and leisure accidents, traffic accidents, poor social relationships and educational level.

Unhealthy diet is measured by 'too much saturated fat' and 'low intake of fruits and vegetables'. Poor social relationships are measured by the frequency with which an individual meets family members, and whether an individual can rely on help from others when ill.

As health measure is used mortality (number of deaths, years of life lost, lost life expectancy), long-standing limiting illness, health expectancy, quality adjusted life-years, contacts to hospitals, contacts to general practitioner, sickness absence from work, health-related early retirement as well as measures for the costs to the health care services, production costs according to the human capital method and the friction method, as well as costs in connection with future consumption.

A great number of Danish data sources have been used, such as the Cause of Death Register, the Danish Health and Morbidity Survey 2000, the Danish National Cohort Study, the National Patient Register, the National Health Insurance Register, the Osterbro Study, Statistics Denmark registers and the register of early retirement pensions of the Social Appeals Board.

The calculations have, as far as possible, been based on Danish data, but estimates of morbidity risks from the international literature have also been used.

The study gives a detailed picture of the impact of risk behaviour and the exposure to risk factors on the public health and the economy.

The study answers questions of the type 'How many deaths, how many admissions to hospital, how many lost healthy life-years, how many early retirement pensions, etc. are related to this risk factor'. And 'how many cases can be avoided if the population is not exposed to the impact of the risk factor'.

A summary of the results of the study will be given on the following pages, partly on the basis of the single risk factors and partly on the basis of the chosen measures for health and economic consequences.

'*Risk factors*'. All health measures are shown for each risk factor, which makes it possible to see the impact of the risk factor in question on all the measurements. It will appear from this, that the measures can weigh differently for different risk factors. A summary of the results categorised according to risk factors is shown on p. 12-25.

"*Measures for health and economic consequences*". The risk factors are examined for each of these measures, and this makes it possible to rank the impact of the risk factors for the health measure in question. It will be seen here that the impact of the individual risk factor depends on the measure applied. A summary categorised according to health measures is shown on p. 26-61. The effects from the individual risk factors are not independent and, therefore, the individual contributions cannot be added. For instance, a fatal traffic accident which involves alcohol can be counted both as a traffic casualty and an alcohol-related death, even though it is only one death.

Risk factors

The following gives an overview of the health and economic consequences of each single risk factor.

Smoking

A division is made into four categories of smokers: 'never' smokers, ex-smokers, moderate smokers and heavy smokers, where heavy smokers are defined as individuals smoking at least 15 cigarettes per day.

The health consequences of smoking are measured partly by comparing smokers and ex-smokers with 'never' smokers, and partly by indirect calculations of the impact of smoking on mortality. Thus, figures are obtained for the extra cases that can be attributed to smoking.

The effect of smoking is considerable on all the applied health measures.

Smoking is responsible for 24% of all deaths, 215,000 years of life lost each year, a loss of 3-3.5 years in the life expectancy of the Danish population. Heavy smokers can expect just over ten fewer life-years without long-standing limiting illness than 'never' smokers. For moderate smokers, the loss of life-years without illness is about six years. The loss of quality-adjusted life-years is 10-11 for heavy smokers and 5-6 for moderate

smokers. To this should be added 17% of all admissions to hospital, 8% of contacts to general practitioners, 2.8 million days of sickness absence from work and almost 5,000 health-related early retirement pensions per year.

Smoking is responsible for an additional expenditure in the health care system of nearly DKK 4.5 billion for the treatment of disease related to smoking. The health care system obtains an annual saving of DKK 1.1 billion on costs as a result of premature death and reduced future expenditure. The annual net costs related to smoking of the health care system are, thus, DKK 3.4 billion. Calculated according to the human capital method smoking is related to an annual production loss of DKK 20.8 billion, and DKK 3.5 billion according to the friction method. Reduced lifetime because of smoking results in a reduced future consumption of DKK 16.3 billion.

For deaths, contacts to general practitioners, sickness absence from work and early retirement pensions the cases related to smoking are of the same size for men and women; whereas smoking men have many more admissions to hospital.

It is well known that heavy smokers are more exposed to disease than moderate smokers and ex-smokers.

The damaging effects of smoking on health are well known, especially regarding mortality, but gradually also for other kinds of health damage. We find the same pattern when applying various methods to the calculation of health damage related to smoking. We, therefore, consider the results for smoking to be reasonably reliable.

The effects of smoking are slightly reduced when including information on alcohol consumption, physical inactivity and overweight. The reduction is clearer in heavy smokers, as an indication that there is a certain clustering of risk factors in this group.

Alcohol

The health consequences of a large alcohol consumption are measured by comparing the health conditions of individuals who exceed the recommended sensible drinking limits to those with a consumption below the limits. Direct calculations based on alcohol-related diagnoses are also made. Hereby, figures are obtained for the additional cases which can be attributed to a large alcohol consumption.

The focus is on a large alcohol consumption and its health consequences. Possible beneficial effects of a moderate alcohol consumption are not estimated.

Especially among men there are pronounced health consequences of a large alcohol consumption.

Each year 3,000 Danes die with an alcohol-related diagnosis, corresponding to 5% of all deaths. Annually, 70,000 life-years are lost, and the life expectancy of Danish men is reduced by one year and four months, and for women by just under half that figure. An alcohol consumption exceeding the recommended sensible drinking limits reduces the expected lifetime without long-standing limiting illness by five years for men and one year for women in comparison with a moderate alcohol consumption. Quality-adjusted life-years are reduced by five for men and just over three for women. To this should be added 28,000 admissions, 10,000 visits to emergency departments and 72,000 out-patient treatments annually. Persons drinking above the sensible drinking limits have more than 150,000 additional contacts annually with their general practitioner and 325,000 extra days of sickness absence from work. On an annual basis, there are 500 cases of health-related early retirement pensions related to alcohol.

Alcohol results in an annual additional expenditure in the health care system of DKK 947 million for the treatment of alcohol-related disease. The health care system makes a yearly saving of DKK 350 million as a result of premature death and saved future consumption. The annual net costs of the health care system related to alcohol are, thus, DKK 597 million. Calculated according to the human capital method, alcohol is related to an annual production loss of DKK 7,229 million, and DKK 585 million

according to the friction method. The production loss corresponds to DKK 5,406 million in saved consumption as a result of reduced lifetime.

For all the measures of health consequences, the alcohol problem is greatest among men. There are at least twice as many cases among men as among women.

It is beyond doubt that a large alcohol consumption is harmful. But there are uncertainties in self-reported information on alcohol consumption, just as bias could be introduced due to non-response when using data from population surveys. The latter may give an underestimation of the scale of the problem. However, we have been able to use national figures based on diagnoses for both mortality, admissions to hospital and early retirement pensions and this considerably strengthens the validity of the results. But we do see an apparent underestimation of the alcohol problem when using self-reported information on alcohol intake. We, therefore, assume that some of the impacts of a large alcohol consumption are underestimated.

The impact of high alcohol consumption is almost halved when information is included on smoking habits, physical inactivity and overweight. There is, thus, a clustering of risk factors among individuals with a large alcohol consumption.

Drug abuse

The health impacts of drug abuse are measured by direct calculations based on diagnoses related to drug abuse. Hereby, figures are obtained for the extra cases that can be attributed to drug abuse.

Each year 1,000 Danes die with a diagnosis related to drug abuse, corresponding to 2% of all deaths. On an annual basis, 28,000 life-years are lost, and the life expectancy of the Danish population is reduced by 3-5 months. To this should be added 4,000 admissions, 1,500 visits to emergency departments, and 6-7,000 out-patient treatments per year. Annually, there are 100 cases of health-related early retirement pensions related to drug abuse.

Drug abuse results in an annual additional expenditure in the health care system of DKK 106 million for the treatment of drug abuse related disease. The health care system obtains an annual saving of DKK 115 million as a result of premature death and saved future consumption. The annual net costs to the health care system related to drug abuse are, thus, below zero. Calculated according to the human capital method, drug abuse is related to a yearly production loss of DKK 3,028 million, and DKK 53 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 2,125 million as a result of reduced lifetime.

For all health measures, drug abuse, in number, is a greater problem for men than for women.

All our calculations are based on national figures on diagnoses, so the uncertainties of the figures are, therefore, modest. Thus, we consider the results for drug abuse to be reasonably reliable.

Physical inactivity

The health consequences of physical inactivity are measured by comparing persons with different levels of activity in their leisure time. Hereby, figures are obtained for the additional cases that can be related to physical inactivity.

Physical inactivity accounts for 7-8% of all deaths, 50,000 years of life lost per annum, and a reduction in the life expectancy of the Danish population of 9-10 months. Physically inactive men can expect just over eight fewer life-years without long-standing limiting illness than men who are physically active. For women the loss of life-years without illness is just over ten. Physical inactivity reduces quality-adjusted life-years by seven. To this should be added 100,000 admissions to hospital, 2.6 million contacts to general practitioners, 3.1 million days of sickness absence from work and almost 5,000 health-related early retirement pensions per year.

Physical inactivity results in an annual additional consumption in the health care system of DKK 3,109 million. The health care system obtains an annual saving of DKK 226 million as a consequence of premature death and saved future consumption. The annual net costs of the health care system related to physical inactivity are, thus, DKK 2,883 million. Calculated according to the human capital method, physical inactivity is related to a yearly production loss of DKK 7,540 million, and DKK 3,029 according to the friction method. The production loss corresponds to a saving in future consumption of DKK 4,240 million as a result of shortened lifetime.

Physical inactivity increases the risk of illness or death, but illness may also be the cause of inactivity. We have attempted to take this fact into account in the analyses, but there is some uncertainty in the calculations because of the reversed causality.

The effect of physical inactivity is somewhat reduced when including information on smoking alcohol consumption and overweight.

Overweight

The health consequences of overweight are measured by comparing moderately overweight and obese individuals to individuals of normal weight. Overweight is defined from BMI in two groups. Persons with a BMI between 25 and 30 are characterised as moderately overweight, and persons with a BMI of 30 and above as obese. We are cal-

culating the extra cases that can be attributed to overweight.

Overweight accounts for just over 2% of all deaths, just over 30,000 years of life lost annually, a loss in the life expectancy of the Danish population of three months for men and eight months for women. Obese men can expect just under five fewer life-years without long-standing limiting illness than men of normal weight. Among obese and moderately overweight women, the loss of life-years without illness is ten and four, respectively. Obese men and women lose just under three and six quality-adjusted life-years, respectively. To this should be added 55,000 admissions to hospital, 1.1 million contacts to general practitioners, 1.8 million days of sickness absence from work, and almost 1,100 health-related early retirement pensions.

Overweight results in an annual additional consumption in the health care system of DKK 1,625 million. The health care system obtains an annual saving of DKK 152 million as a result of premature death and saved future consumption. The annual net costs of the health care system related to overweight are, thus, DKK 1,473 million. Calculated according to the human capital method, overweight is related to an annual production loss of DKK 6,290 million, and DKK 2,115 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 2,540 million as a result of shorter lifetime.

For the health measures related to mortality and contacts to general practitioner, women account for approximately twice as many cases as men related to overweight. For overweight-related admissions to hospital and sickness absence from work, there is no significant difference between men and women.

It is well known that obese individuals are most exposed to disease. For part of the measures, it is also seen that the moderately overweight can be found between those of normal weight and the obese. It is, however, not the case for all the measures. For instance, moderately overweight men of 35 years and above have a lower rate of mortality than men of normal weight, moderately overweight women of 75 years and above have the lowest rate of mortality and the lowest frequency of admission to hospital, and moderately overweight men of 65 years and above have the lowest frequency of contact to a general practitioner.

It is well known that the association between BMI and various health measures is U-shaped, but it is not entirely unambiguous when the health consequences start to appear. Nor is there necessarily the same effect of a high BMI in different age groups. We consider, the results for the obese to be reliable, but are more uncertain of the findings for the moderately overweight. Self-reported information on weight and height may be faulty, but this does not necessarily mean anything for the calculation of deaths and cases of illness related to overweight.

However, if relatively fewer obese are included in the examinations of the population we will be underestimating the scale of the problem.

The impact of overweight is somewhat reduced when including information on smoking, alcohol consumption and physical activity in the analyses.

Unhealthy diet

The health consequences of an unhealthy diet are assessed from two factors, too much saturated fat and low intake of fruits and vegetables. The additional deaths as a result of too much saturated fat or low intake of fruits and vegetables are calculated as proportions of specific cause of death groups. We calculate the additional cases that can be ascribed to an unhealthy diet.

Too much saturated fat accounts for 4% of all deaths, just over 20,000 years of life lost per year, a loss in the life expectancy of 4-5 months. A low intake of fruits and vegetables gives a similar figure.

The annual production loss related to increased mortality as a consequence of too much saturated fat in the diet has been calculated at DKK 391 million according to the human capital method, and DKK 15 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 2,012 million as a result of shorter lifetime. The production loss related to an increased mortality rate

as a consequence of low intake of fruits and vegetables has been calculated at DKK 395 million according to the human capital method, and DKK 15 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 2,065 million as a result of shorter lifetime.

It is as difficult to quantify the influence of the diet on health, as it is hard to get reliable data from self-reported information. Over the years, there have been varying estimates of the impacts of fruits and vegetables on the development of cancer.

This is one of the reasons why some uncertainty must be expected. It is likely that the proportion of the Danish population who consume too much saturated fat and has a low intake of fruits and vegetables is underestimated. Therefore, the health consequences of an unhealthy diet are similarly underestimated.

It is presumably a minor problem that we have, to a large degree, based our calculations on international estimates of relative risks.

Unsafe sex

The health consequences of unsafe sex are measured by direct calculations on the basis of a number of specific sexually transmittable diseases, and induced abortions. Hereby, figures are obtained for the addi-

tional cases that can be ascribed to unsafe sex.

Each year there are 300 deaths in Denmark that can be related to unsafe sex, corresponding to 0.5% of all deaths. Each year 6-7,000 life-years are lost, and the life expectancy of the Danes is reduced by two weeks for men and 1.5 months for women. To this should be added 10,000 admissions and just under 50,000 out-patient visits. Each year there are 50 cases of health-related early retirement pensions related to unsafe sex.

Unsafe sex results in an annual additional consumption in the health care system of DKK 283 million. The health care system obtains an annual saving of DKK 26 million as a result of premature death and saved future consumption. The annual net costs of the health care system related to unsafe sex are, thus, DKK 257 million. Calculated according to the human capital method, unsafe sex is related to an annual production loss of DKK 576 million, and DKK 11 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 513 million as a result of shorter lifetime.

For most health measures, the consequences of unsafe sex are greater among women, but more reportable sexual diseases are found in men. In men hiv/aids, syphilis and gonorrhoea are the most predominant sexual diseases, while cancer of

the cervix is the most dominant disease among women.

A number of specific diagnoses indicate diseases related to unsafe sex. All our calculations are made from national figures based on diagnoses, and the statistical uncertainties of the figures are, therefore, modest. Consequently, we consider the results for unsafe sex to be relatively reliable. But as we have knowledge of reported and diagnosed cases only, we have to assume that we underestimate the health consequences of unsafe sex.

Hypertension

We have used elevated systolic blood pressure as marker for hypertension. We define a blood pressure under 140 mmHg as normal and blood pressure above 160 mmHg as seriously elevated. A blood pressure between 140 and 160 we describe as moderately elevated.

The additional deaths related to hypertension are calculated as proportions of specific cause of death groups. Hereby figures are obtained for the additional cases that can be attributed to hypertension.

Each year there are more than 2,000 deaths in Denmark related to hypertension, corresponding to just under 4% of all deaths. Each year just over 40,000 life-years are lost, and the life expectancy of the Danish population is reduced by nearly nine months for men and six months for women.

The production loss related to hypertension has been calculated in accordance with the human capital method at DKK 1,936 million per year, and DKK 71 million in accordance with the friction method. The production loss corresponds to a saving in future consumption of DKK 3,461 million as a result of shorter lifetime.

Accidents at work

Deaths as a result of accidents at work are based on figures from the Danish Working Environment Authority.

Each year 50 Danes die in occupational accidents, nearly all of them are men, who in total lose 1,700 life-years. To this should be added 2,000 admissions and 72,000 visits to emergency departments annually, out of which three quarters of the patients are men. The health consequences of accidents at work are, thus, very predominantly a problem related to men.

Accidents at work result in an annual additional consumption in the health care system of DKK 108 million. The health care system obtains an annual saving of DKK 6 million as a result of premature death and saved future consumption. The annual net costs of the health care system related to accidents at work are, thus, DKK 102 million. Calculated according to the human capital method, accidents at work are related to an annual production loss of DKK 198 million, and DKK 3 million according to the friction method. The production loss

corresponds to a saving in future consumption of DKK 128 million as a result of shorter lifetime.

The information on deaths comes from the National Working Environment Authority, and all hospital contacts related to accidents at work ought, in principle, to have a specific marker. All our calculations are, thus, based on national figures and must be considered as reliable. We, therefore, consider the results relating to accidents at work to be comparatively reliable.

Occupational disease

The additional deaths resulting from occupational disease are calculated as proportions of a large number of specific cause of death groups. We calculate the additional cases that can be related to occupational disease.

Each year, there are 2,000 deaths in Denmark attributable to occupational diseases, 85% of which are among men. Together, these men lose 25,000 life-years annually and the life expectancy of Danish men is reduced by nine months.

Calculated in accordance with the human capital method, occupational disease accounts for an annual production loss of DKK 1,278 million, and DKK 44 million in accordance with the friction method. The production loss corresponds to a saving in future consumption of DKK 2,530 million as a result of shorter lifetime.

The underlying calculations are based on a single Finnish study and concern only deaths. The calculations must therefore necessarily be considered with some caution, as there may be problems in transferring Finnish estimates to Danish conditions. Besides, changes in working conditions may affect the estimates.

Psychosocial factors at work

The health consequences of psychosocial factors at work are estimated for all individuals engaged in active employment on the basis of information on the demands of and influence on the work. Comparison is made with the group who states that they are subject to high demands at work and, at the same time, have a high degree of influence on their work. Hereby, figures are obtained for the additional cases that can be ascribed to psychosocial factors at work.

Psychosocial factors at work are related to 2.5% of all deaths, just over 40,000 years of life lost annually and a loss in the life expectancy of the Danish population of 6-7 months. Psychosocial factors at work reduce the expected lifetime without long-standing limiting illness by just under five years for men and just over two for women. The loss in quality-adjusted life-years is three for men and one for women. To this should be added 30,000 admissions to hospital, half a million contacts to general practitioners, 1.5 million days of sickness absence from work, and 2,500-3,000 cases of health-related early retirement pensions.

Psychosocial factors at work result in an annual additional consumption in the health care system of DKK 855 million. The health care system obtains an annual saving of DKK 169 million as a result of premature death and saved future consumption. The annual net costs of the health care system related to psychosocial factors at work are, thus, DKK 686 million. Calculated according to the human capital method, psychosocial factors at work are related to an annual production loss of DKK 13,960 million, and to DKK 1,767 million according to the friction method. The production loss corresponds to savings in future consumption of DKK 3,086 million as a result of shorter lifetime.

For the health measures related to psychosocial factors at work, the figures show almost the same pattern for men and women. Women have more hospital admissions than men, while men have more contacts with general practitioners and more sickness absence from work.

Generally, individuals whose work is characterised by high demands and a high level of influence have the lowest frequencies when we measure mortality, admissions to hospital, contacts to general practitioner, and sickness absence from work.

The psychosocial working environment influences health, particularly illustrated for cardiovascular disease. But many aspects play a part, and we have elucidated only a small corner. Furthermore, there are com-

paratively few deaths in the age groups engaged in active employment and, finally, there are few individuals in the most affected group. All in all, our calculations should be interpreted with caution.

The effect of the psychosocial factors at work is somewhat reduced when including information on smoking, alcohol consumption, overweight, and physical activity.

Passive smoking

The extra deaths as a result of passive smoking are calculated on the basis of information on the risk of exposure to passive smoking and the number of Danes who are exposed to passive smoking. We calculate the additional cases which can be ascribed to passive smoking.

Passive smoking is responsible for just over 3% of all deaths, 25,000 years of life lost annually and a loss in the life expectancy of the Danish population of 4-6 months.

Death related to passive smoking results in an annual production loss of DKK 637 million according to the human capital method, and DKK 24 million according to the friction method. The production loss corresponds to an annual saving in future consumption of DKK 2,191 million as a result of shorter lifetime.

It is difficult to quantify the importance of passive smoking on health, even though in recent years much new knowledge of the

health hazards of passive smoking has come to light. There is now a general acceptance that passive smoking increases the risk of lung cancer, heart disease, diseases of the respiratory tract, and stroke, but it is still uncertain whether the same relative risks apply for passive smokers as for active smokers. And it must also be assumed that there is considerable uncertainty as to the number of individuals exposed to passive smoking and what dose. Therefore, there is a good deal of uncertainty in the calculations of the health consequences of passive smoking.

Home and leisure accidents

The main types of home and leisure accidents are from accidents in the home, in day care centres and schools, in connection with sports and other leisure activities. The number of deaths and contacts to hospitals as a result of home and leisure accidents is calculated directly from diagnoses in national registers.

Each year, 1,800 Danes die as a result of home and leisure accidents. Each year men lose 15,000 life-years and women 10,000, and there are 230,000 visits to emergency departments involving men, and 200,000 involving women. To this should be added more than 30,000 hospital admissions.

Home and leisure accidents result in an annual additional consumption in the health care system of DKK 1,169 million. The health care system obtains an annual sav-

ing of DKK 92 million as a result of early death and saved future consumption. The annual net costs of the health care system related to home and leisure accidents are, thus, DKK 1,077 million. Calculated according to the human capital method, home and leisure accidents are related to an annual production loss of DKK 1,477 million, and DKK 24 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 2,027 million as a result of shorter lifetime.

The distribution on gender is fairly equal, but among women deaths and admissions to hospital are concentrated on the oldest.

The information on deaths and admissions to hospital comes from national registers and must be assumed to give a correct picture of the pattern of home and leisure accidents. We, therefore, consider the results concerning home and leisure accidents to be reasonably reliable.

Traffic accidents

The number of deaths and contacts to hospitals as a result of traffic accidents are calculated directly from diagnoses in national registers.

There are many serious accidents in the traffic. In the years around 2000, approximately 500 Danes died in a traffic accident (in 2004, however, the figure was below

400). Of these deaths, three-fourths were among men. Each year men lose 14,000 life-years and women 5,000 as a result of traffic accidents. To this should be added 50,000 visits to emergency departments and 7,000 admissions.

Traffic accidents result in an annual additional consumption in the health care system of DKK 198 million. The health care system obtains an annual saving of DKK 54 million as a result of premature death and saved future consumption. The annual net costs of the health care system related to traffic accidents are, thus, DKK 144 million. Calculated in accordance with the human capital method, traffic accidents are related to an annual production loss of DKK 1,693 million, and DKK 18 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 1,186 million as a result of shorter lifetime.

Men are involved in more deaths, admissions and visits to emergency departments related to traffic accidents than women. The difference is largest for deaths and smallest for visits to emergency departments.

Information on deaths and admission to hospital comes from national registers and is considered to give a correct picture of the health consequences of traffic accidents. We, therefore, consider the results concerning traffic accidents to be reliable.

Poor social relationships

The health consequences of poor social relationships are assessed on the basis of information on how often a person meets family members and the access to help from others in the case of illness. Comparison is made with the group that states that they meet family members often, and the group stating that they can rely on help from others in the case of illness. Hereby, figures are obtained for the additional cases that can be ascribed to poor social relationships.

Each year, 2% of all deaths are related to poor social relationships, 15-20,000 years of life lost, a loss in the life expectancy of the Danish population of 3-6 months for men and 2-3 months for women. Individuals with poor social relationships can expect fewer life-years without long-standing limiting illness than individuals with strong social relationships, just as poor relationships reduce quality-adjusted life-years. To this should be added 10,000 admissions to hospital, 200-250,000 contacts to general practitioners, 100,000 days of sickness absence from work and approximately 50 cases of health-related early retirement pensions.

Individuals who rarely meet their family have an annual additional consumption in the health care system of DKK 282 million. The health care system obtains an annual saving of DKK 131 million as a result of premature death and saved future consump-

tion. The annual net costs of the health care system related to individuals who rarely meet their family are, thus, DKK 151 million. Persons who cannot rely on help from others in the case of illness have an annual additional consumption in the health care system of DKK 395 million. The health care system obtains an annual saving of DKK 95 million as a result of premature death and saved future consumption. The annual net costs of the health care system related to individuals who cannot rely on help from others in the case of illness are, thus, DKK 300 million.

The calculation according to the human capital method shows that individuals who rarely meet their family have an annual production loss of DKK 1,630 million. According to the friction method, the production loss is calculated at DKK 43 million. The production loss corresponds to a saving in future consumption of DKK 1,944 as a result of shorter lifetime. Persons who cannot rely on help from others contribute with an annual production loss of DKK 1,021 million according to the human capital method, and DKK 124 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 1,408 million as a result of shorter lifetime.

The health measures do not show an unambiguous pattern with regard to gender differences.

It is well known that relationships with other persons are important to health. It is possible to measure many aspects of these relationships, where we have measured only two of them. This, combined with the fact that the occurrence of poor social relationships in the material is comparatively low, makes us interpret the results with some caution.

The effect of poor social relationships is somewhat reduced when including information on smoking, alcohol consumption, physical activity and overweight. For several measures by up to half. This indicates that there is a clustering of behaviour-related risk factors among individuals with poor social relationships.

Education

We operate with two definitions of education. One divides educational groups into levels (low, intermediate and high), and the other divides according to years of combined school education and vocational training.

The health consequences related to education are measured by comparing individuals with low and intermediate levels of education to individuals with a high level, and by comparing persons with fewer years of combined school education and vocational training to persons with more years of combined school education and vocational training. Hereby, figures are obtained for

the additional cases that can be related to a low educational level.

Less than 13 years of combined school education and vocational training is related to 13% of all deaths, more than 100,000 years of life lost per annum, a loss in the life expectancy of the Danes of one year and ten months for men and one year and seven months for women. Men with a low educational level can expect just over eight fewer life-years without long-standing limiting illness than men with a high educational level. For women, the difference is just over seven years. Life-years without illness lost for men and women with an intermediate educational level are 4.5 years for men and 2.5 years for women. Individuals with a low educational level have just over five fewer quality-adjusted life-years than individuals with a high educational level; those with an intermediate level have 2-3 fewer quality-adjusted life-years. To this should be added that persons with less than 15 years of combined school education and vocational training have an additional 135,000 admissions to hospital, 2.7 million contacts to general practitioners, 2.8 million days of sickness absence from work, and 2,600 health-related early retirement pensions.

Individuals with less than 15 years of combined school education and vocational training contribute with an annual additional consumption in the health care system of DKK 3,756 million. The health care system obtains an annual saving of DKK 588 million as a result of premature death

and saved future consumption. The annual net costs of the health care system are, thus, DKK 3,168 million. Calculated according to the human capital method, less than 15 years of combined school education and vocational training is related to an annual production loss of DKK 16,801 million, and DKK 5,629 million according to the friction method. The production loss corresponds to a saving in future consumption of DKK 9,356 million as a result of shorter lifetime.

For health measures related to mortality, hospital admissions, contacts to general practitioners and sickness absence from work there are almost no gender differences which are relatable to educational level. It is general that a longer education and a higher educational level promote better health. However, one should bear in mind that the impact ascribed to short education depends very much on how we define our reference group. The better the health of the reference group, the greater the effect attributed to educational level.The impact of the educational level is substantially reduced when including information on smoking, alcohol consumption, physical activity and overweight.

Consequently, there is an uneven distribution of these risk factors in the various educational groupings.

Measures for health and economic consequences

The following gives an outline of the impact of the risk factors for each measure of health and economic consequences.

Deaths

Deaths are measured as additional deaths or as premature deaths.

Each year, there are 14,000 premature deaths among smokers and ex-smokers and 7-8,000 among persons with less than 13 years of combined school education and vocational training.

For a large number of risk factors we have calculated that between 1,000 and 4,000 premature deaths occur each year. The risk factors are physical inactivity, alcohol, hypertension, the two indicators for an unhealthy diet, occupational disease, psychosocial factors at work, home and leisure accidents, the two indicators for poor social relationships along with overweight and drug abuse.

There are approximately 500 deaths in the traffic each year, approximately 300 cases related to unsafe sex and approximately 50 accidents at work. For part of the risk factors, we see roughly the same number of deaths among men and women. Deaths related to alcohol, hypertension and occupational disease as well as traffic and accidents at work most frequently occur among men. The differences are particularly large for occupational diseases, and the comparatively few cases of accidents at work occur almost only among men. Among overweight individuals there are twice as many extra deaths among women. The relatively modest number of deaths related to unsafe sex occurs almost only among women.

For some of the risk factors deaths among children and young people are important. Deaths before 25 years of age are responsible for 20-30% of all traffic accidents, 10-20% of the accidents at work, and 4-5% of the cases of home and leisure accidents.

Figure 1   Deaths in Denmark related to various risk factors. Annual number of deaths for men and women
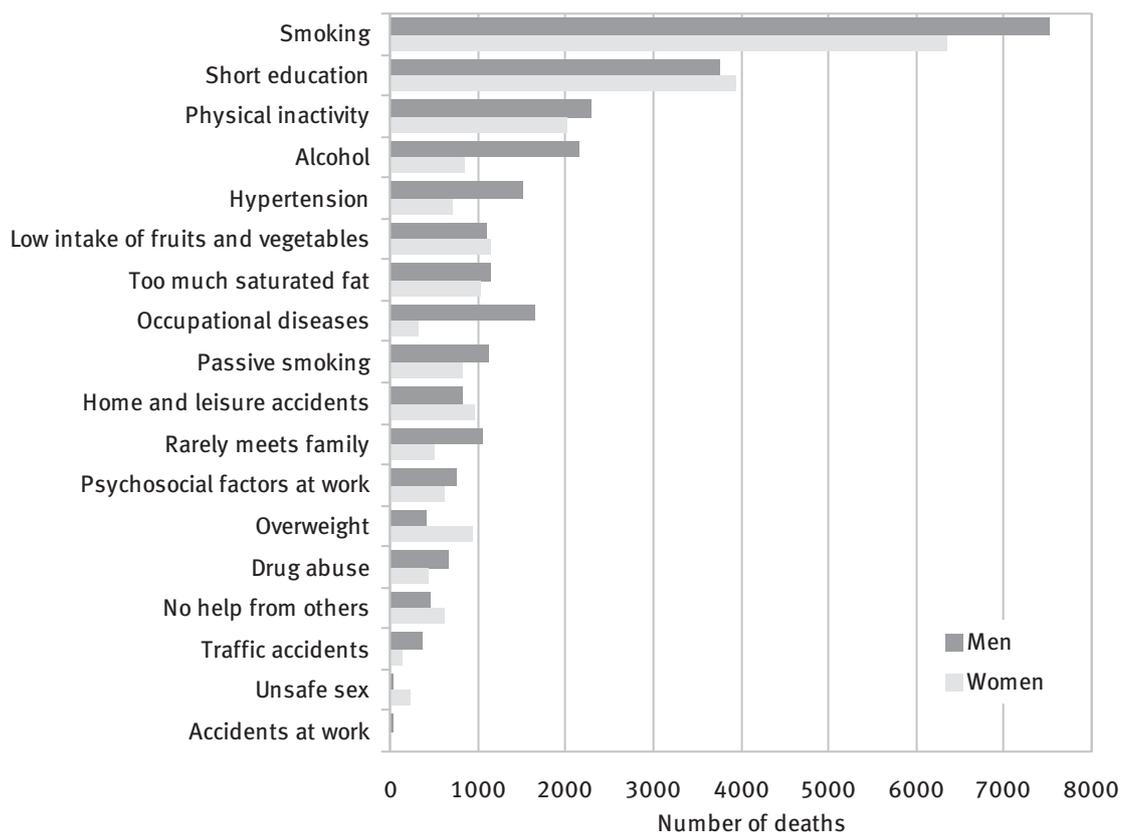
Years of life lost

When calculating years of life lost, deaths among young people count comparatively more than deaths among older people. This is in contrast to the above calculations of premature deaths, where one death weights equally regardless of age at death.

Smokers and ex-smokers annually lose almost 215,000 life-years, almost 100,000 of which are among women. There are more than 100,000 life-years lost among individuals with less than 13 years of combined school education and vocational training and 70,000 years of life lost because of alcohol.

For a large number of risk factors, there are each year 15,000-50,000 years of life lost. This is the case for physical inactivity, psychosocial factors at work, occupational disease, overweight, home and leisure accidents, traffic accidents, the two indicators for an unhealthy diet, and the two indicators for poor social relationships.

Deaths relating to unsafe sex result annually in approximately 7,000 years of life lost, accidents at work in just below 2,000, and drug abuse in approximately 1,000.

For several of the risk factors, we see approximately the same number of years of life lost among men and women. But there are exceptions. For alcohol and traffic accidents, men have 2.5-3 times as many years of life lost as women, for occupational disease almost five times as many, and loss of life-years due to accidents at work is almost exclusively seen among men. The reverse is the case for overweight and unsafe sex, where there are more than twice as many years of life lost among women than men.

Especially deaths due to accidents weigh relatively heavily among children and young people

Figure 2   Years of life lost in Denmark related to various risk factors. Annual number of years of life lost for men and women
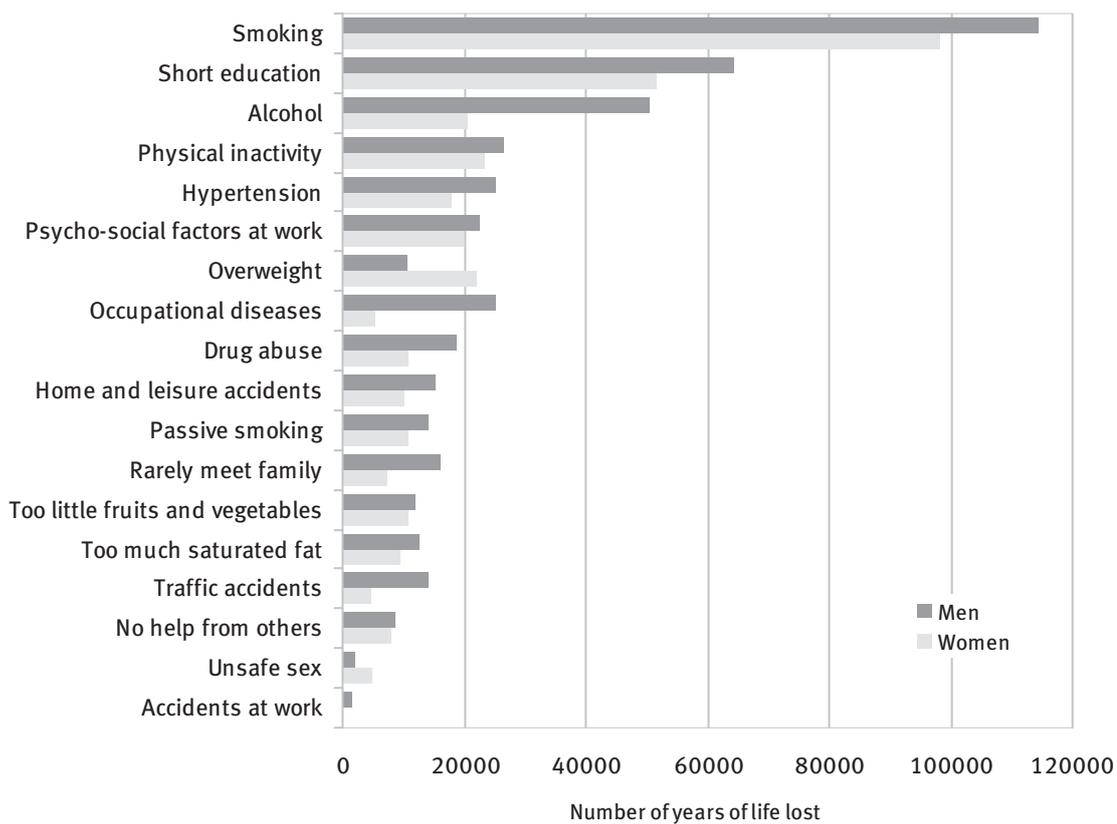
Loss of life expectancy

As for calculations of years of life lost, it also applies for loss of life expectancy that deaths among young people weigh more heavily than deaths among the elderly.

Smoking reduces the life expectancy for men by 3.5 years and for women 3 years. Also, a short combined school education and vocational training contributes with a great loss, 1.5-2 years.

For many of the risk factors there is, for both men and women, a loss of 0.5-1 year. This applies to alcohol, physical inactivity, psychosocial factors at work, occupational disease, overweight, drug abuse, home and leisure accidents, traffic accidents, the two indicators for an unhealthy diet, and the two indicators for poor social relationships.

There is a small loss for women due to unsafe sex, whereas accidents at work hardly contribute at all to a loss of life expectancy.

For several of the risk factors, men and women have almost the same loss of life expectancy. For alcohol, men have a loss that is nine months larger than that of women, for smoking and occupational diseases 6-7 months, for educational level, traffic accidents and the indicator 'rarely meets family members' just over three months. The reverse is the case for overweight women where the life expectancy is four months longer than for men.

Figure 3   Loss of life expectancy of the Danes related to various risk factors. Loss of life expectancy (years) for men and women
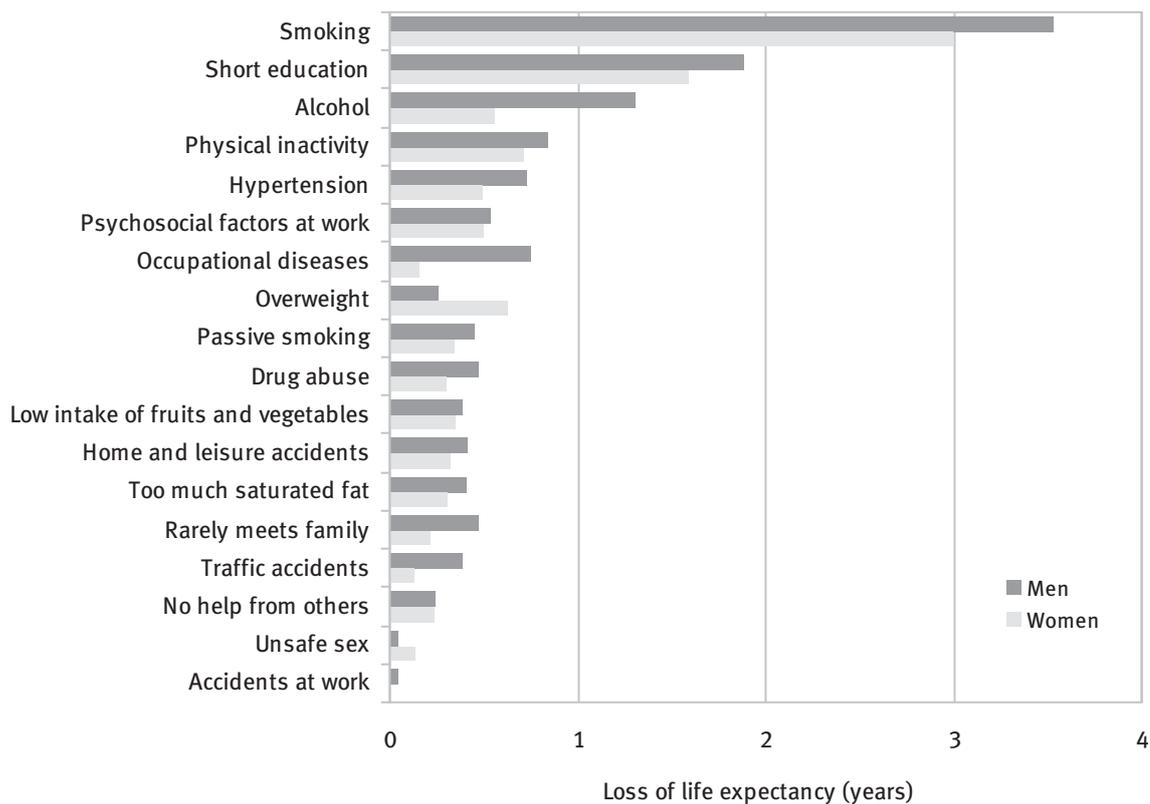
Long-standing limiting illness

Calculations of long-standing illness among the Danes above 25 years of age are based on self-reported information on the illness from the Health and Morbidity Survey 2000.

A low educational level and smoking weigh most heavily. Thus, social inequality in health contributes to long-standing limiting illness in almost 190,000 Danes when educational level is applied as a measure of social differences, while smoking is the reason why approximately 163,000 Danes suffer from long-standing limiting illness.

Long-standing limiting illness is related to physical inactivity in just below 47,000 cases.

Moderately overweight men have a similar risk of illness as men of normal weight. Disease related to overweight is illustrated in the figure as disease due to obesity for men and moderate overweight or obesity for women. Just over 14,600 men and 28,500 women are estimated to suffer from long-standing limiting illness due to obesity, while moderate overweight among women makes a further contribution of 33,000 per-

sons suffering from disease. The effect of overweight may be underestimated because of a tendency among the respondents to state their weight rather on the small side and their height rather on the large side.

An alcohol intake in excess of the recommended sensible drinking limits is estimated to explain almost 10,000 cases of long-standing limiting illness among men. For women no increase in the occurrence of disease is seen for this reason. Under-reporting of alcohol consumption may, however, mean that the impact of a high alcohol consumption is underestimated.

The two indicators for poor social relationships and psychosocial factors at work contribute modestly to long-standing limiting illness. But 20,000 women suffer from disease that can be related to not being able to rely on help from others in the case of illness.

The disease burden related to overweight is far greater for women than for men. Illness related to physical inactivity and the indicator 'no help from others' are also more frequent among women than men. For the remaining risk factors, the disease burden is larger for men.

Figure 4   Danes with long-standing limiting illness related to various risk factors. Number of ill men and women in 2000
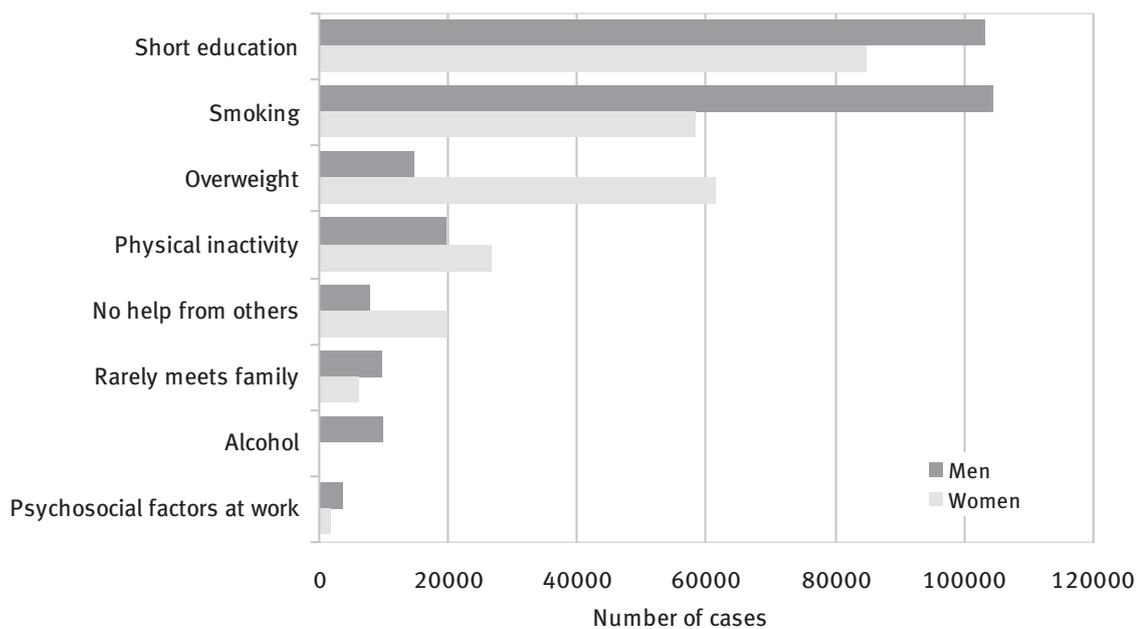
Loss of expected lifetime without long-standing limiting illness

Loss of healthy life-years is an indicator, which combines morbidity and mortality. The indicator is presented for 25-year-olds as life expectancy without long-standing limiting illness, which is lost because of exposure to a risk factor. As a risk factor in many cases reduces life expectancy, both expected lifetime without and with illness might be shorter. Therefore, the results, as they are shown here, should not stand alone but be viewed in context with the total life expectancy and the expected lifetime with long-standing limiting illness.

For the risk factors smoking, overweight and educational level, the results are shown in the figure divided on several levels.

Physical inactivity and smoking carry the greatest weight. For instance, the figure illustrates the number of fewer life-years without long-standing limiting illness to be expected by a heavy smoker, a moderate smoker and an ex-smoker in comparison with a 'never' smoker. Heavy smokers lose more than ten life-years without illness in comparison with 'never' smokers. Sedentary persons lose 8-10 life-years without illness in comparison with physically active persons. Men and women who cannot rely on help from others may expect just over six and 11 fewer life-years, respectively, without long-standing limiting illness than those who can rely on help. Individuals with a low educational level have 7-8 fewer life-years without long-standing limiting illness than those with a high education. Obese women may expect ten fewer life-years without long-standing limiting illness than women of normal weight. Obese men lose five life-years without illness compared to men of normal weight. Psychosocial factors at work, high alcohol consumption, together with the variable that describes if one only rarely meets family members, each contribute with a loss of 4-5 life-years without illness for men and 1-2.5 lost years for women.

The loss of life-years without illness related to overweight is notably greater for women than for men. The same is the case for physical inactivity and the indicator 'no help from others'. Among moderate smokers, ex-smokers and those with high alcohol consumption, men have more years of life lost without illness than women. Also among those with a low or intermediate educational level men have most years of life lost without illness, just as men lose more life-years without illness because of psychosocial factors at work.

Figure 5   Loss of expected lifetime without long-standing limiting illness related to various risk factors
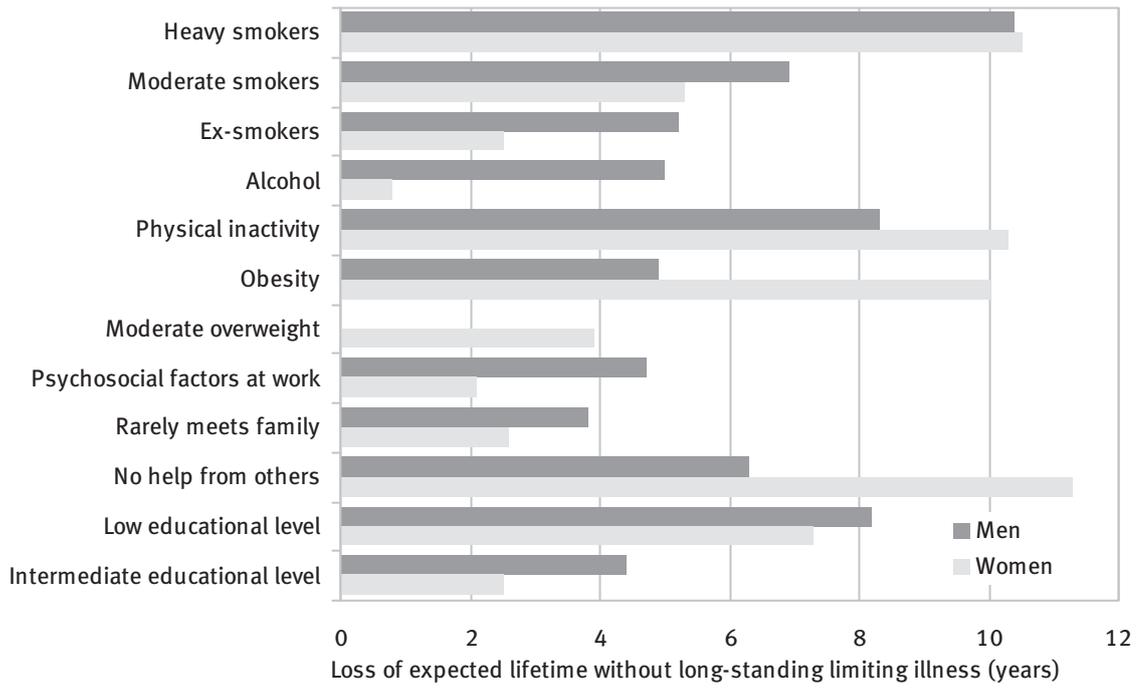
Loss of quality-adjusted life-years

Quality-adjusted life-years (QALYs) combine overall health state and mortality. Quality-adjusted life expectancy is calculated as life expectancy for 25-year-olds, adjusted with health preferences obtained via Danish EQ-5D values, established from questions about mobility, self-care, usual activities, pain/discomfort and anxiety/depression.

For the risk factors smoking, overweight and educational level, the results are shown in the figure divided on several levels.

Heavy smokers have 10-12 fewer QALYs than 'never' smokers. Physically inactive individuals lose approximately seven QALYs in comparison with physically active individuals.

Persons who cannot rely on help from others can expect 5-6 fewer QALYs than those who can rely on help.

Individuals with a low educational level have 5-6 fewer QALYs than individuals with a high educational level.

By drinking more than the recommended limits for alcohol intake, quality-adjusted life-years are reduced by five for men and just over three for women.

Obese men and women can expect three and six fewer QALYs, respectively, than those of normal weight.

Rare family contact reduces QALYs by just below four for men and just over two for women.

Psychosocial factors at work reduce QALYs by just over three for men and just below one for women.

Overweight has a greater negative impact on women than on men, while alcohol and psychosocial factors at work reduce quality-adjusted life-years more for men than for women.

Figure 6   Loss of quality-adjusted life expectancy related to various risk factors
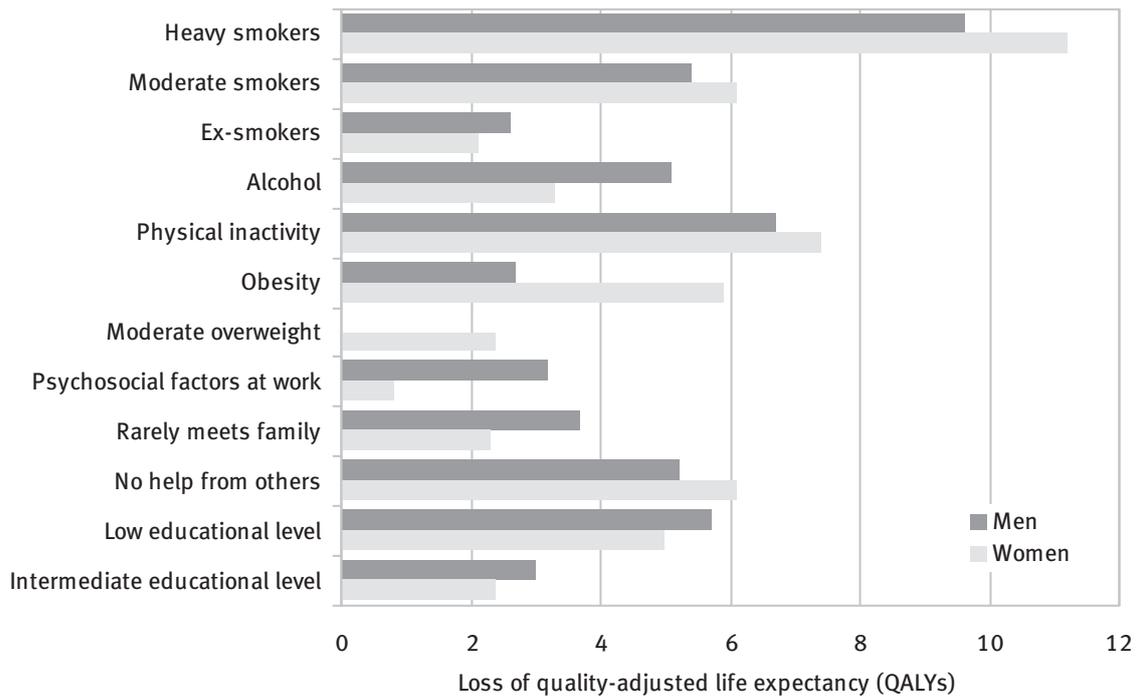
Hospital admissions

Three factors contribute greatly to the number of hospital admissions. They are smoking, less than 15 years of combined school education and vocational training, and physical inactivity. Each of these risk factors represented 135-165,000 additional hospital admissions each year.

Overweight is related to approximately 55,000 extra admissions, while home and leisure accidents, psychosocial factors at work, and a large alcohol consumption each contribute with approximately 30,000 additional admissions.

The two indicators of poor social relationships, rarely meeting family members and not relying on help from others in the case of illness, together with unsafe sex each contribute with approximately 10,000 admissions, while there are minor contributions from traffic accidents, drug abuse and accidents at work.

In Denmark, there is almost the same number of admissions among men and women each year. Distributed on risk factors, more important gender differences are seen. Men have twice as many extra admissions as women due to smoking and alcohol and four times as many related to psychosocial factors at work. Admissions due to unsafe sex occur almost only among women, and admissions related to accidents at work and among those who rarely meet family members, are almost exclusively seen among men.

Women have more admissions related to physical inactivity.

There are a relatively large number of admissions among children and young people due to traffic accidents, home and leisure accidents and unsafe sex.

Figure 7   Hospital admissions in Denmark related to various risk factors. Annual number of admissions for men and women
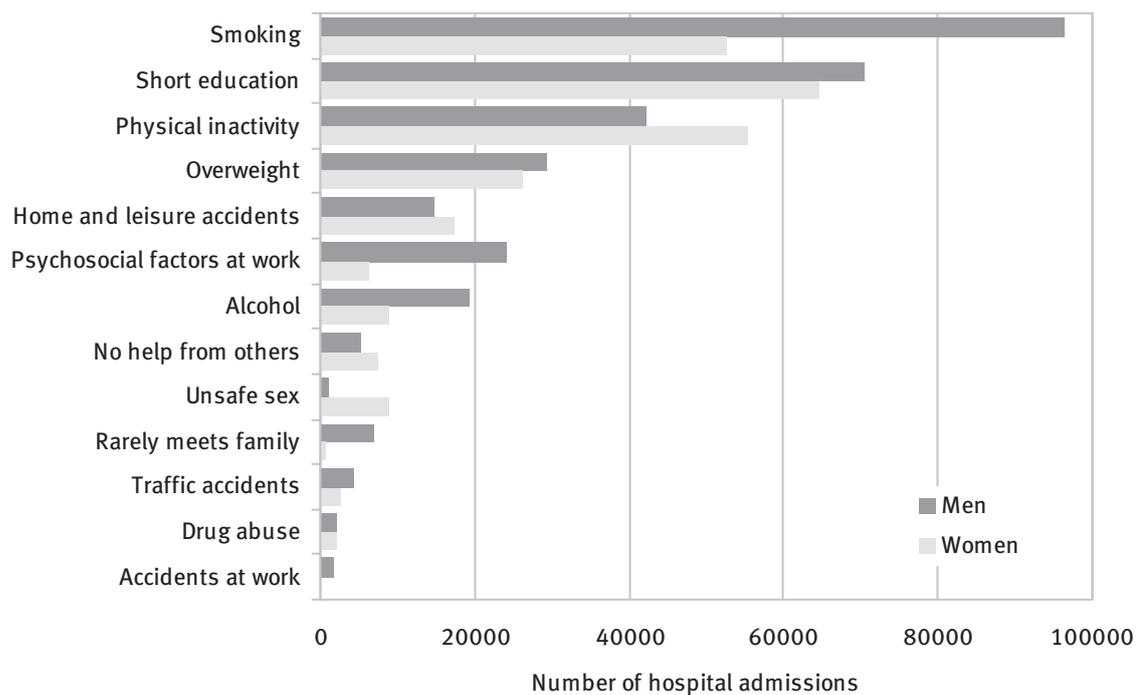
Visits to emergency departments

For visits to emergency departments, the available information has been on five risk factors only: work, traffic, home and leisure accidents together with alcohol and drug abuse.

Home and leisure accidents contribute greatly, as both men and women make more than 200,000 visits to emergency departments each year.

There are just over 70,000 visits to emergency department annually due to accidents at work, and there are 50,000 visits to emergency departments due to traffic accidents.

Alcohol with 10,000 cases and drug abuse with 1,500 play a very minor part in this connection.

Men make approximately 25% more visits to emergency departments than women.

An almost similar difference between men and women is seen for home and leisure accidents and traffic accidents.

For all five risk factors, men make more visits to emergency departments than women. Men are responsible for more than 50,000 visits to emergency departments due to accidents at work, while the figure is 20,000 for women.

For all the five risk factors, cases among children and young people account for a relatively large proportion of the casualty visits.

Figure 8 Visits to emergency department in Denmark related to various risk factors. Annual number of visits to emergency departments for men and women
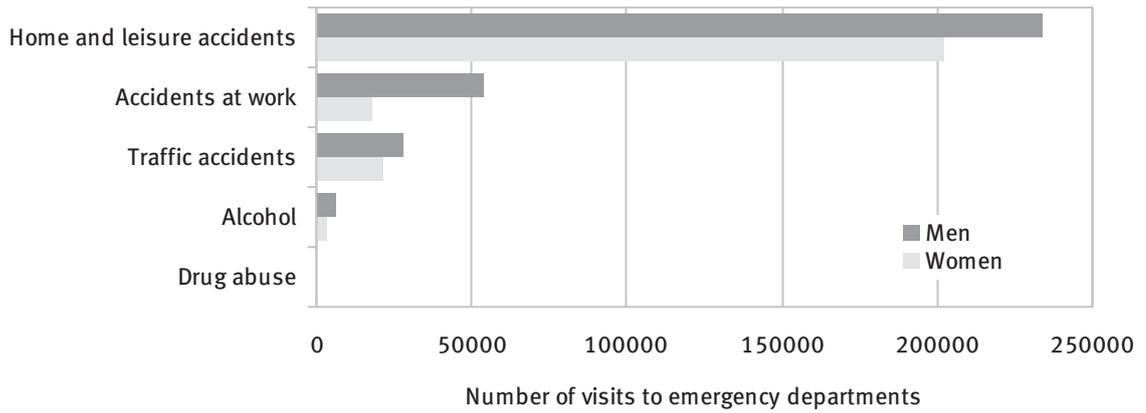
Out-patient visits

For out-patient visits information has been available only on contacts related to alcohol, drug abuse and unsafe sex.

For men, 50,000 out-patient visits were related to alcohol, while there were 8,000 cases related to unsafe sex and 4,000 cases related to drug abuse.

Among women there were almost 40,000 visits due to unsafe sex, more than 20,000 due to alcohol and 3,000 due to drug abuse.

For unsafe sex, there are a relatively large number of cases in young people among the out-patient visits.

Figure 9   Out-patient visits in Denmark related to various risk factors. Annual number of out-patient visits for men and women
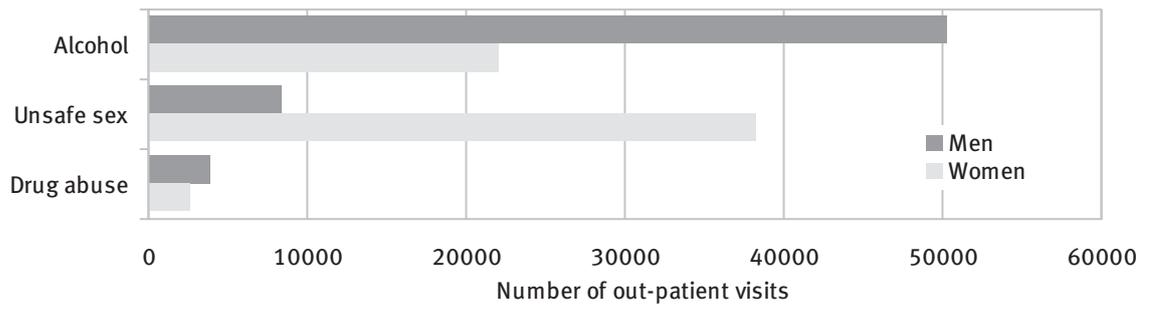
Contacts to general practitioners

It has been possible to assess contacts to general practitioners for eight risk factors.

There are a total of 3.7 million extra contacts to general practitioners among persons with less than 15 years of combined school education and vocational training. There are 2.7 million additional contacts among smokers and ex-smokers, followed by physical inactivity with 2.6 million and overweight with 1.1 million.

Psychosocial factors at work are related to just over half a million contacts, and there are 200,000 additional contacts among those who drink above the recommended limits. In between we find the two indicators for poor social relationships ('no help from others' and 'rarely meets family members').

Women generally have more contacts to their general practitioner than men.

Smoking contributes with almost the same number of contacts among men and women, but otherwise there are a number of gender differences in the distribution of the additional contacts. For contacts related to psychosocial factors at work, there are twice as many among men as among women, for alcohol there are 4-5 times as many. The reverse is the case for the indicator 'no help from others', where almost all the extra contacts are seen among women, and for physical inactivity there are twice as many among women as among men.

Figure 10 Contacts to general practitioners in Denmark related to various risk factors. Annual number of contacts (in 1,000s) for men and women
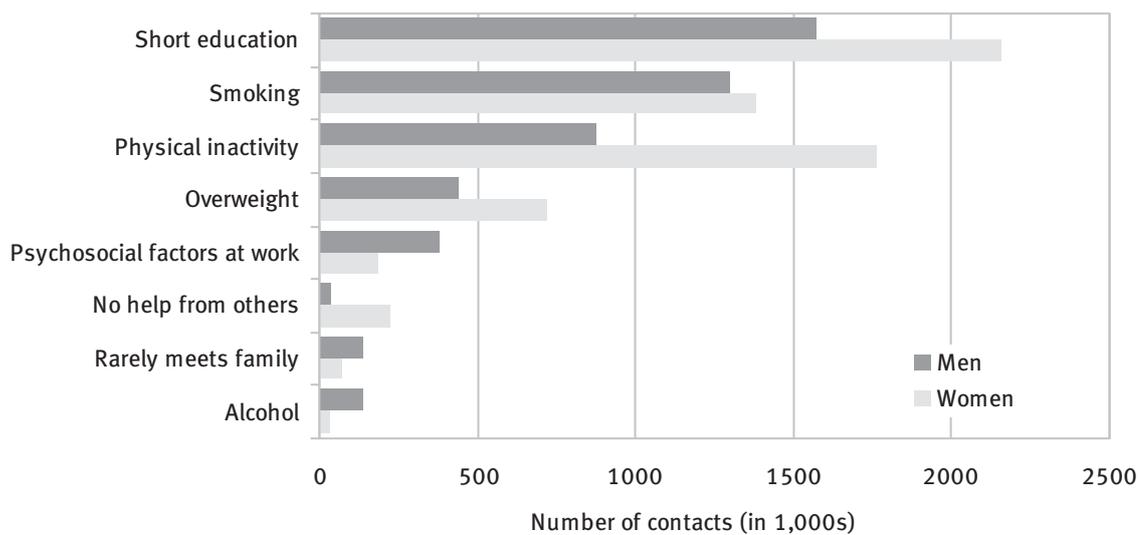
Sickness absence from work

Sickness absence from work is estimated for eight risk factors. Among those rarely meeting family members additional days of sickness absence had not been estimated, and this factor is therefore not included in the figure. The estimation of sickness absence has only been made for individuals engaged in active employment.

There are 4.8 million extra days of sickness absence among persons with less than 15 years of combined school education and vocational training. There are 3.1 million extra days of sickness absence among physically inactive persons, and 2.8 among smokers and ex-smokers.

Overweight contributes with 1.9 million and psychosocial factors at work with 1.5 million days of absence. An extra 300,000 days of absence have been found among persons with a large alcohol consumption, and 100,000 among those stating that they cannot rely on help from others.

The annual average number of days of sickness absence is six for men and eight for women. We find that educational level is related to three times as many extra days of absence for men as for women, and for individuals with a heavy psychosocial workload, men have twice as many days of absence as women. Alcohol almost only contributes with days of absence among men. There are almost no days of absence related to the indicator 'no help from others'.

The gender difference in absolute figures is very large for those with less than 15 years of combined school education and vocational training, where men account for 75% of the extra days of absence, and physical inactivity, where women account for 70% of the cases.

Figure 11 Days of sickness absence in Denmark related to various risk factors. Annual number of days of absence (in 1,000s) for men and women
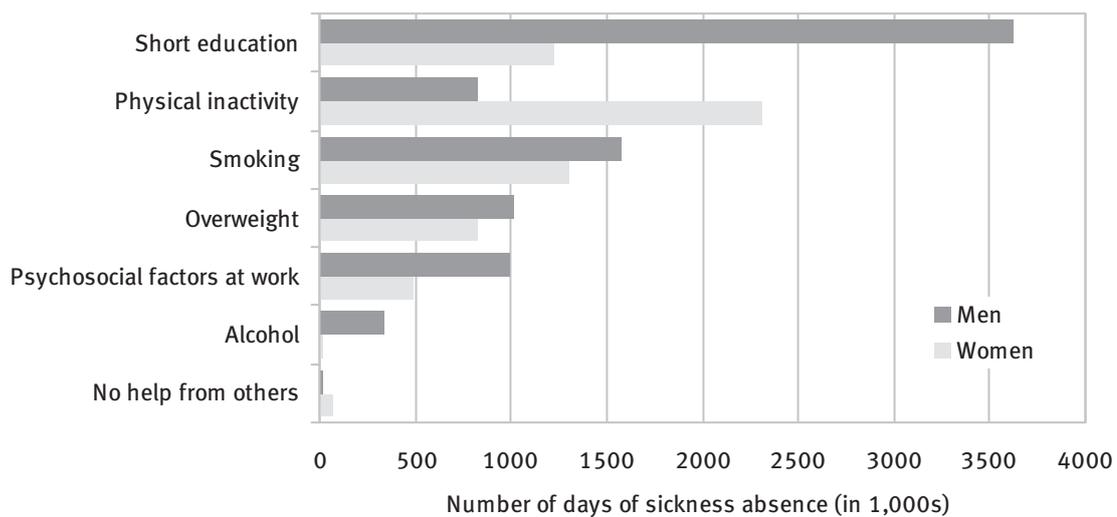
Early retirement pensions

The distribution of allocated early retirement pensions is illustrated for ten risk factors. The estimation of early retirement pensions has been made only for individuals in the age group 25-64 years.

Smoking peaks with 5,000 early retirement pensions. There are also many extra early retirement pensions among persons with a heavy psychosocial workload and among those with less than 15 years of combined school education and vocational training. There are also a considerable number of cases related to physical inactivity, overweight and alcohol (among men).

The two indicators for poor social relations, together with drug abuse and unsafe sex, are related to comparatively few cases. The smallest number is seen for unsafe sex, where there are approximately 50 early retirement pensions annually.

On an annual basis, almost the same number of early retirement pensions is allocated to men and women. The largest absolute differences in the extra cases related to risk factors are seen for psychosocial factors at work and overweight, where there are 3-400 more cases among women. The reverse is the case for alcohol.

Figure 12   Early retirement pensions in Denmark related to various risk factors. Annual number of allocated early retirement pensions for men and women
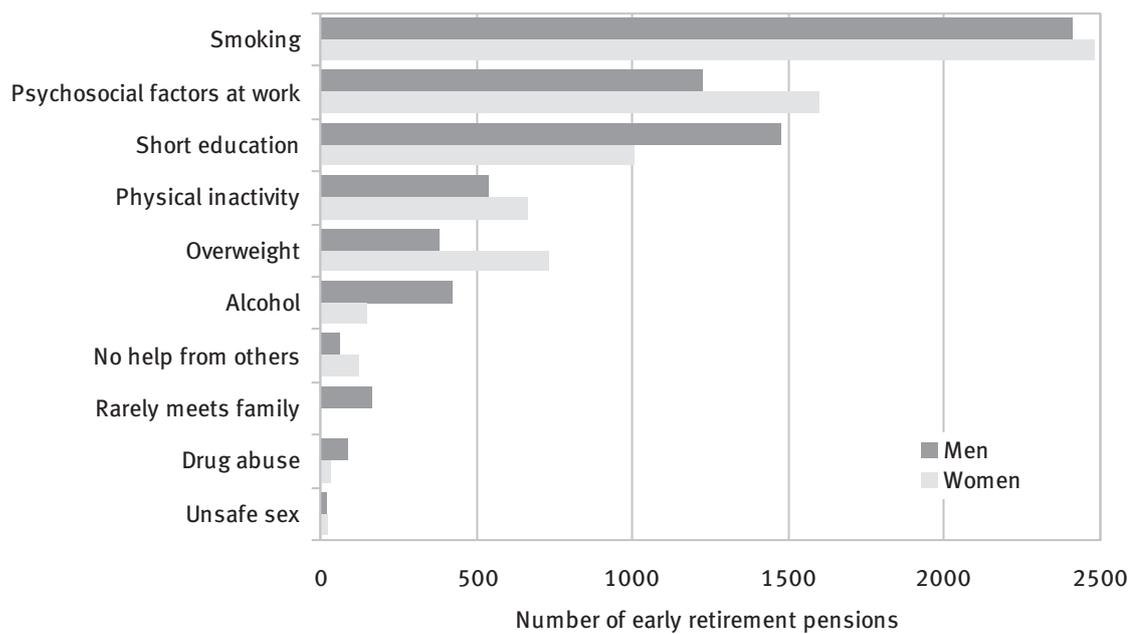
The costs of the health care system

The annual costs to the health care system in relation to the single risk factors are estimated on the basis of calculations of the use of the hospital sector and the services from the primary care practitioners. The costs of the hospital sector include admissions, out-patient contacts and emergency department visits, which have been valuated by means of current, Danish DRG/DAGS-rates. The use of services from the primary care practitioners has been calculated in relation the gross fee paid to the providers (general practitioners, dentists, physiotherapists, etc.), but does not contain patient charges or basic fees for general practitioners.

The necessary information on resource use has not been available for all risk factors. The calculation shows the figures for the resources that are available. All the necessary data have been available only for alco

hol, while for the other risk factors, one or more resource use elements have been missing. Consequently, comparisons across the risk factors should be interpreted with great caution.

From the calculations shown, it appears that smoking, physical inactivity and less than 13-15 years of combined school education and vocational training are related to very large costs to the health care system.

For a number of risk factors, there are considerable gender differences in the resources used in the health care system. The costs for men are considerably larger than for women in relation to smoking, alcohol, psychosocial factors at work, and considerably larger for women than for men in relation to physical inactivity, unsafe sex and not being able to rely on help from others in the case of illness. There is hardly any difference between men and women in relation to drug abuse, overweight, home and leisure accidents and educational level.

Figure 13   Costs of the health care system in Denmark related to different risk factors. Costs in millions 2005 DKK
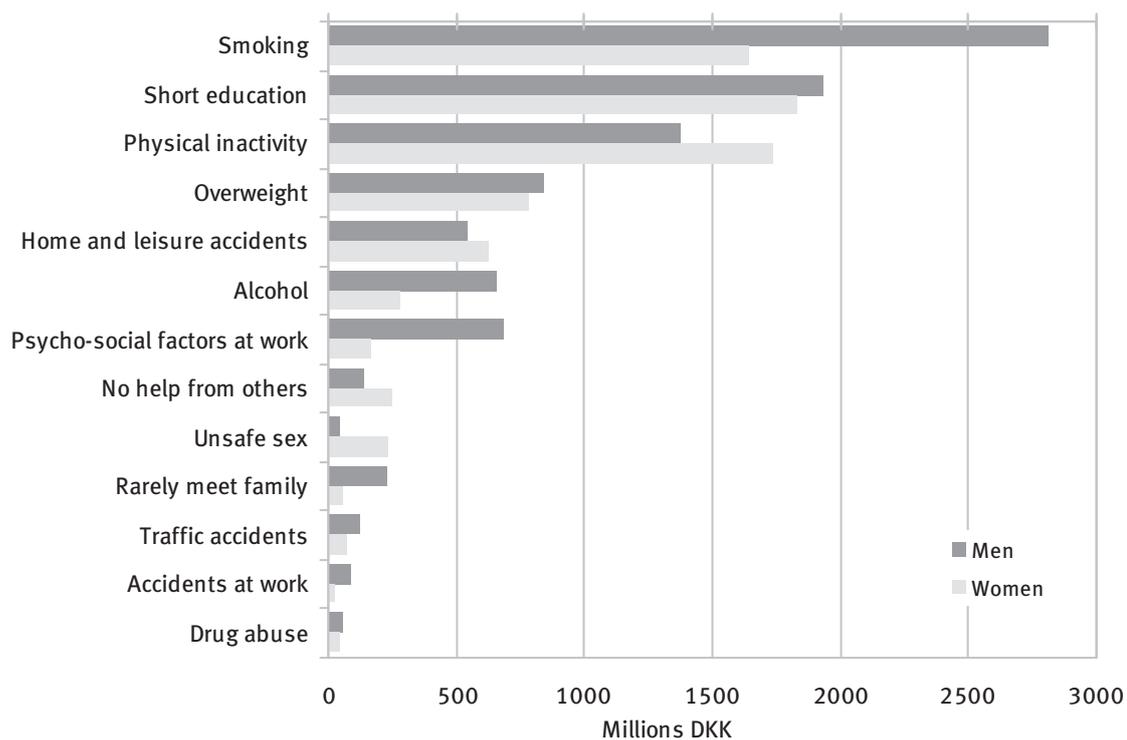
The net costs of the health-care system

The net costs of the health care system include costs in connection with the treatment of disease related to the risk factors, savings in treatment costs in connection with shorter lifetime, and additional costs related to an earlier time of death. The sum of these costs is called the net costs of the health care system.

The net costs show the total annual costs to the health care system for those risk factors where the full data needed to estimate this figure have been available. For some risk factors is has not been possible to estimate the treatment cost for diseases related to the risk factor. In these cases the net cost has not been estimated even though the data required to calculate the cost associated with premature deaths have been available. Interpretations should be made with caution when comparing across risk factors.

Smoking, educational level and physical inactivity each put pressure on the net costs of the health care system with approximately three billion DKK per year. Overweight and home and leisure accidents put pressure on the health care system with more than one billion DKK net per year.

The net costs to the health care system are larger for men than for women for smoking, overweight, alcohol, traffic and accidents at work. The net costs are larger for women in relation to educational level, physical inactivity, the indicator for not being able to rely on help from others in the case of illness, and unsafe sex.

Figure 14   The net costs of the health care system in Denmark related to different risk factors. Costs in millions 2005 DKK
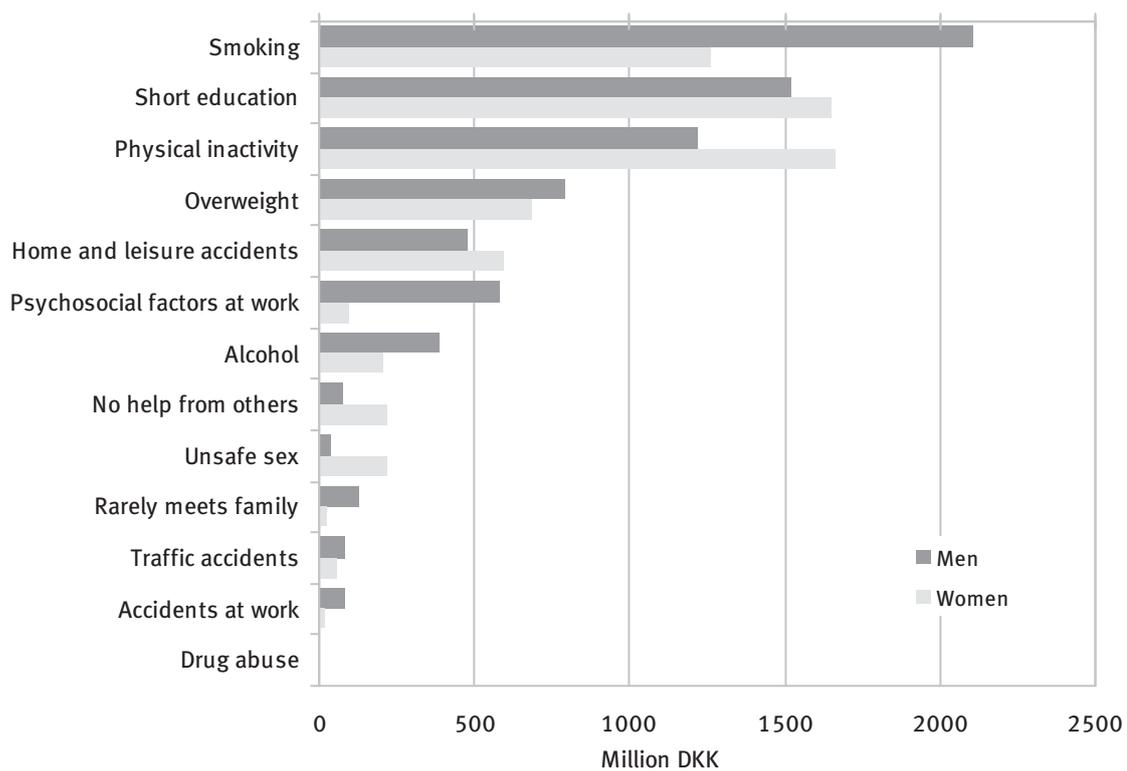
Costs of production loss, the human capital method

When a person is not participating on the labour market there is a production loss to society. The value of the production loss can be calculated on the basis of sickness absence from work and premature retirement from the labour market as a result of early retirement pension or death. The production loss is valued as average gross salary (i.e. wage including pension contribution and tax). There are two alternative approaches to estimating the duration of the production loss. In the human capital method, the production loss is assumed to last from the time of retirement from the labour market until the general pension age (65 years). The alternative approach, the friction method, assumes that the person leaving the labour market is replaced by a new person after a short friction period (three months). This approach presupposes, among others, the existence of vacant resources on the labour market (i.e. unemployment).

In the calculation of production losses, retirement from the labour market as a result of death is included for all risk factors. For some of the risk factors, also the costs of production loss related to sickness absence from work and to early retirement pension are included (tobacco, alcohol, physical inactivity, overweight, psychosocial factors at work, and the two indicators for poor social relationships and educational level).

The production loss among men is considerably larger for most of the risk factors, including smoking, alcohol, drug abuse, hypertension, psychosocial factors at work, home and leisure accidents, and educational level. The reason for the gender difference is both that men are in greater risk of leaving the labour market because of these risk factors, and that the average production value (gross wage) is higher among men than women. The only exception is production loss related to physical inactivity, which is of roughly the same size for men and women.

Figure 15   Costs of production loss in Denmark related to various risk factors calculated according to the human capital method. Costs in millions 2005 DKK
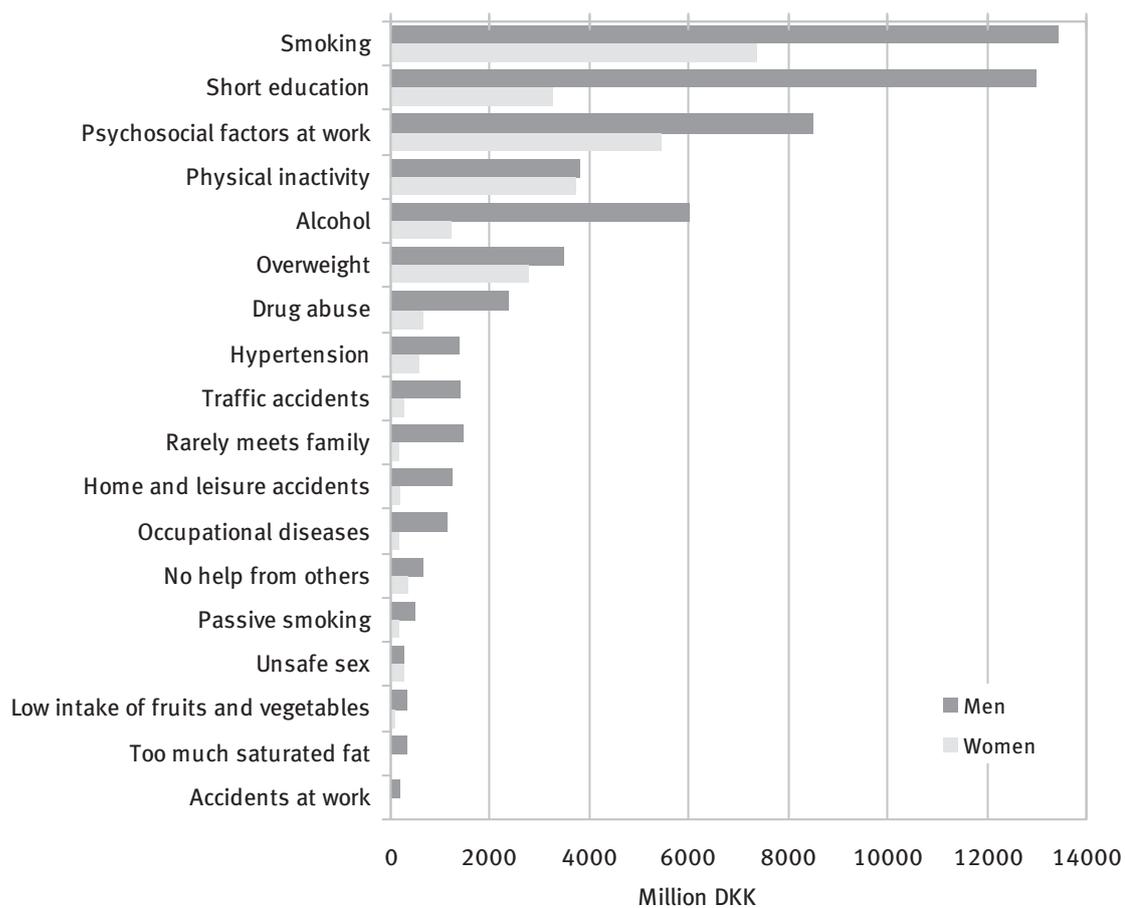
Costs of production loss, the friction method

In contrast to the human capital method, the friction method assumes that production loss occurs in the first three months after a person has left the labour market. His or her tasks (and the ensuing production) will subsequently be replaced by a new person. The other assumptions as to the value of the production loss (gross wage, etc.) are identical for the two methods.

Smoking, physical inactivity, overweight, psychosocial factors at work, and educational level are risk factors which are connected with large costs of production loss. The production loss is larger for men than for women for most of the risk factors, with the exception of physical inactivity, where the production loss among women is just under twice the size of that of men.

Figure 16   Costs of production loss in Denmark related to various risk factors, calculated in accordance with the friction method. Costs in millions 2005 DKK
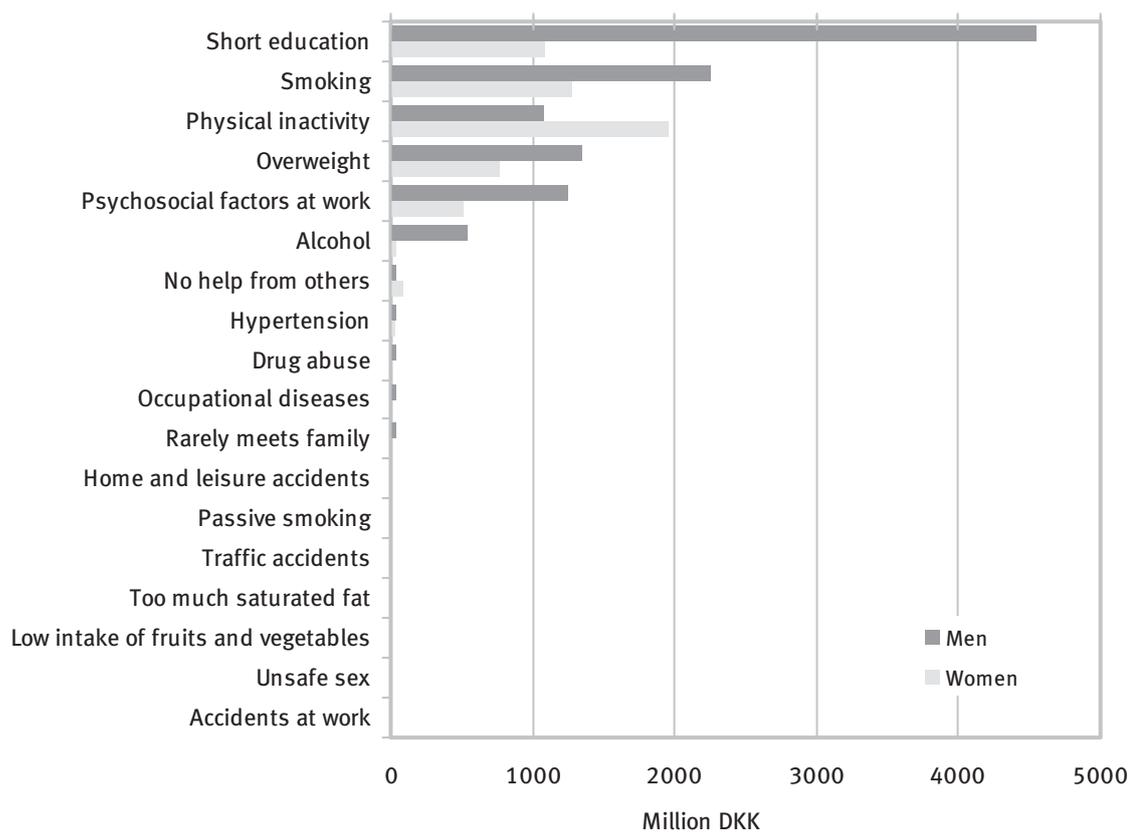
Future other consumption

In addition to the resource use in the health care system, humans also consume other amenities (e.g. food, housing, transportation, entertainment). The use of these resources is termed other consumption.

The calculation of savings in future other consumption differentiates the description of the costs of the production loss.

When an individual dies prematurely there is a saving in other consumption in the period from the time of death to the expected time of death. This represents a saving in the analysis. As it is assumed that other consumption would have taken place during the lost remaining lifetime, the amounts in question are comparatively large. In the calculations we have used a 5% discount rate. The value of the future other consumption is larger if a lower discount rate is used.

The analysis of future other consumption shows that smoking, educational level, alcohol and physical inactivity are connected with great savings. This is first and foremost due to the close relation between years of life lost and future other consumption.

There are great future savings in other consumption in connection with smoking, educational level and alcohol. For men, the greatest savings are for smoking, educational level, alcohol, hypertension, occupational disease, drug abuse, and for the indicator stating that one rarely meets family members. For women, the saving is greatest for overweight, while savings are of roughly the same size for men and women for the remaining risk factors.

*Figure 17   Future savings in other consumption in Denmark related to various risk factors.
Savings in millions 2005 DKK*
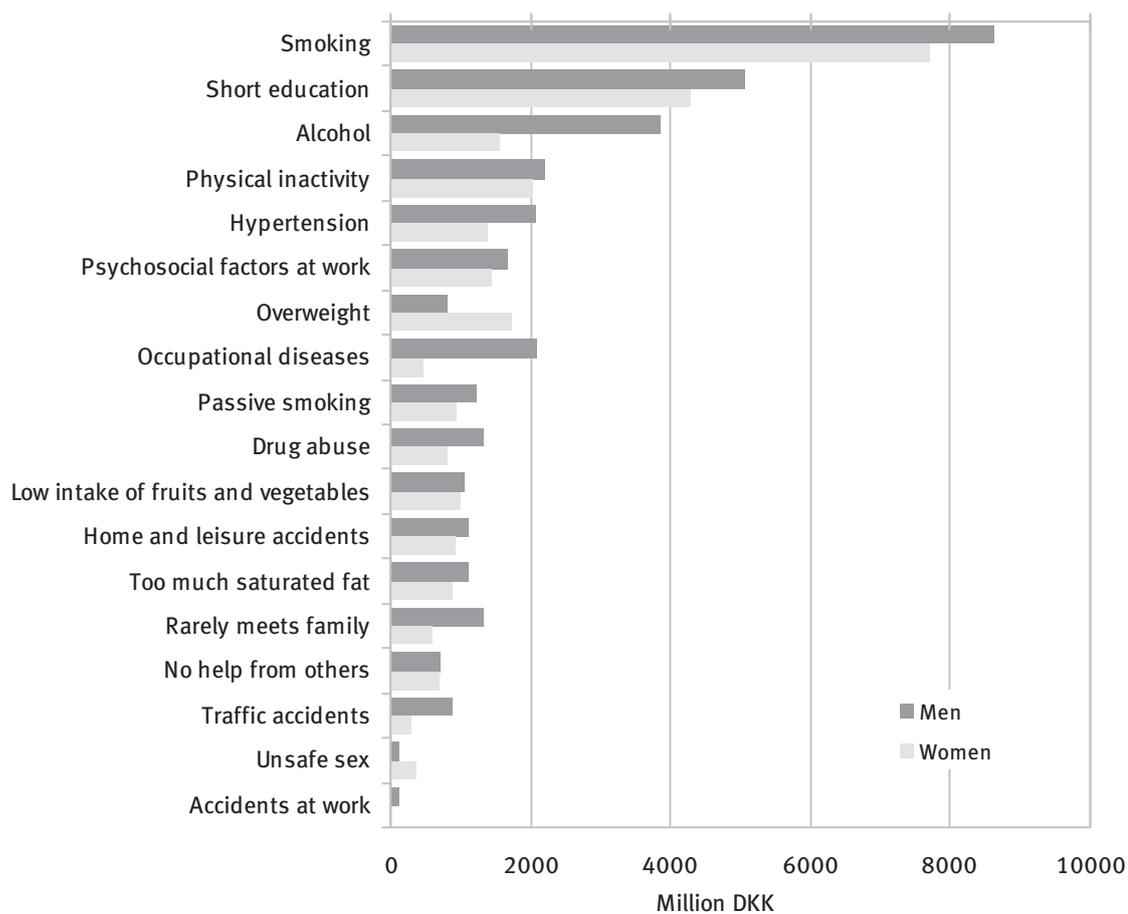
DALY

The WHO has calculated disability-adjusted life-years (DALYs) for a large number of risk factors, and nine of those are included in this study.

DALY combines mortality and morbidity in a summary measure and is based on the results of the Global Burden of Disease Study 2000. A DALY should be understood as a lost healthy life-year and the burden of disease as a measure for the gap between the present health state and the ideal situation, where everyone lives to a high age without disease.

The mortality is based on an analysis of the most recent available national information on mortality distributed on causes. The morbidity is calculated on the basis of incidence, prevalence, duration and degree of seriousness of the disease and injury.

The extreme points are 17-18% for smoking and less than 0.5% for accidents at work.

Smoking contributes, for both men and women, with the greatest proportions. Then follows alcohol, which is due, in particular, to a large alcohol consumption among men.

Among both men and women, overweight and hypertension account for large proportions of the total DALY. The share is a little greater for men for the two factors.

Physical inactivity, a low intake of fruits and vegetables, drug abuse and unsafe sex contribute for both men and women with 1-3% of the total DALY, the greatest contribution being from physical inactivity.

Figure 18 DALY for Denmark related to various risk factors. Proportion (%) of total DALY for men and women
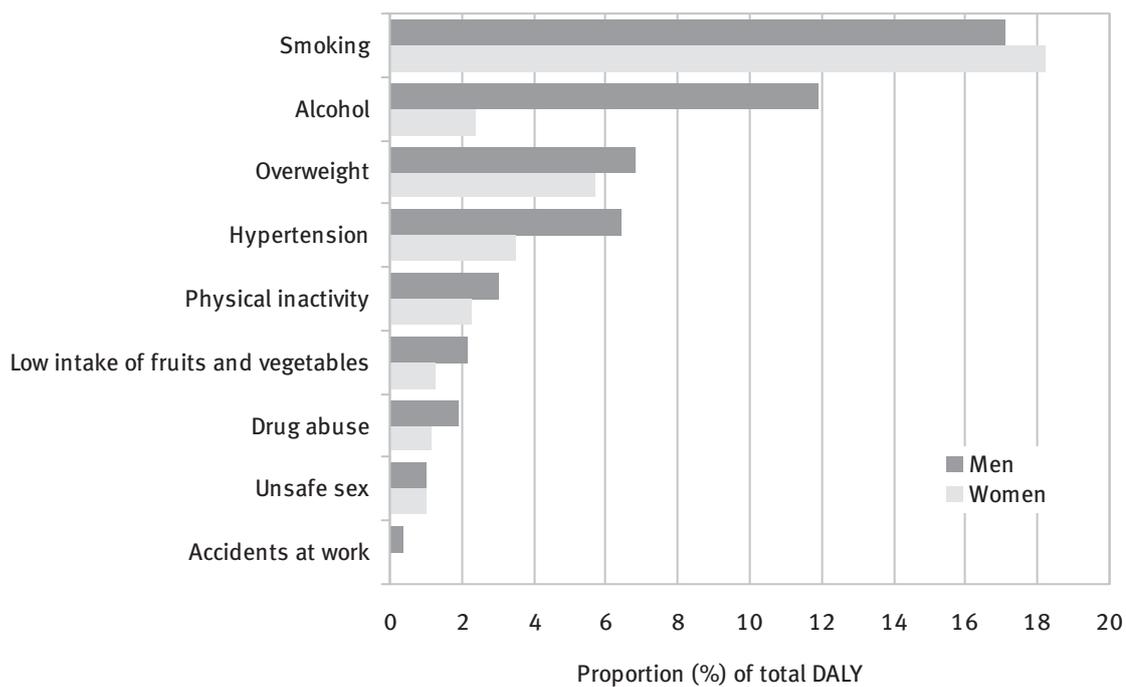
Similar studies from other countries

The causes of diseases are complex and multifactorial, and to relate the measures for health and economic consequences to the risk factors it is necessary to make a number of crude assumptions. Nonetheless, the method can provide greater insight into the impact of a number of factors on the health state of the population, and it can, thus, be useful in the planning of preventive measures both nationally and regionally.

The ranking of risk factors depends on the chosen measure. More decisive is the fact that the ranking of risk factors does not take into account the different levels of causes. A comparison of smoking and educational level requires careful interpretation, as the impact of low education goes, in part, via a larger proportion of smokers. In a similar way, a comparison between physical inactivity, overweight and an unhealthy diet will require thorough interpretation.

Nonetheless, it is evident from the different rankings that smoking, educational level, physical inactivity, alcohol and overweight play a large part for most of the measures for health and economic consequences. For specific measures, as e.g. visits to emergency departments, accidents play an important role.

The importance of the chosen risk factors has changed dramatically in the last 50 years, and it is probable that, within the foreseeable future, the ranking will change again.

Although the purpose of the present work was to illustrate the impact of risk factors in Denmark, a comparison with similar studies from other countries is of interest. In the following, various national and international risk factor projects are mentioned.

A study from New Zealand distributed the deaths on a number of risk factors (1). A combined factor comprising diet factors like total energy intake, saturated fat, salt, fruits and vegetables, together with derived effects on cholesterol, blood pressure, and overweight accounted for most deaths. The next three factors were smoking, cholesterol and a measure for relative poverty, followed by systolic blood pressure, overweight, physical inactivity, and diabetes. A low intake of fruits and vegetables, alcohol, illegal drugs, traffic accidents, and unsafe sex were further down the list.

It has been calculated that 37% of all cancer deaths in high-income countries could be ascribed to nine risk factors, where smoking, alcohol and overweight were the most important (2).

In the USA, it was calculated that half of all deaths in 2000 could be ascribed to behaviour and some risk factors that could be changed (3,4). The risk factors responsible for the largest proportion of the total number of deaths were smoking (18%), unhealthy diet and physical inactivity together (15%), and alcohol (3.5%). Further down the list were traffic accidents, unsafe sex and illegal drugs.

In Holland, smoking was the most important factor for mortality with 15% (5). The factors for too much saturated fat, low intake of fruits and vegetables, physical inactivity, hypertension, and obesity, each account for 5-6% of all deaths. Measured by quality-adjusted life-years, alcohol and smoking were the most important with 8-9%, followed by hypertension and obesity with 4-5%, too much saturated fat and physical inactivity with 3%, and a low intake of fruits and vegetables with 2%.

In Australia, a considerable proportion of the total burden of disease could be attributed to smoking, physical inactivity, obesity, hypertension, and high cholesterol level (6). In the Australian study an attempt has been made to calculate the impact of each risk factor independently of the other risk factors, but it is stated that the complex connections between the risk factors make this difficult.

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This publication is a summary of a
report that presents the first compre-
hensive analysis of the impact of
selected risk factors for public health
in Denmark.

The consequences of 19 selected risk
factors (lifestyle, biological and social
conditions) are analysed in relation
to 18 measures of health conse-
quences and economic welfare (life
expectancy, life-years without long-
standing limiting illness, hospital
admissions, and costs to society).

The result is a comprehensive docu-
mentation of the impact of the most
important risk factors for the overall
health status and costs to those
engaged in disease prevention and
health promotion.