WHITE PAPER

Social Inequality in Cancer in Denmark

Second edition

Social Inequality in Cancer in Denmark
White Paper
Second edition

Prepared by:
Maja Halgren Olsen, postdoc, MSc
Trille Kristina Kjær, senior researcher, MSc
Susanne Oksbjerg Dalton, Professor, Consultant

Survivorship and Inequality in Cancer
Danish Cancer Society Research Center
Strandboulevarden 49
DK-2100 Copenhagen

Responsible person:
Mads Melbye, Head of Research

Publisher:
The Danish Cancer Society
May 2023

Translated from Danish by:
Translated By Us ApS

Graphic design and layout:
Updated layout: Grafisk Rådgivning
Original layout (2019): Anne-Marie Krogh

Print:
Grafisk Rådgivning
Printed editions: 100 copies
The white paper can be downloaded at **www.cancer.dk/whitepaper2**

PREFACE

In 2019, the Danish Cancer Society published a white paper on social inequality in cancer based on the 134 studies that had been conducted in the field at the time. The conclusion was clear: social inequality exists throughout the cancer trajectory in Denmark. In this updated version, the evidence base has been expanded to include 74 additional studies, yet the conclusion remains the same. Danes who have a short education, low income or live alone have a higher risk of getting cancer and a lower chance of surviving cancer than Danes who have a longer education, higher income or cohabit. Surprisingly few knowledge gaps have been filled. We continue to have limited knowledge about inequalities within the diagnostic process, rehabilitation, palliative care and patient-centred care. In these areas, we do not live up to our reputation of having comprehensive health data in Denmark. There is a justified fear that this data gap is accompanied by a large socioeconomic gap in cancer outcomes.

This is an area that the Danish Cancer Society views with great concern. Since the first edition of the white paper, the society has contributed to the establishment of Danish Research Center for Equality in Cancer (COMPAS) developing and testing clinical interventions to counteract social inequality in cancer trajectory. It is also encouraging that over 100 organisations have now put health inequalities on the agenda in the Alliance Against Social Inequalities in Health.

Unfortunately many challenges remain and our work is far from over. We are currently confronted with a shortage of healthcare professionals, cancer patients who cannot receive timely treatment and an increasingly complex healthcare system that places a high degree of responsibility on the individual patient. This presents challenges for vulnerable patients and magnifies the need for additional efforts to address social inequality.

As the white paper emphasises, more knowledge is needed to ensure a sound basis for future action. Among other things, there is a need to facilitate, systematise and prioritise ongoing monitoring of who uses and benefits from health services in Denmark in order to make sure that differences can be brought to light. This kind of work is difficult to achive funding for, and should be incorporated into the regular monitoring work of the healthcare system.

Inequality in cancer and in health in general, has many causes and very little is known about effective interventions. This should, however, not hinder a targeted effort to promote initiatives that would most likely be effective: prevention of smoking, excessive alcohol consumption, physical inactivity and overweight and obesity, as well as the incorporation of more flexibility into healthcare systems in order to ensure that they can accommodate patients' varying social circumstances and respond to those with the greatest need.

Addressing the systematic inequalities present throughout the cancer trajectory requires a broad effort. For this second edition of the white paper, Professor Finn Diderichsen has provided an expert opinion that discusses possible approaches and is addressed to officials and policy makers working to reduce inequality in cancer – and health in general – in municipalities, regions and in the collaboration between municipalities, general practice and hospitals in connection to acute hospitals (in Danish "sundhedsklynger").

Copenhagen, 11 April 2023
Mads Melbye, Professor, Doctor of Medical Science (D.M.Sc.).
Head of Research
The Danish Cancer Society

1

Summary

The aim of this white paper is to provide a comprehensive, systematic overview of social inequality in cancer in Denmark for the period 2008-2022. This chapter briefly summarises the main findings of the white paper.

SUMMARY

Cancer is unevenly distributed across socioeconomic groups in Denmark

In Denmark, a few cancers (melanoma, prostate cancer and breast cancer) are more common among people who have a long education (Figure 1), high income or live with a partner. The vast majority of cancers are, however, more common among people who have a short education, low income or live alone.[1-19] Social inequality is particularly high for smoking related cancers, such as cancers of the larynx, pharynx, lung, oral cavity and oesophagus. These cancers are between 1.6 and 3.8 times more common among people who have a short education compared

SOCIAL INEQUALITY IN CANCER RISK

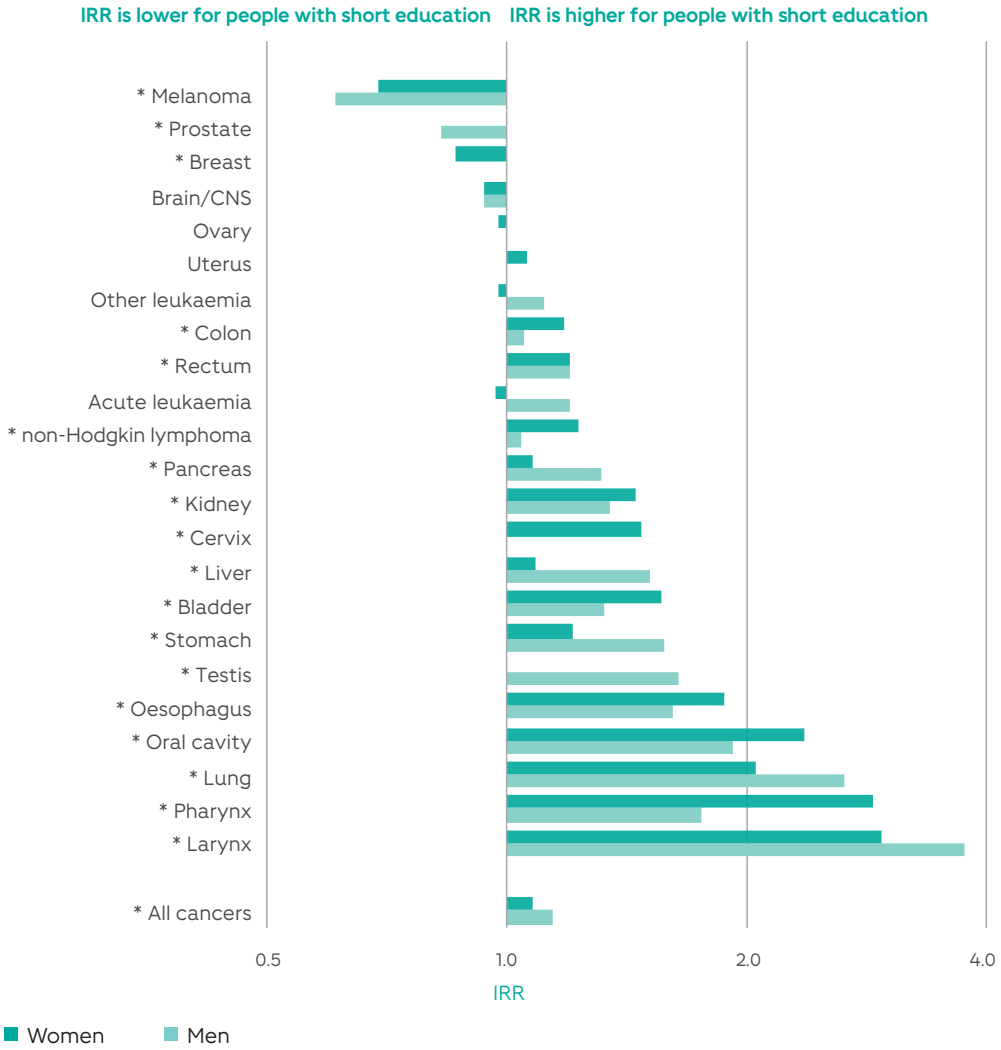


Figure 1
Age-adjusted incidence rate ratio (IRR) for cancer in men and women, 30-89 years, Denmark, 2017-2018

Data source
Cancer in Denmark, Danish Cancer Society (2022)[1]

Comparison group
Education: short vs. long

Note
* Indicates statistically significant difference

Glossary
CNS: central nervous system

When the IRR is below 1.0, cancer incidence is lower among people with short compared to long education. When the IRR is 1.0, there is no difference in cancer incidence in the two education groups. When IRR is greater than 1, cancer incidence is higher among people with short compared to long education

to those who have a long education.[1] For some cancers (brain/CNS, ovarian, uterine and leukaemia), there is no statistical difference in incidence across education groups (Figure 1).[1] A number of studies have also observed that the risk of cancer among children and adolescents (0-19 years) was higher among children whose parents had long education or high income, compared to those whose parents had short education or low income.[20-22]

In terms of cancer survival, for nearly all types of cancer, patients who have short education (Figure 2) or low income have poorer survival compared to patients who have long education or high income.[1,3,7,9-19,23-44] This pattern is also observed for some types of childhood cancer.[45,46] Among children diagnosed with 11 different chronic diseases, social inequality in mortality was most pronounced for children with a cancer diagnosis.[47]

When comparing patients diagnosed in 2005-2009 with patients diagnosed in 1987-1991, the difference in five-year survival between cancer patients with high and low income has increased over time.[33] For patients diagnosed in 2007-2014, the difference in five-year survival between patients with long and short education has remained at the same high level.[1] To illustrate this difference with a simple thought experiment: if cancer patients with short or medium education had had the same survival as patients with long education, the number of cancer patients still alive five years after a cancer diagnosis would increase by one third.[1]

SOCIAL INEQUALITY IN CANCER SURVIVAL

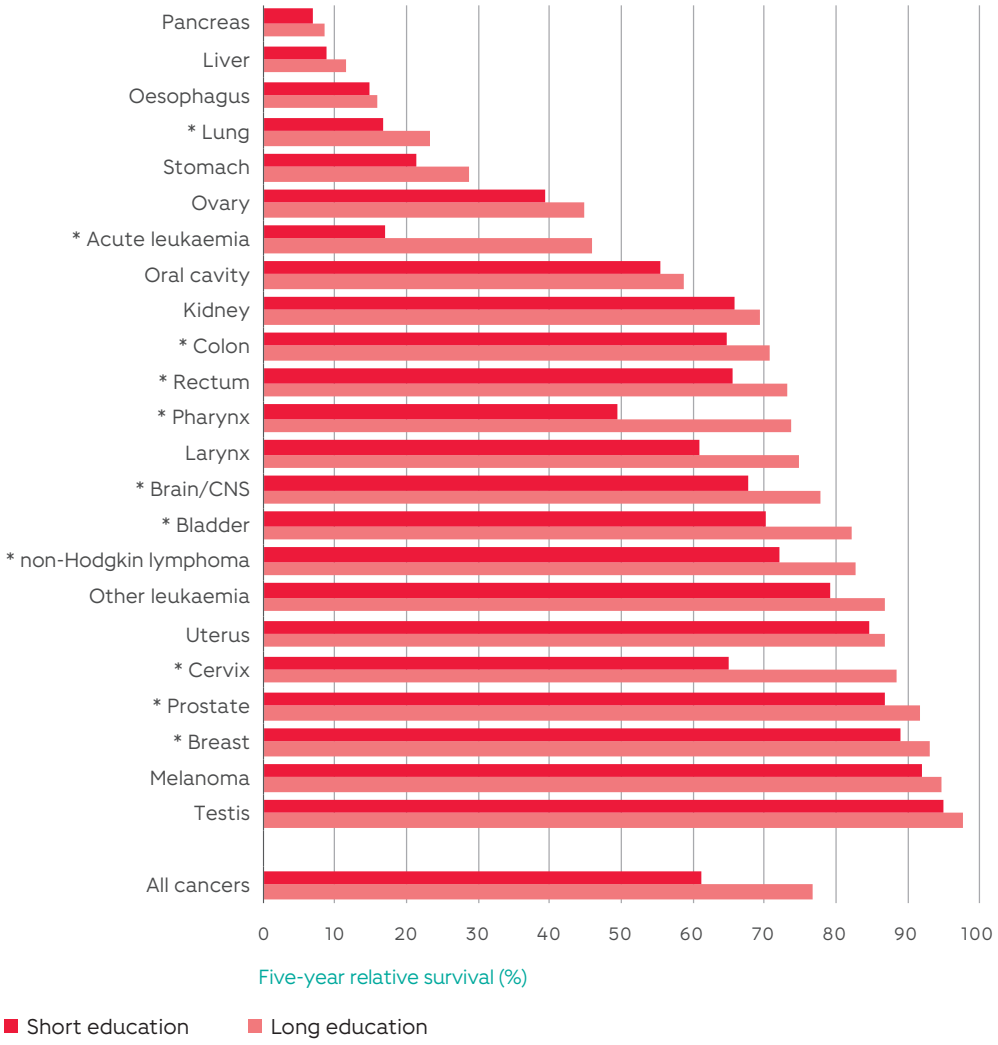


Figure 2
Five-year relative survival for men and women diagnosed with cancer from 2011-2014, with short and long education, respectively

Data source
Cancer in Denmark, Danish Cancer Society (2022)[1]

Note
*Indicates statistically significant difference

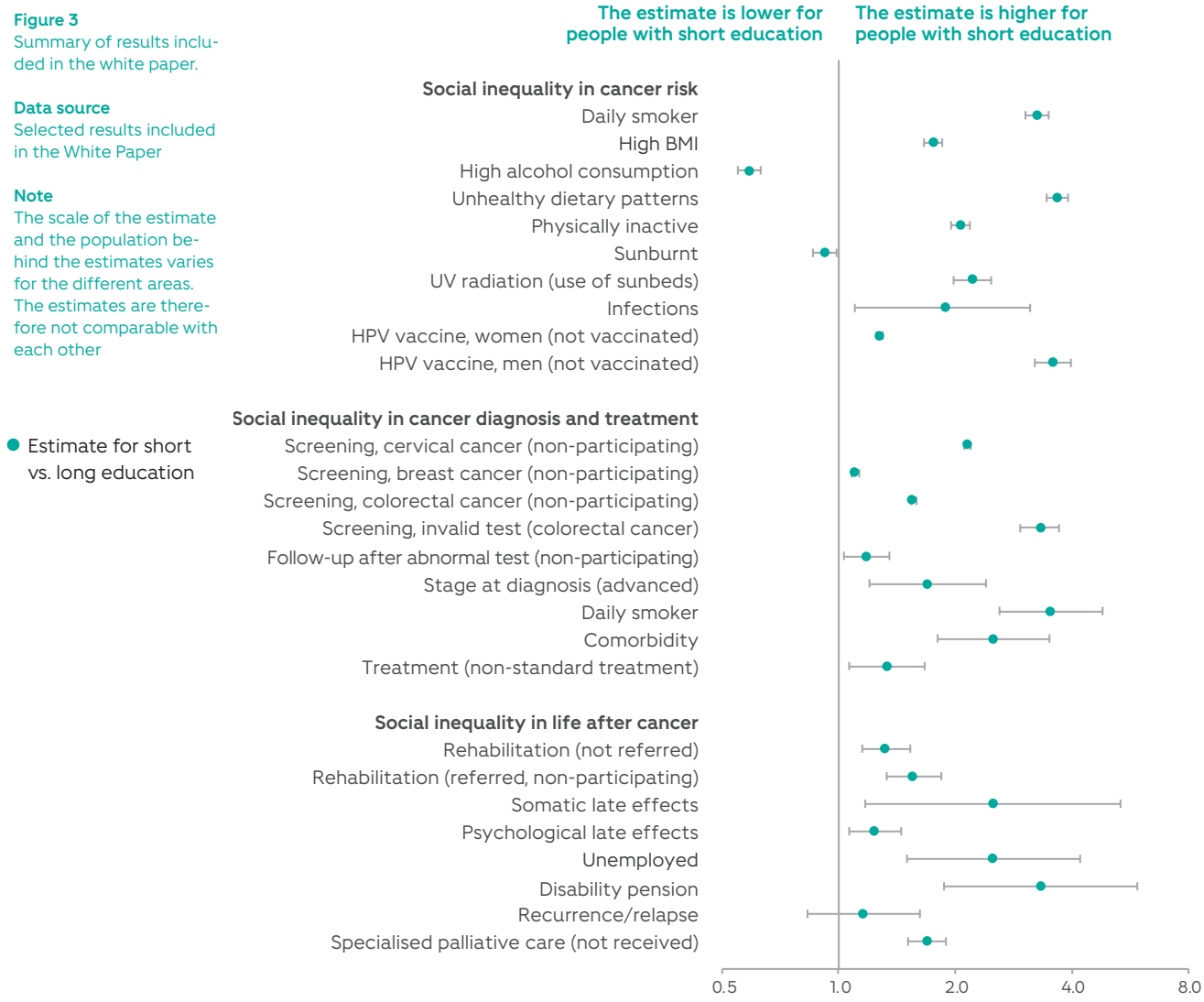
Glossary
CNS: central nervous system

SOCIAL INEQUALITY THROUGHOUT THE CANCER TRAJECTORY

Figure 3
Summary of results included in the white paper.

Data source
Selected results included in the White Paper

Note
The scale of the estimate and the population behind the estimates varies for the different areas. The estimates are therefore not comparable with each other



"Equality in health is important because good health is one of the most important prerequisites for people's freedom to live the life they value."

"The second edition of the White Paper on social inequality in cancer in Denmark details the existence of social inequality in the risk of getting cancer as well as in treatment, aftercare and the consequences of having had cancer. The White Paper also identifies a wide range of issues that contribute to our understanding of the causes of these inequalities."

"Although many individual factors affect disease trajectories, it is important to know whether there is evidence of social inequalities emerging within the organisation when planning and making policy decisions."

Finn Diderichsen
Translated quotes from the expert opinion to the second edition of the White Paper Social Inequality in Cancer in Denmark[51]

This systematic link between patients' socioeconomic position and various measures related to cancer incidence and prognosis in the population is in this white paper referred to as social inequality in cancer. Inequality exists regardless of whether the patients' education, income, occupational status, cohabitation status or ethnicity is used as socioeconomic indicator. The degree of social inequality varies depending on the socioeconomic indicator used and the type of cancer being studied. Overall, however, there is a strong tendency for people who have short education, low income, loose affiliation to the labour market, no cohabitating partner or a minority background to be in a worse position throughout the cancer trajectory compared to people who have longer education, higher income, permanent affiliation to the labour market, a cohabiting partner, or an ethnic Danish background (Figure 3).

The existence of social inequality in cancer in Denmark was systematically investigated for the first time in 2008 by researchers at the Danish Cancer Society Research Center in the comprehensive population-based study CANULI.[48] Since then, a substantial number of research projects have documented the extent of social inequality at different steps of the cancer trajectory and investigated different causal mechanisms.

Knowledge of causal mechanisms is the key to improvement. It is only through understanding how socioeconomic position affects cancer risk and prognosis after cancer that targeted interventions and programmes can be developed to improve cancer outcomes for the most disadvantaged groups, thus reducing social inequality in cancer.

The aim of this White Paper is to provide a comprehensive, systematic overview of clinical epidemiological research on social inequality in cancer in Denmark for the period 2008-2022. The White Paper is based on 208 studies that have in various ways investigated the association between socioeconomic position and a cancer-related outcome in Denmark.

EXAMPLES OF SOCIAL INEQUALITY IN CANCER IN DENMARK

- The incidence of new cases of cancer varies across socioeconomic groups in Denmark. People with long education have 1.4 times higher incidence of melanoma compared to people with short education, whereas the incidence of cancers of the larynx is over three times higher among people with short compared to long education.
- For all cancers studied, patients with short education have lower survival rates than patients with long education. Among all cancer patients diagnosed from 2011-2014, 61% of patients with short education were alive after five years, compared to 77% of cancer patients with long education.
- Young women and men, whose mothers have long education, are respectively more than 1.3 and 3 times as likely to have been vaccinated against HPV compared to young women and men, whose mothers have short education.
- People with short education or low income are more likely to be diagnosed with advanced stage cancer. For cervical cancer a part, but not all, of the social inequality can be explained by differences in screening participation.
- People with low socioeconomic position are more likely to have other concurrent chronic illnesses (comorbidity). For prostate cancer, colorectal cancer and head and neck cancers, for example, differences in comorbidity explain a substantial part of the social inequality in survival rates.
- There is social inequality in treatment for some cancer patients. For example, patients with short education who are diagnosed with acute myeloid leukaemia are 32% less likely to receive intensive treatment, and lung cancer patients with short education are 25% less likely to receive standard treatment, compared to patients with long education.
- Among patients diagnosed with head and neck cancer, who were daily smokers at diagnosis, patients with low income were 2-4 times more likely to continue to smoke daily, both during and one year after treatment, compared to patients with high income. Differences in smoking status at diagnosis explained a significant part of the survival disparity.
- Patients with short education are less likely to be referred to rehabilitation (HR 0.8) and less likely to attend the offered rehabilitation (HR 0.6) compared to patients with long education.
- Patients with short education have 2.5 times higher odds of being unemployed and up to five times higher odds of being receiving disability pension in the year after diagnosis, compared to cancer survivors with long education. A significant part of this social inequality was driven by differences in the physical demands of job types across education groups.
- Among non-curable cancer patients, patients who have short education, low income or live alone are less likely to receive specialised palliative care. The same is observed for basic palliative care, for which this patient group is less likely to have received reimbursement for medicine due to terminal illness.
- Social inequality in survival after most studied cancers is partly driven by differences in stage at diagnosis, comorbidity, performance status, treatment and lifestyle. For patients with oropharyngeal cancer, up to 30% of the inequality in survival was associated with differences in smoking behaviour.

The studies included in the white paper show that social inequality exists at all stages of the cancer trajectory (Figure 3, Table 1). Thus it appears that cancer patients who have short education, low income or live alone do not benefit from primary prevention, diagnostic procedures, treatment and follow-up interventions to the same extent as more resourceful patients. While the causes of social inequality in the cancer trajectory are complex, a number of possible causal mechanisms have been identified: differences in health literacy, lifestyle, healthcare utilisation, stage at diagnosis, comorbidity, communication with health professionals, treatment and referral to rehabilitation (Table 1). There is a need for more knowledge on how health services can be adapted to meet the different conditions and needs of patients.

For many areas of the cancer trajectory, social inequality remains underreported or based on older data, particularly for less common cancers as well as those cancers and areas of the cancer trajectory for which information is not systematically collected (Table 2). In addition, there is very little evidence on interventions targeting social inequality in the cancer trajectory in Denmark. We call for systematic collection of health data throughout the cancer trajectory and prioritisation of an ongoing evaluation of the use and impact of health interventions in different socioeconomic groups.

Photo: Tomas Bertelsen

TABLE 1 MAIN FINDINGS

THE CANCER TRAJECTORY

Social inequality in new cancer cases (incidence)
While a few cancers in Denmark are more common among people with long education, high income or a cohabiting partner, the vast majority of cancers are more common among people with short education, low income or no cohabiting partner.

Social inequality in screening participation
The participation in screening for cancer in Denmark is lower among people with short education, low income, who live alone or people with minority background.

Social inequality in stage at diagnosis
For most cancers studied, there is social inequality in disease stage at diagnosis in Denmark.

Social inequality in treatment
For most cancers studied, there is social inequality in cancer treatment received in Denmark.

Social inequality in rehabilitation
Danish cancer patients with low socioeconomic position have more unmet needs for rehabilitation, but are less likely to be referred to and participate in cancer rehabilitation in Denmark.

Social inequality in late effects
There is social inequality in both physical and psychological late effects of cancer in Denmark, such as cardiovascular disease, pain, impaired physical functioning, anxiety and depression.

Social inequality in labour market affiliation
There is social inequality in labour market affiliation after cancer in Denmark.

Social inequality in palliative care
There is social inequality in access to specialised palliative care and a trend towards social inequality in basic palliative care.

Social inequality in cancer survival
Cancer patients in Denmark with low socioeconomic position have poorer survival, almost regardless of which type of cancer they are diagnosed with, compared to cancer patients with higher socioeconomic position.

MECHANISMS

Knowledge of risk factors and symptoms
There are socioeconomic differences in knowledge of a number of risk factors for and symptoms of cancer.

Health literacy
There are differences in health literacy and barriers to health promotion. The current health discourse in society resonates more with people who have a high socioeconomic position.

Risk factors
Many risk factors for cancer are more prevalent in people with short education or low income.

Health care utilisation
There are differences in the use of health services across different socioeconomic groups, e.g. GP consultations, HPV vaccination, screening participation and referral to rehabilitation.

Communication with health professionals
There are socioeconomic differences in the interpretation and communication of symptoms, communication with health professionals and understanding of health messages.

Patient-related and system-related interval
There is little research on whether there is social inequality in the interval from when a patient first experiences a symptom to he or she seek medical attention. No clear socioeconomic differences have been observed in the interval from first contact to GP to diagnosis and treatment.

Comorbidity
There is a higher prevalence of concurrent chronic illnesses (comorbidity) among people with short education or low income. These diseases both affect the options for cancer treatment and survival.

Lifestyle during and after treatment
There is social inequality in lifestyle factors among cancer patients.

TABLE 2 AREAS IDENTIFIED AS INSUFFICIENTLY INVESTIGATED

KNOWLEDGE GAPS	RECOMMENDATIONS
1 Less common cancers and cancers for which clinical information is not systematically collected are highly underrepresented in the evidence.	» Systematic collection of clinical information for all types of cancer is encouraged. » It is encouraged to facilitate the use of socioeconomic data across borders (Nordic/international) to identify potential social inequality in rare cancers.
2 Little is known about the time before and after primary cancer treatment, and the existing knowledge is based on older data.	» Systematic data collection and mapping of social inequality is encouraged for: • The pre-diagnostic period • Patient-related issues (health literacy, lifestyle factors, quality of life, symptoms and late effects) • Needs assessment, referral to and participation in rehabilitation and palliative care • Cancer recurrence/relapse
3 Little is known about effective interventions to counteract social inequality in the cancer trajectory.	» The development and testing of interventions targeting the following areas is encouraged: • The pre-diagnostic period • Identification of vulnerable patients • Navigation of the health care system • Optimisation of lifestyle before, during and after treatment • Managing comorbidity before, during and after treatment • Treatment of late effects • Utilisation of health care services
4 For many areas, the evidence is based on data that is over 10 years old and thus does not necessarily reflect current conditions.	» Prioritisation of continuous monitoring of the use and impact of health interventions in different socioeconomic groups is encouraged.

The white paper demonstrates systematic social inequality throughout the cancer trajectory (Table 1). A number of possible causal mechanisms have been identified (Table 1), but important knowledge gaps remain (Table 2).

PURPOSE

The aim of this white paper is to provide a comprehensive, systematic overview of the extent of social inequality in cancer in Denmark as well as the causal mechanisms driving this inequality.

The white paper considers social inequality in cancer through a life course perspective, covering the entire cancer trajectory from social inequality in early exposure to risk factors, screening, diagnostics, treatment, late effects, follow-up, rehabilitation, recurrence/relapse, palliative care and survival.

DELIMITATIONS

This white paper is limited to the Danish setting and primarily describes clinical epidemiological studies published from 2008 to 2022. These studies have been further complemented, where appropriate, with figures from national reports. This version of the white paper has been updated to include new studies published from 2019-2022.[49]

That some areas of the cancer trajectory, as well as many mechanisms behind social inequality and the less common cancers, are poorly characterised, is simply a result of the limited scientific studies in these areas. This should not be interpreted as no social inequality in these areas.

The white paper identifies a number of mechanisms that contribute to social inequality in the cancer trajectory. The relationship between socioeconomic position and a cancer-related outcome is complex and results from the interaction of broad structural, clinical and individual factors. These complexities are rarely addressed in the Danish clinical epidemiological literature on which this white paper is based.

2

Theoretical basis and definitions

This chapter presents the theoretical basis for analysing social inequality in cancer and defines the main concepts used later in the white paper

Social inequality in cancer is defined here as a systematic association between the socioeconomic position of population groups and a cancer-related measure, such as incidence, treatment or survival.

SOCIAL INEQUALITY IN CANCER

Social inequality in cancer exists when a systematic association is observed between the socioeconomic position of population groups in society and a cancer-related measure. E.g. a systematic difference between the educational attainment or income of population groups and their incidence of cancer or the cancer treatment they have received.

Socioeconomic position

Socioeconomic position is defined in the white paper as the social and economic factors that influence the position of an individual or group in society.[50]

Socioeconomic position can be measured using various indicators, including the socioeconomic position of parents, ethnicity, educational attainment, cohabitation status, occupational status, income or area of residence. Although the indicators are related to each other, they measure different aspects of a person's socioeconomic situation at different stages of life. The white paper uses educational attainment (length of education completed) as the primary indicator of socioeconomic position. In some cases, results will also be shown for e.g. cohabitation status, occupational status, income and ethnicity to reflect patterns across socioeconomic indicators. The meaning of each indicator is outlined below and described in more detail in Appendix 1.

Social difference vs. social gradient

Social inequality in cancer is a phenomenon that affects the entire population. Social inequality in cancer is not only a result of that e.g. a smaller,

EDUCATION
- Reflects the transition from childhood (the socioeconomic circumstances in which one is raised) to adulthood (socioeconomic position achieved).
- May impact one's future job prospects and income.
- Is associated with understanding of health information, communication with health professionals, navigation in the healthcare system.

COHABITATION STATUS
- Whether one lives with a partner or alone.
- May impact social support, healthcare navigation and lifestyle.

OCCUPATIONAL STATUS
- Reflects how people have transformed their education and training into a job.
- May impact material living standards, lifestyle, social status and exposure to occupational health and safety factors.
- Occupational status affects health, but health also affects occupational status (reverse causality).

INCOME
- Varies greatly over the course of a person's life.
- May impact material living standards, lifestyle and status in society.
- Income affects health, but health also affects income (reverse causality).

AREA OF RESIDENCE
- Reflects socioeconomic and contextual factors in the neighbourhood.
- May impact e.g. access to health services.

ETHNICITY
- May impact health behaviour, understanding of health messages, communication with health professionals, healthcare navigation and lifestyle.
- Danes who have a minority background are less likely to have a qualifying education, and have higher unemployment rate and lower income than people who have an ethnic Danish background.

vulnerable population group have a poorer survival rate than the rest of the population. Rather, it is documented that there exists a systematic social gradient across the socioeconomic spectrum where e.g. cancer survival increases incrementally as income rises. The same gradient can be observed for education, with e.g. patients with primary school as their highest level of education having poorer survival than patients with vocational training, who in turn have poorer survival rates than patients with higher education. It is important to emphasise that the relationship between socioeconomic position and cancer does not tell us anything about the risk for individuals, but only about the risk among population groups as a whole.

Choice of comparison group

The extent of social inequality in cancer depends on which groups are compared. Results will vary depending on whether only the most dissimilar groups in the population are compared (e.g. people with short compared to long education) or whether inequalities between groups and group size have been accounted for, as in an index. In the literature described in the white paper, there is a strong tendency for social inequality in cancer to be analysed as a contrast between the groups in the least favourable position compared to those in the most favourable position, e.g. differences in treatment received between people with short compared to long education. The size of the various socioeconomic groups in the studies is, however, usually evenly distributed. The population is often divided into e.g. quartiles or quintiles according to income, and groups based on educational attainment tend to be broadly defined.

Odds ratio (OR)

The relationship between two variables (e.g. between educational attainment and a binary outcome such as being a smoker or non-smoker) is often measured as an odds ratio (OR), which takes into account differences in e.g. the gender and age composition of the groups being compared by adjusting for gender and age. An OR of 1.0 means that there is no difference in e.g. smoking status between the two groups being compared. If the OR is greater than 1.0, the prevalence of smokers is higher than in the comparison group, and if the OR is less than 1.0, the prevalence of smokers is lower than in the comparison group. For example, an OR of 2.4 for advanced cervical cancer among patients with short education means that patients with short education are 2.4 times more likely to be diagnosed with advanced cervical cancer compared to patients with long education.

In contrast, an OR of 0.68 for treatment completion means that patients with short education are 32% less likely to complete treatment compared to patients with long education. The comparison group chosen varies in different studies. To simplify communication in the white paper, where appropriate, the estimate has been converted [1/(the original OR reported in the study)] to ensure the same comparison group in all the studies described.

Hazard ratio (HR)

A hazard ratio (HR) is used to measure the relationship between two variables in studies where the time perspective is important. One example is for social inequality in unemployment, which follows patients after diagnosis and looks at who becomes unemployed, while taking into account that some may retire or may not survive the disease. An HR of 1.0 means that there is no difference in unemployment between the two groups being compared. If the HR is greater than 1.0, the unemployment rate is higher compared to the comparison group, and if the HR is less than 1.0, the unemployment rate is lower compared to the comparison group. Where appropriate, the estimate of HR is also converted [1/(the original HR reported in the study)] to ensure the same comparison group in the studies.

Confidence intervals (CI)

Confidence intervals indicate the uncertainty of the study result, e.g. the observed odds ratio or hazard ratio. A wide confidence interval indicates that there is considerable uncertainty in the results of the study. If the confidence interval includes **1.0**, e.g. OR: 1.4 (**0.7-2.8**), the result is interpreted as no statistically significant difference in the two groups compared, as an OR of 1.0, corresponding to no difference, is within the possible range of values. In the white paper, the confidence interval is given in brackets after the estimate, and in figures as an interval before and after the point specifying the estimate (•).

The time perspective

The latency period for the development of cancer is often long, and late effects can occur many years after the end of cancer treatment. Thus, some of the social inequality observed in the cancer trajectory today is rooted in and a result of conditions that existed several decades ago. For example, it has been estimated that a change in smoking prevalence will not have an impact on the incidence of new cases of lung cancer until 15 years later.[8] This time perspective is important to keep in mind, both in terms of understanding current trends in social inequality in cancer, as well as in relation to the prioritisation of interventions and prevention of social inequality in cancer.[52]

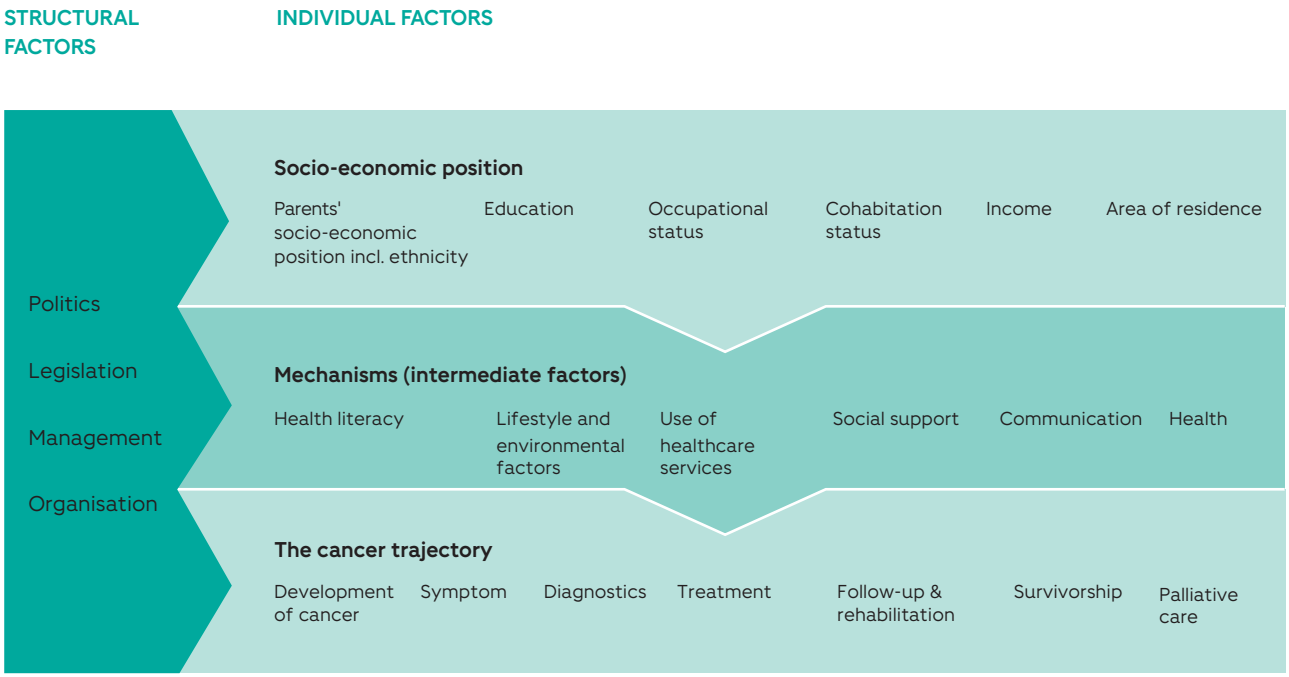


Figure 4
Model: Correlation between socioeconomic position and cancer outcomes

Source
Specifically developed for this purpose with inspiration from the Danish Health Authority's report: 'Inequality in Health – causes and initiatives' [52] and Galobardes et al. (2006). "Indicators of socioeconomic position (part 1)[50]. Please refer to these publications for detailed information on which determinants impact social inequality in health in general, as well as the interaction between structural and individual factors.

CAUSAL MECHANISMS

Many factors contribute to the social inequality seen in the cancer trajectory. These can only be understood through a life course perspective, where the interplay between structural conditions in society and individual factors – throughout life – influences different stages of the cancer trajectory, from the risk of developing cancer to diagnosis, treatment, rehabilitation, palliative care and survival. These correlations are outlined in Figure 4 and explained in the following text.

Structural factors

Structural conditions in society, outlined on the left in Figure 4, impact a wide range of individual factors. The division of labour in society creates different socioeconomic positions. In addition to upbringing, cognitive development, health and local environment, an individual's socioeconomic position depends on a wide range of macropolitical factors such as the availability of education and redistributive policies.[52]

Societal laws and structures also impact a wide range of lifestyle factors and the use of health services (middle box on the right in Figure 4). For example, health behaviour is regulated through the availability and pricing of alcohol and tobacco. Vaccinations and cancer screening are offered to specific target groups, and a large number of occupational health and safety regulations have been centrally adopted to regulate the level of exposure to harmful substances.

Looking at the cancer trajectory itself, a wide range of policies and processes affect all stages of the pathway (bottom right box, Figure 4). In addition to the availability and accessibility of healthcare services, national cancer patient pathways have been implemented to e.g. support rapid and standardised cancer diagnostics. National Clinical Guidelines should ensure standardised, high-quality treatment, and the pathway programme for rehabilitation and palliative care should improve coherence across sectors.

Individual factors

Socioeconomic position

The top of the model (Figure 4) illustrates the evolution of a person's socioeconomic position over the course of their life: from parental socioeconomic position, including ethnicity, to educational attainment, occupational status, cohabitation status, income and area of residence. These indicators are related to each other, but measure different aspects of a person's socioeconomic situation at different stages of life. The individual indicators of socioeconomic position and their impact on the intermediate factors and the cancer trajectory are described in more detail in Appendix 1.

Mechanisms (intermediate factors)

The patients' socioeconomic position impacts a wide range of factors that can affect the trajectory cancer, such as lifestyle, use of healthcare services, health literacy and communication with health professionals. For the latter, the term health literacy is often used as an umbrella term for the patient's ability to access, understand and act on health information, as well as the ability to communicate with health professionals and to seek out and navigate the healthcare system.[55] The patient's health literacy can affect, for example, when the patient recognises symptoms of cancer and seeks medical attention, how health information is understood and whether the patient completes treatment and participates in rehabilitation.

Here, these factors are referred to as intermediate factors, or simply mediators, and are outlined in the centre box in Figure 4. For example, there is an association between educational attainment and daily smoking, which is a strong risk factor for many cancers. Smoking is therefore a possible mediator that may partially explain the social inequality in smoking-related cancer incidence. Socioeconomic differences in the intermediate factors thus contribute to the social inequality observed in the cancer trajectory.

The cancer trajectory

The cancer trajectory is outlined at the bottom of Figure 4, from the risk of developing cancer to diagnosis, treatment, rehabilitation, palliative care and survival. As the figure illustrates, a wide range of (intermediate) factors influence the risk of getting cancer and the consequences of having cancer. The individual cancer case or outcome will often arise from the interaction of these factors. Thus, some socioeconomic groups may be more susceptible or vulnerable to a given risk factor because they are simultaneously exposed to one or more other factors, or have fewer opportunities to change, manage, cope or adapt.[53,54] The same amount and duration of a given risk factor may therefore have different effects in different socioeconomic groups.[53,54] As outlined in Figure 4, the cancer trajectory can also be modified by structural conditions, e.g. how different health services are designed.[53] Since most interventions and measures in the cancer trajectory require a large mobilisation of the patient's resources, social inequality can also arise if structural conditions or interventions do not address the fact that patients have different prerequisites for performing the targeted health behaviour.[53,55] This is also referred to as organisational health literacy, i.e. the ability of the healthcare system to accommodate citizens' varying health literacy.[55] This applies to e.g. changing a given lifestyle, complying with treatment, or participating in rehabilitation.

"We need to organise a healthcare system in which the individual's health literacy does not become an obstacle to prevention, early detection, treatment and rehabilitation. Organisational health literacy is about responding to the different health literacy of citizens by strengthening the flexibility of the healthcare system and reducing its demands and complexity"

Niels Sandø
Translated quote from Sundhedskompetence i det danske sundhedsvæsen, Danish Health Authority, 2022[55, p. 3]

Photo: Tomas Bertelsen

3

Methods

This chapter reviews the selection of the scientific literature on which the white paper is based.

SEARCH STRATEGY

A systematic literature review was conducted in the literature database PubMed[56] using a broad search strategy, searching for all relevant indicators and synonyms for social inequality and cancer. The search string has been developed in co-operation with librarians and information specialists at the Royal Library and the Department of Design and Communication at the University of Southern Denmark. The search report is attached as Appendix 2.

Given the major changes in the socioeconomic composition of the population (Figure 5) and improvements in the field of cancer, the search was limited to studies published in 2008 or later.

QUALITY ASSESSMENT

The quality of the studies was assessed on a scale from 1 (lowest) to 5 (highest), based on good scientific practice in terms of methodology, data, size and generalisability of the study.

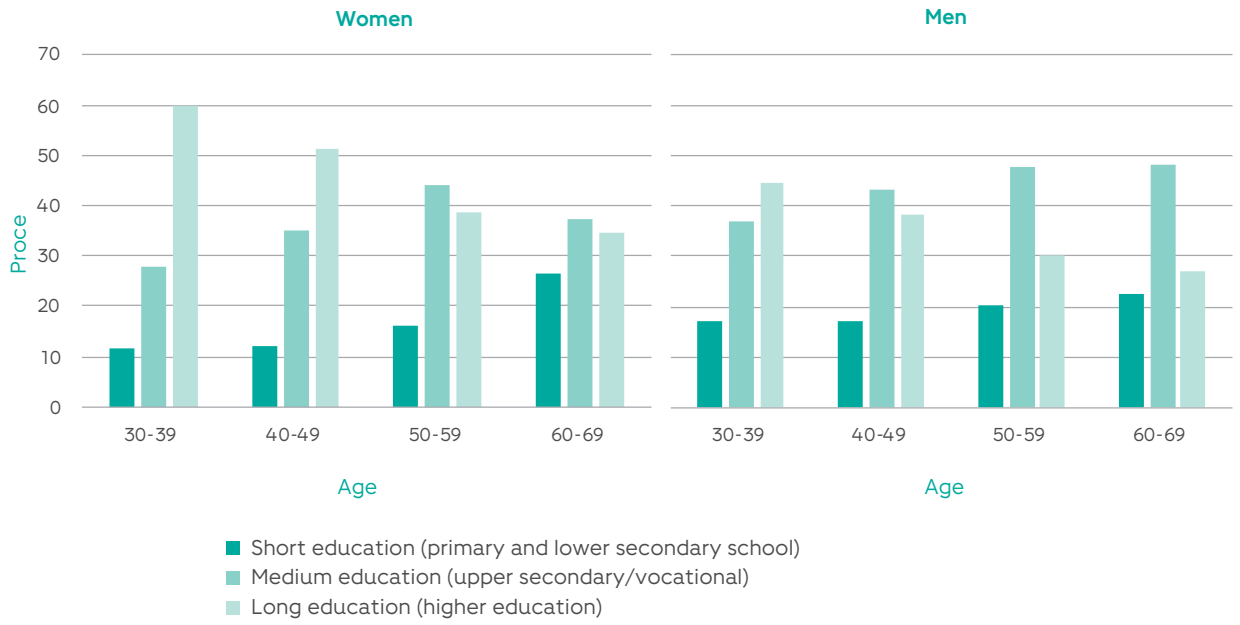
LITERATURE DATABASE

All studies were entered into an interactive literature database with information on cancer type, socioeconomic position, cancer-related measure, results, design, methodology and quality assessment. The database can be filtered by these areas to provide an overview of relevant articles for each area.

Figure 5
Proportion of the population with short, medium or long education according to age and gender, Denmark, 2021

Data source
Statistics Denmark StatBank[57]

Note
Percentages do not add up to 100, as the share of patients whose educational attainment was unknown (<2%) is not included



EVIDENCE BASE

The literature review resulted in 861 articles. Following title and abstract screening, 442 were selected for full-length review, of which 208 studies were included. The overall quality of the studies is above average, with an overall quality score of 3.8 (with 5 being best).

The criterion for the included studies was that they had to provide risk estimates of a cancer-related measure that included at least one of the predefined indicators of socioeconomic position. In addition, the risk estimate should, as a rule, be adjusted or stratified for age and gender, as there are large differences in, for example, educational attainment (Figure 5) and income across these factors.

Furthermore, the indicator should generally not be adjusted for mediators (variables that are part of the causal chain) or other socioeconomic indicators, as this results in an underestimation of possible social differences. Studies that fundamentally met these criteria were included, even if the primary purpose of the study was not to investigate social inequality in cancer.

Figure 6 shows the number of publications according to cancer type. The term 'broad scope' includes articles that are based on the entire population of cancer patients, as well as articles that have relevance for all cancers, e.g. social inequality in knowledge of cancer symptoms. Among individual cancers, more than half of the articles investigate breast cancer, gynecological or colorectal cancer.

NUMBER OF ARTICLES BY CANCER TYPE

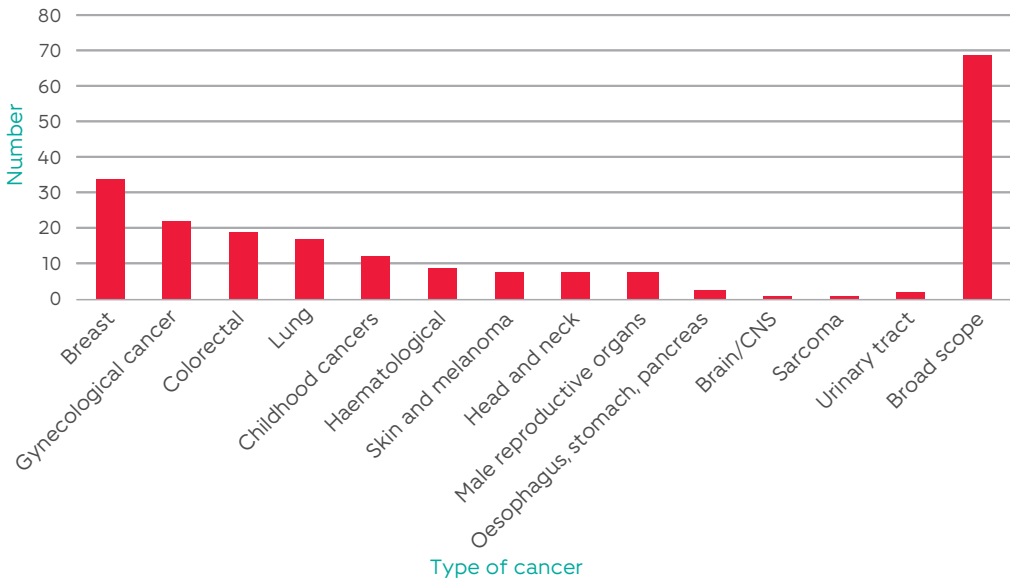


Figure 6
Number of articles included in the white paper by main diagnostic group

Data source
Articles included in the white paper

Glossary
CNS (central nervous system)

Figure 7 indicates the number of articles addressing the different cancer-related outcome measures. While most articles examine social inequality in incidence and survival, a number of studies also look into the mechanisms behind these inequalities, such as differences in HPV vaccination rates and screening, stage at diagnosis and treatment. In addition, a number of articles deal with differences in the consequences of cancer, both in terms of affiliation to the labour market and physical and psychological late effects.

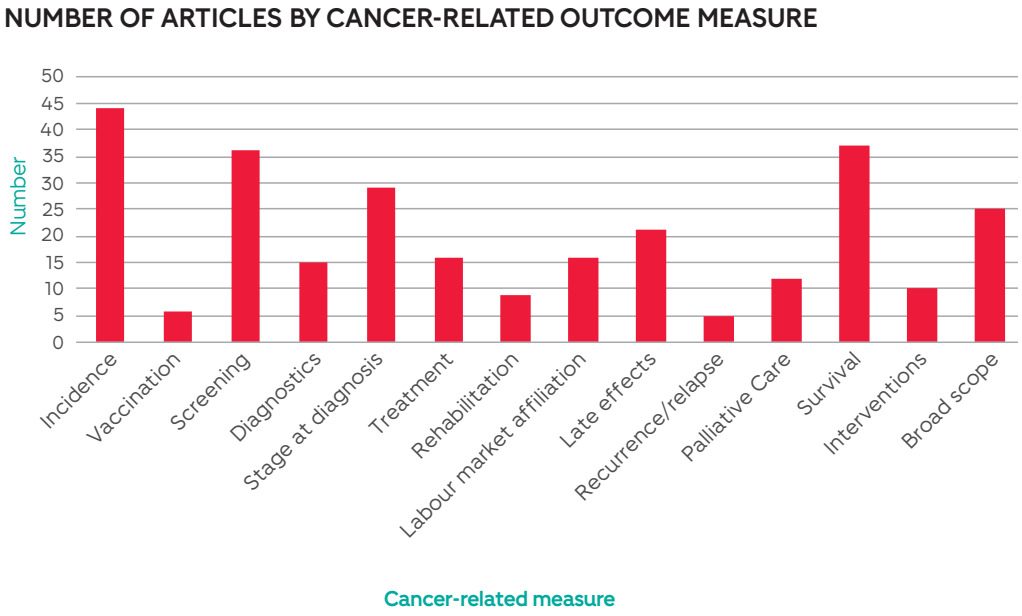


Figure 7
Number of articles included in the white paper according to cancer-related measure

Data source
Articles included in the white paper

Note
Some articles cover several areas

4

Social inequality in cancer risk

This and the following chapters review the evidence on social inequality in cancer in Denmark. The chapters follow the cancer trajectory from a life course perspective, from social inequality in cancer risk, screening, diagnostic work-up and treatment of cancer, to late effects, follow-up, rehabilitation, recurrence/relapse, palliative care and survival.

This chapter addresses social inequality in exposure to a range of lifestyle and environmental factors, all of which are associated with the development of cancer. This denotes differential exposure to cancer risk factors, and refers to the fact that people of different socioeconomic positions have been exposed to risk factors to varying degrees during their childhood and adolescence, in their workplace and through their lifestyle and health behaviours. This plays a crucial role in the distribution of cancer incidence across different socioeconomic groups in society. In this context, it is important to emphasise that the latency period for cancer development is often long and that some of the social inequality observed in cancer incidence today is rooted in, and the result of, conditions that existed several decades ago.

SUMMARY – SOCIAL INEQUALITY IN CANCER RISK

- People with short education, low income, or no employment, as well as people who live alone or have minority background are less aware of risk factors for cancer.
- The prevalence and accumulation of a number of risk factors for cancer: smoking, overweight/obesity, physical inactivity, use of sunbeds, occupational factors and infections decrease as levels of education or income increase.
- Some cancer risk factors, such as alcohol consumption for people aged ≥65 years, are more common among people with long education, and this group is also more likely to have experienced sunburn during the preceding year.
- Young people whose mothers have short education are less likely to be vaccinated against HPV.
- There is social inequality in the motivation to change unfavourable lifestyles.
- The current health discourse in society sets demands and expectations that are difficult for people with a low socioeconomic position to fulfil.

THE MAIN LIFESTYLE AND ENVIRONMENTAL CAUSES OF CANCER

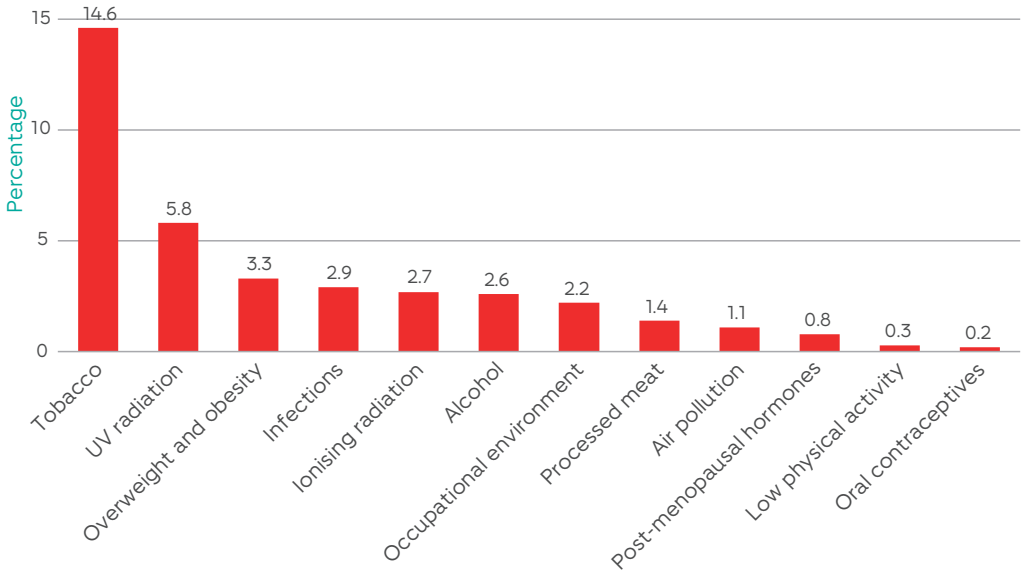


Figure 8
Proportion of cancer cases in Denmark in 2018 attributable to known, preventable carcinogenic risk factors[58]

Smoking is the most important lifestyle factor that causes cancer (Figure 8).[58] Other known preventable risk factors such as overweight/obesity, certain infections, alcohol, diet, hormone therapy, physical inactivity and oral contraceptives are also attributed as causes of a significant proportion of cancer cases in Denmark.[58] In addition, a number of environmental factors such as exposure to radiation (UV or ionising (radioactive) radiation) or carcinogens in the workplace are also important causes of cancer.[58]

Combined, these 12 preventable risk factors have been estimated to account for 32% of all cancer cases in Denmark in 2018.[58]

The higher the level of exposure, the higher the risk of cancer. This refers to both the total time exposed to the risk factor as well as the strength or intensity of the risk factor. Furthermore, simultaneous exposure to several risk factors at once may cause interactions enhancing the effects of individual risk factors.

SOCIAL INEQUALITY IN LIFESTYLE FACTORS

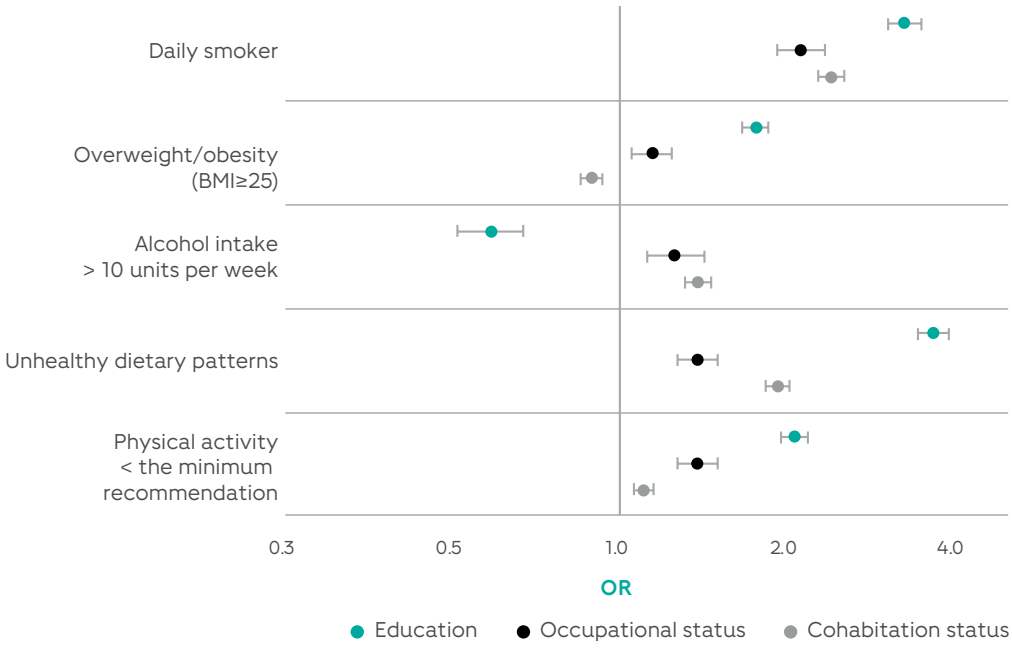


Figure 9
Odds Ratio (OR) for lifestyle factors associated with risk of cancer, adjusted for gender and age, according to socioeconomic indicator, Denmark, 2021

Data source
Danish Health Authority, Health of the Danes – The National Health Profile 2021 (2022)[59]

Comparison group
Education: mandatory vs. medium tertiary
Occupational status: unemployed vs. employed. Cohabitation status: single (unmarried) vs. married

TOBACCO, OVERWEIGHT/OBESITY, ALCOHOL, DIET AND PHYSICAL INACTIVITY

Tobacco, overweight/obesity, alcohol, diet and physical inactivity are among the most important preventable lifestyle factors associated with the risk of developing cancer.[58] In order to provide a comprehensive overview of the extent of social inequality in these risk factors in Denmark, we include statistics from the report: The Health of the Danes – The National Health Profile 2021.[59] The figures are based on the questionnaire survey: 'How are you?', which was sent in 2021 to 324,000 randomly selected individuals aged 16 years or older and residing in Denmark. In total, 183,646 (57%) of selected individuals responded to the survey. The results are thus not fully representative of the Danish population, but an attempt is made to account for this by weighting the responses.[59]

The results of the study show that there is social inequality present in key preventable risk factors for cancer. Daily smoking, overweight/obesity (BMI≥25), unhealthy dietary patterns (low intake of fruit, vegetables and fish and high intake of fat, especially saturated fat), and physical inactivity (physical activity levels below the WHO minimum recommendations) are all more prevalent among people who have short education, are unemployed, or live alone, compared with people who have long education, employment or are married (Figure 9).[59] However, overweight/obesity is less prevalent among people who live alone and are unmarried compared to those who are married (Figure 9).[59]

SOCIAL GRADIENT IN LIFESTYLE FACTORS

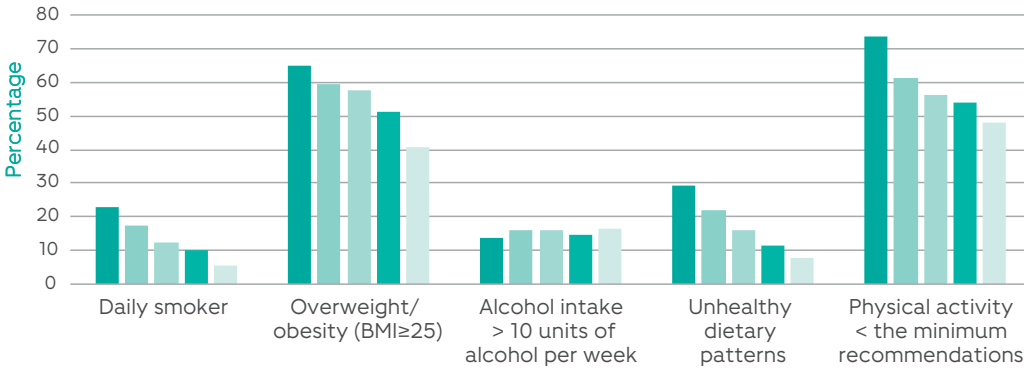


Figure 10
Proportion who smoke daily, have overweight/ obesity (BMI≥25), have high alcohol consumption, unhealthy dietary patterns, are physically inactive, according to educational attainment, Denmark, 2021

Data source
Danish Health Authority, Health of the Danes – The National Health Profile 2021 (2022)[59]

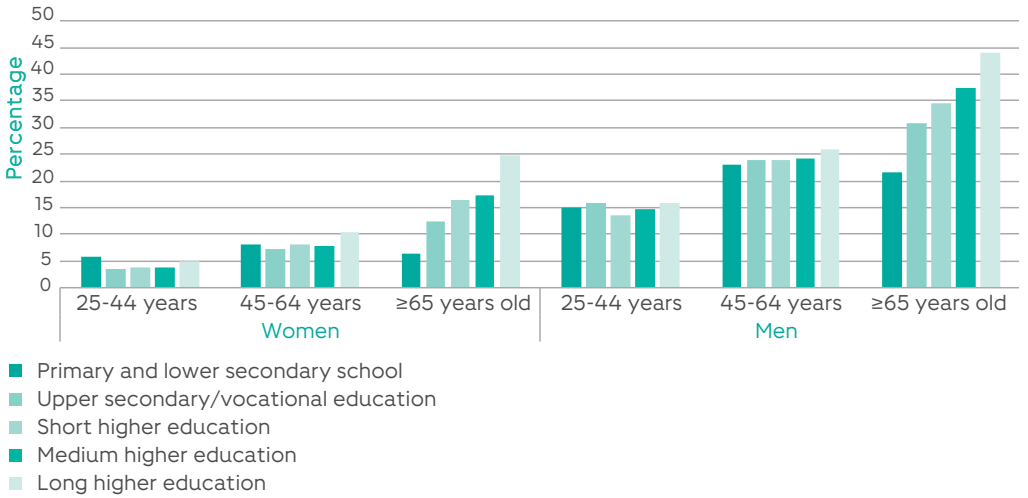


Figure 11
Proportion drinking more than 10 units of alcohol in a typical week, according to age, gender and educational attainment, Denmark, 2021

Data source
Danish Health Authority, Health of the Danes – The National Health Profile 2021 (2022)[59]

For tobacco, overweight/obesity, diet and physical inactivity, there is a clear social gradient, with the proportion of people who smoke daily, have overweight/obesity, have an unhealthy dietary pattern or are physically inactive decreasing systematically as educational attainment increases (Figure 10).[59]

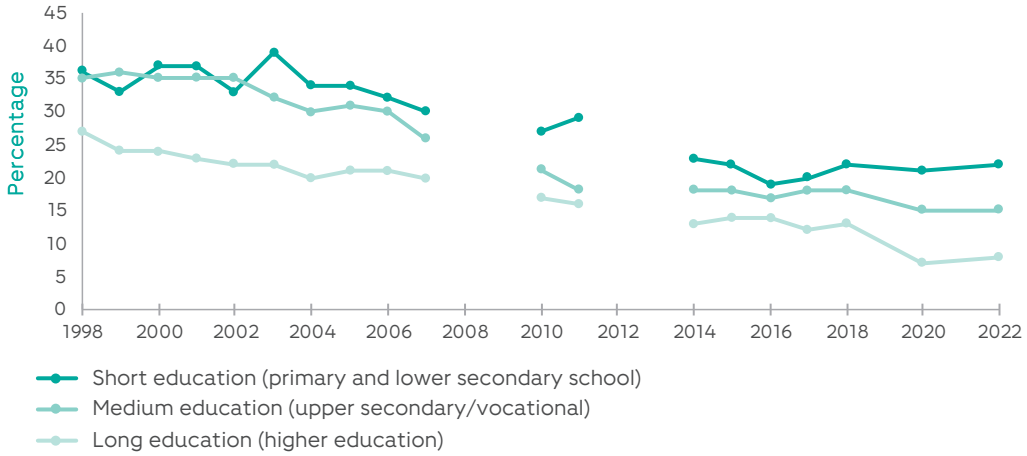
In terms of alcohol consumption, people who live alone and are unmarried, and people who are unemployed are more likely to drink more than 10 units per week compared to people who are married or in employment (Figure 9).[59] However, for education, there is an inverse social gradient (Figure 9), with the proportion drinking more than 10 units per week increasing with increasing educational attainment (Figure 10).[59] However, this pattern is only observed for people aged ≥65 years (Figure 11).[59]

SOCIAL INEQUALITY IN SMOKING OVER TIME

Figure 12
Proportion of daily smokers, according to educational attainment, Denmark, 1998-2022

Data source
Smoking habits in Denmark, Development from 1994 to 2017[60] & Smoking habits in Denmark 2018[61], 2020[62], 2022[63]

Note
The survey does not include figures for 2008-09 or 2012-13



Changes over time

Several different national questionnaire surveys regularly map a number of lifestyle factors among Danes. We have summarised the results of the surveys to give an impression of social inequality in these lifestyle factors over time. However, the results should be interpreted with caution, as definitions, methods and the composition of the population vary over time.

Figure 12 shows the development in Danes' smoking behaviour during the period 1998-2022, according to educational attainment. Throughout the period, the proportion of people who smoke daily is higher among those with a short compared to long education. In 2022, 22% of people whose highest completed level of education was primary or lower secondary school answered that they smoked daily, compared with 8% among people with a higher education.[63] The figure also shows that the proportion of people in the population who smoke daily has generally decreased over the past decades, but has remained at the same level in recent years.[62,63] In addition, an increase in the use of smokeless nicotine products, especially among young people, has been observed.[63,64] Among young people, there are large differences among educational institutions in the proportion of people who smoke daily, e.g. 9% among upper secondary school students[65] and 29% among vocational school students[66] in 2019. Among young people in employment with a short education, 8% use smokeless nicotine daily, compared to 4% among young people in employment with a medium or long education.[64]

If this smoking pattern persists among young people throughout their lives, there is a considerable risk that social inequality in the health consequences of smoking will continue for generations to come.

Figure 13 shows the difference in various lifestyle factors for the period 1987-2021 for people with short and long education, respectively. Although social inequality in daily smoking is still high, it seems to have decreased slightly in recent years. For overweight/obesity, unhealthy dietary patterns and physical inactivity, social inequality appears to have increased. Particularly for the latter, however, this may also be due to changes in the methodology of the calculation. For alcohol consumption, which for many years had been highest among people with long education, the latest figures show only a modest difference across education groups in the proportion of people drinking more than 10 units per week.

SOCIAL INEQUALITY IN LIFESTYLE FACTORS OVER TIME

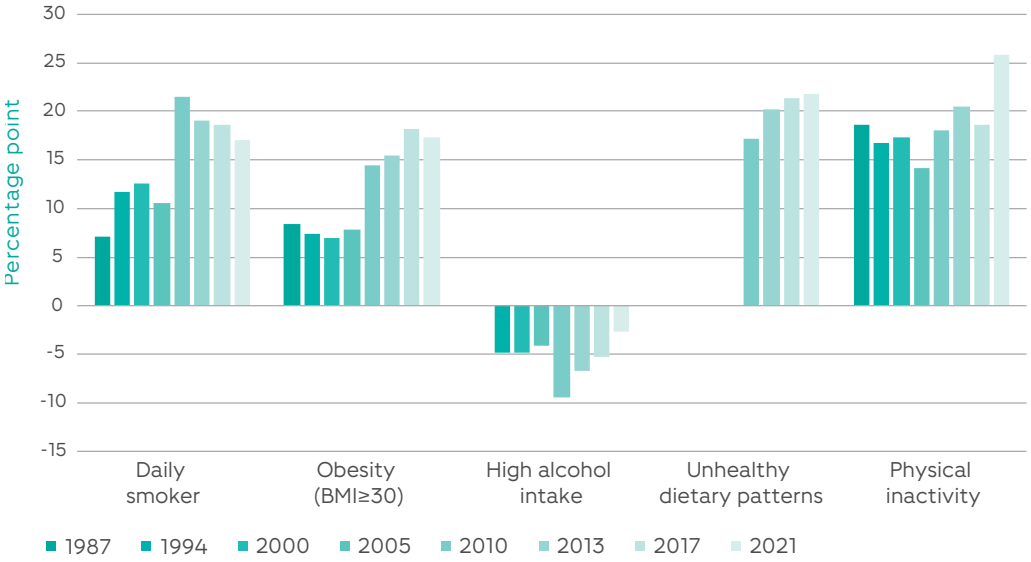


Figure 13
Difference (percentage points) between the proportion of people with short vs. long education who smoke daily, have obesity, high alcohol consumption, unhealthy dietary patterns, or are physically inactive, Denmark, 1987-2021

Data source
Health and morbidity surveys 1987, 1994, 2000, 2005, National Institute of Public Health & National Health Profile 2010, 2013, 2017, 2021, Danish Health Authority

Note
Data are collected and compiled using varying methods over time, and the figures are unadjusted and do not take into account that the composition of the population and e.g. recommendations for alcohol intake varies over time

Motivation for lifestyle change

Among daily smokers, the majority (74%) want to quit smoking.[59] However, there are considerable socioeconomic differences. Motivation to quit smoking is lowest among people whose highest completed level of education is primary or lower secondary school (64%) compared to people who have e.g. medium higher education (79%) (OR: 0.6 (0.5;0.7).[59] The same trend is seen for people who drink more than 10 units in a typical week who would like to reduce alcohol consumption (18% vs. 29%, OR 0.6 (0.5;0.8), and among people with an unhealthy dietary pattern who would like to eat more healthy (43% vs. 68%, OR 0.6 (0.5;0.7)), as well as for physically inactive people who would like to be more physically active (48% vs. 79%, OR 0.4 (0.4;0.4)).[59]

WORKING ENVIRONMENT

There are large variations in the risk for most cancers among people in different occupations.[67-76] Some of the increased risk can be attributed to differences in exposure to a wide range of chemicals, dust, asbestos, or night work.[67-76] Overall, it is estimated that 2-4% of cancer cases in Denmark in recent years are due to exposure to a number of specific carcinogenic risk factors in the working environment.[58,77] In general, people with short or vocational education are the most exposed to carcinogenic factors in the working environment.[78] In some industries or occupations, an increased incidence of certain cancers has been demonstrated where it has not been possible to identify specific carcinogenic exposures, e.g. among firefighters, painters or employees in the Armed Forces.[71,79,80] There are also occupations where there is a pattern of increased incidence of cancers normally associated with heavy consumption of alcohol and tobacco, e.g. among employees in restaurants, breweries, in the tobacco industry and among seafarers.[81,82] Most of the observed increased incidence of cancer across occupational groups can probably be attributed to differences in lifestyle and other socioeconomic factors.[69,71,72] However, the importance of occupation for cancer incidence varies greatly for different cancers, and there is also evidence of a possible protective effect of, for example, occupational exposure (outdoor work) to UV radiation for a number of cancers.[67] For lung cancer, a European prospective cohort study concludes that exposure to specific occupational factors can explain approx. 14% of the observed social inequality in incidence.[78]

ENVIRONMENTAL FACTORS

Outdoor air pollution, such as diesel exhaust and particulates, and indoor air pollution, such as radon, increase the risk of lung cancer and possibly other cancers.[83-86] Recent research points to a complex interaction between socioeconomic position and air pollution, with Danes who have long education or high income, as well as Danes who have a minority background, living in places with more air pollution.[87] A Danish study shows that people living in municipalities with high unemployment, low income and short educational attainment have the lowest exposure to radon at levels that are harmful to health (8%), while the highest exposure is found in municipalities with a predominance of people with medium socioeconomic position (56%).[88] This is probably because there is more radon present in single-family homes than in e.g. flats.

In addition to possible differential exposure to environmental factors, social inequality in cancer may also arise from differential susceptibility to the adverse health effects of environmental factors across socioeconomic groups, or if environmental factors interact with other risk factors that are socially unequally distributed in the population, such as smoking.[52] However, a meta-analysis based on European studies does not find clear differences in the impact of air pollution on lung cancer risk across education groups and smoking status.[52]

In addition to the above, structural factors, such as distance and access to health services, as well as other contextual and socioeconomic factors in the immediate environment, such as the physical environment, social environment, norms and lifestyles, can influence the cancer trajectory. For example, a higher incidence of breast cancer and lung cancer is found in densely populated areas, and a higher incidence of lung cancer but lower incidence of prostate cancer in areas with high unemployment, despite accounting for a wide range of individual socioeconomic differences.[4]

UV RADIATION FROM SUN OR SUNBED

Ultraviolet radiation from the sun or sunbed is a major cause of skin cancer, both common skin cancer and melanoma. The total amount of UV radiation is important for cancer risk, but exposure to high-intensity UV radiation, such as sunburn, sunbed use or travel to destinations with a high UV index, also has an impact. Vulnerability is particularly high during childhood and adolescence.

Studies for the period 2007-2015 show that the odds of having been sunburnt within the past year are lower among young people whose parents have short education (0.7 (0.7-0.8))[89] and among adults with short education (OR 0.92 (0.86-0.99), respectively)[90] compared to parents or adults with long education. Conversely, the odds of having used a sunbed at least once over the course of a year are higher for young people whose parents have short education (OR 2.2 (2.0-2.5))[91] and for adults with short education (OR 3.3 (1.9-5.6))[92]. There are no recent studies by socioeconomic position, but numbers from the Danish Cancer Society and TrygFonden show a moderate increase in both the proportion of people who have been sunburnt[93] and the proportion of sunbed users[94] in the period 2015-2020.

In some occupations, workers are exposed to the sun during working hours. In a survey of a group of working men and women, 68% of those who work primarily outdoors had short education.[95] The study pointed out that the use of sun protection during work activities is highly neglected compared to the use of sun protection during leisure activities. Among outdoor workers, the majority (89%) had experienced sunburn during working hours, half (50%) had not considered that sun exposure at work can cause skin cancer, and over half rarely or never protected themselves with sun cream (66%), long trousers or long-sleeved shirts (58%).[95]

EXOGENOUS HORMONES

The use of exogenous hormones, such as hormone supplements during menopause in women, is associated with a higher risk of cancer, particularly breast cancer (HR: 1.8 (1.6-2.0)), ovarian cancer (HR: 1.7 (1.3-2.3)) and uterine cancer (HR: 1.9 (1.5-2.4)).[96] At the same time, a protective effect of exogenous hormone use during menopause has been observed for colorectal cancer (HR:0.8 (0.7-1.0)), although mainly in combination with other lifestyle factors.[96] Studies have observed a moderately higher use of exogenous hormones among women with long education compared to women with short education in the period 1981-2008.[5,6,97] The use of exogenous hormones in menopause decreased significantly during this period[97], but no recent measures according to socioeconomic position are available.

INFECTIONS

Certain bacteria, viruses and parasites can cause cancer. In Denmark, infection with human papillomavirus (HPV) is the main cause of cervical cancer and a number of other cancers. Infection with the bacterium helicobacter pylori may also in rare cases play a role in the development of gastric cancer. Although the few studies available are not very recent, differences in the prevalence of these infections have been found among different socioeconomic groups.[98,99] Danish men with short education who attended conscription examination were twice as likely to be infected with HPV compared to men with long education.[98] Differences in sexual behaviour accounted for only a small part of this difference (OR: ranged from 2.0 to 1.9 (1.1-3.1) when adjusted).[98] An older study among randomly selected Danes born from 1922-1952 observed that people with long education had significantly lower odds (OR:0.5 (0.4-0.8)) of chronic infection with helicobacter pylori compared to people with short education. A social gradient was observed, with odds decreasing systematically with increasing educational attainment.[99]

HPV VACCINATION

HPV (human papillomavirus) is a virus that can cause cancer. HPV vaccination protects against two to seven HPV types, which together are found to cause 70-90% of all cervical cancer cases. In addition, the vaccine also protects against anal cancer and cancer of the external female genitalia and is believed to protect against certain types of cancer of the oropharynx and penis.

After a period of lower HPV vaccination coverage, high participation can again be observed (91% of girls and 89% of boys born in 2008).[100] There is social inequality in who have been vaccinated against HPV in Denmark.[101-105] Among the first cohorts in the target group (1996-1997), a higher proportion of young women whose mothers had long education (94%) were vaccinated against HPV compared to young women whose mothers had short education (89%).[104]

Similarly, social inequality is seen in vaccination coverage among young men in Denmark (born 1979-2004) who paid for the vaccine themselves in the period 2006-2013.[103] For both sexes, social inequality is present regardless of whether the measure is the mother's educational attainment, income, marital status or ethnicity (Figure 14).[101-104] Girls with an ethnic background other than Danish have lower vaccination coverage, even when differences in socioeconomic factors are taken into account.[101,102] However, vaccination coverage varies further according to country of origin, region of residence and also over time.[102]

A more recent report from Statens Serum Institut finds the same correlations between socioeconomic position and vaccine coverage for girls for the 2001-2004 cohorts.[106]

INEQUALITY IN HPV VACCINATION

Figure 14
Odds ratio (OR) and Hazard Ratio (HR) for having received HPV vaccination among young Danish women and men

Data source
Young women: Slattelid et al. (2015)[104] Young men: Bollerup et al. (2015)[103]

Please note
The figures are for young women, born 1996-1997, vaccinated from 2009-2012[104] and for young boys, born 1979-2004 and vaccinated from October 2006 - June 2014[103]

Comparison group
Education: short vs. long Income: low vs. high. Marital status: unmarried vs. married.
Occupational status: unemployed vs. in employment. Ethnicity: Danes with minority background vs. ethnic Danes

WHO IS OFFERED THE HPV VACCINATION?

HPV vaccination is part of the Danish childhood vaccination programme, where all children are offered HPV vaccination free of charge from the age of 12 until the age of 18. This has been available for girls since 2009 and for boys since 1 July 2019. The first HPV vaccine was authorised in 2006, and was offered free of charge from 2008 and 2012 to Danish women born between 1985 and 1995. For Danes who were not covered by the vaccination programme, the vaccine cost between EUR 180 and EUR 535.

REMINDER ABOUT HPV VACCINATION

On 15 May 2014, the Danish government implemented a system that sent a reminder to all parents whose children had not adhered to the childhood vaccination programme. During the first year, 14% of young women who received a reminder about HPV vaccination were subsequently vaccinated – among them, especially women of non-Western origin (OR: 2.0 (1.6-2.6)), and to a slightly lesser extent young women whose mothers had short compared to long education (OR 0.8 (0.6-0.99)). No significant differences in vaccination uptake after the reminder were observed according to the mother's income or occupational status.[107] On 1 August 2019, a new reminder system was launched, and custody holders now receive a reminder shortly before the vaccination date, and another reminder after the vaccination date has passed.

Photo: Tomas Bertelsen

ACCUMULATION OF MULTIPLE CONCURRENT RISK FACTORS

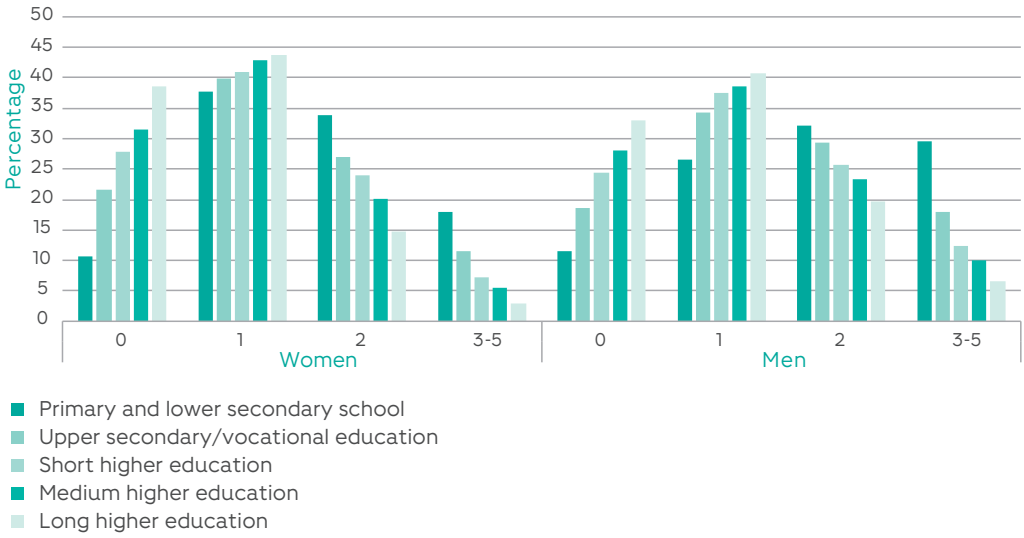
Many of the above risk factors are more prevalent among people with short education or low income, and there is also a social gradient in the proportion of people who have two or more of these risk factors at the same time (Figure 15).[59]

An accumulation of multiple risk factors or other differences in health behaviours may enhance the effect of a given risk factor. Thus, the impact of each risk factor may be greater if a person is simultaneously exposed to other causes of the same disease. This means that social inequality in cancer may also arise because some socioeconomic groups are more susceptible to a given risk factor because they are also exposed to one or more other risk factors.[53]

Figure 15
Number of co-occurring risk factors (daily smoking, high alcohol consumption, unhealthy dietary patterns, physical inactivity, obesity (BMI ≥ 30), among women and men ≥ 25 years, Denmark, 2021

Note
Age-adjusted percentage

Data source
Danish Health Authority, Health of the Danes – The National Health Profile 2021 (2022)[59]



KNOWLEDGE OF RISK FACTORS

Knowledge of cancer risk factors can influence one's health behaviour. A 2011 telephone interview survey of 3,000 randomly selected Danes over the age of 30 found that over 95% knew that smoking increases the risk of cancer, whereas less than 25% knew that infection with HPV is a risk factor for cancer.[108] The survey observed clear social inequality in knowledge of risk factors, with people with short education, low income, no employment, or minority background less likely to know about 9 out of 13 selected risk factors for cancer.[108] Other studies and more recent surveys show the same trend. People with short education are less aware that alcohol[109] and overweight/obesity[110] are risk factors for cancer and that sunburn and sunbed use can increase the risk of melanoma[111].

HEALTH LITERACY AND BARRIERS TO HEALTH PROMOTION

It is not only the knowledge of a given risk factor that influences whether a given behaviour or behavioural change occurs. A qualitative study describes the existence of socioeconomic differences in health literacy and barriers to health promotion.[112] Across socioeconomic groups, there are differences in the opportunities to change, manage, cope or adapt and there are differences in how health practices are perceived, transformed and performed.[112] The study indicates that the current health discourse in society, which encourages individuals to be proactive and take responsibility for their own health, resonates more with people with a high socioeconomic position, and that the discourse sets requirements and expectations that are difficult to fulfil among people with a low socioeconomic position. Thus, the current health discourse may contribute to perpetuating social inequality in health.[112]

THE IMPORTANCE OF DIFFERENCES IN RISK FACTORS FOR CANCER INCIDENCE

The social inequality in risk factors described above is reflected in the pattern of cancer incidence in the population (Figure 1). In general, it can be said that cancers associated with smoking, overweight/obesity and unhealthy diet are more common in people with short education or low income (e.g. head and neck cancers, lung cancer, kidney cancer and colorectal cancer), while breast cancer, which is associated with high alcohol consumption, is more common in women with long education or high income.[1,48] In addition, prostate cancer and melanoma occur more frequently among people with long education and high income (Figure 1).[1,48] The reasons for this are underexplored, but for prostate cancer men with long education have a higher use of PSA testing than men with short education.[113,114] For melanoma, the greater exposure to UV radiation from the sun among people who have long education compared to people with short education is probably a crucial cause.[89,90]

Studies have shown that part of the higher incidence of breast cancer among women with long education can be explained by differences in alcohol consumption, use of exogenous hormones, and reproductive factors such as number of pregnancies and age at first pregnancy.[5,6,115] In a prospective cohort study, the higher incidence of breast cancer among women with long compared to short education was partially explained when the analysis accounted for differences in alcohol consumption, BMI, hormone supplementation and reproductive factors (HR ranged from: 1.2 (1.0-1.4) to 1.1 (0.9-1.3) after adjustment).[6] Similarly, a study has shown that the higher incidence of breast cancer north of Copenhagen is associated with differences in reproductive factors in the area.[115]

The potential for prevention

A study among women diagnosed in 1981-2001 estimated that differences in alcohol consumption explained 26% of the excess cases of breast cancer among women with long education compared to women with short education.[5] In addition, differences in age at first birth explained 32%, number of completed pregnancies 19%, and use of hormone supplements 10%.[5] Combined, these factors explained 57% of the excess cases of breast cancer among women with long education, which is less than the sum of the four factors individually.[5] This example illustrates how multiple lifestyle factors and the impact of lifestyle factors on the development of cancer are strongly related to each other. It is therefore difficult to calculate the impact of individual factors on social inequality in cancer incidence and thus the potential for prevention.

The social inequality in cancer incidence is a result not only of differences in exposure to risk factors, but also of differences in susceptibility to risk factors.[53,54] For example, a Danish study shows that patients with short education are more susceptible to the effect of smoking on lung cancer risk.[116] Some of this difference may be due to differences in smoking behaviour, e.g. how and how much they smoke. Nonetheless, a targeted intervention that reduces the number of smokers with short education will lead to a larger decrease in lung cancer incidence compared to interventions that reduce the number of smokers with long education. Similarly, an intervention that leads to the same absolute reduction in smoking rates in all socioeconomic groups will lead to a greater reduction in lung cancer among people with short education and thus to a reduction in inequality.[116]

Sibling and twin studies have been used to investigate the impact of risk factors to which one is exposed during childhood and early adolescence on social inequality in cancer incidence. By looking at twins and siblings who have attained varying levels of education, the importance of early lifestyle and environmental factors, as well as any genetic factors shared by siblings, can be taken into account.

A sibling study showed that much of the social inequality in lung cancer may be attributable to differences in early acquired lifestyle factors, as the association between educational attainment and lung cancer risk was significantly smaller among siblings.[117] For colorectal cancer, the association with educational attainment was stronger among siblings. This may reflect the fact that unknown factors associated with differences in siblings' educational attainment have a greater impact on colorectal cancer risk than the risk factors shared by siblings. For breast cancer, the same socioeconomic gradient was found among siblings as among non-siblings. Thus, the common risk factors and genetic factors shared by siblings do not appear to explain social inequality in breast cancer incidence.[117] This is supported by a study of 16,310 female twins, 518 of whom developed breast cancer.[118] The study found the same differences in breast cancer incidence as in the general population, indicating that social inequality in breast cancer risk is due to risk factors that people are exposed to later in life.[118]

5

Social inequality in cancer diagnosis and treatment

This chapter examines the extent of social inequality in the cancer trajectory from socioeconomic differences in cancer screening and diagnostic processes, to stage at diagnosis, comorbidity, lifestyle during and after treatment, and socioeconomic differences in treatment.

SUMMARY – SOCIAL INEQUALITY IN THE CANCER TRAJECTORY

Screening

People with short education, low income, minority background or who live alone:

- participate less in screening
- more often have an invalid screening result after colorectal cancer screening
- participate less in follow-up after an abnormal screening result

From symptom to treatment

- People with short education, low income, minority background or who live alone are less likely to recognise specific symptoms of cancer.
- Socioeconomic conditions influence how people perceive, interpret and communicate a given symptom to their doctor.
- Few studies have investigated socioeconomic differences in the reported time between first symptom and first physician contact and have not found clear differences.
- No clear socioeconomic differences has been observed in the time from referral to diagnosis or initiation of treatment.

Stage at diagnosis

- There is social inequality in stage at diagnosis. People with short education, low income or who live alone are more likely to be diagnosed with advanced cancer.

Comorbidity

- Cancer patients with low socioeconomic position have a higher prevalence of comorbidity.

Treatment

- For the cancers investigated, patients with short education or low income are less likely to receive the treatments studied. These differences are also seen in studies that take into overall differences in comorbidity and clinical factors.

Lifestyle during and after treatment

- Cancer survivors with short education have higher odds of being smokers, having a sedentary lifestyle and having unhealthy dietary habits.
- Among head and neck cancer patients who were smokers at diagnosis, patients with low income had the highest odds of remaining smokers during and after treatment.

The role of intermediate factors in social inequality in cancer survival

- For most cancers investigated, socioeconomic differences in screening, stage, comorbidity, treatment and lifestyle explain a substantial part of the social inequality in survival.

SOCIAL INEQUALITY IN CERVICAL CANCER SCREENING

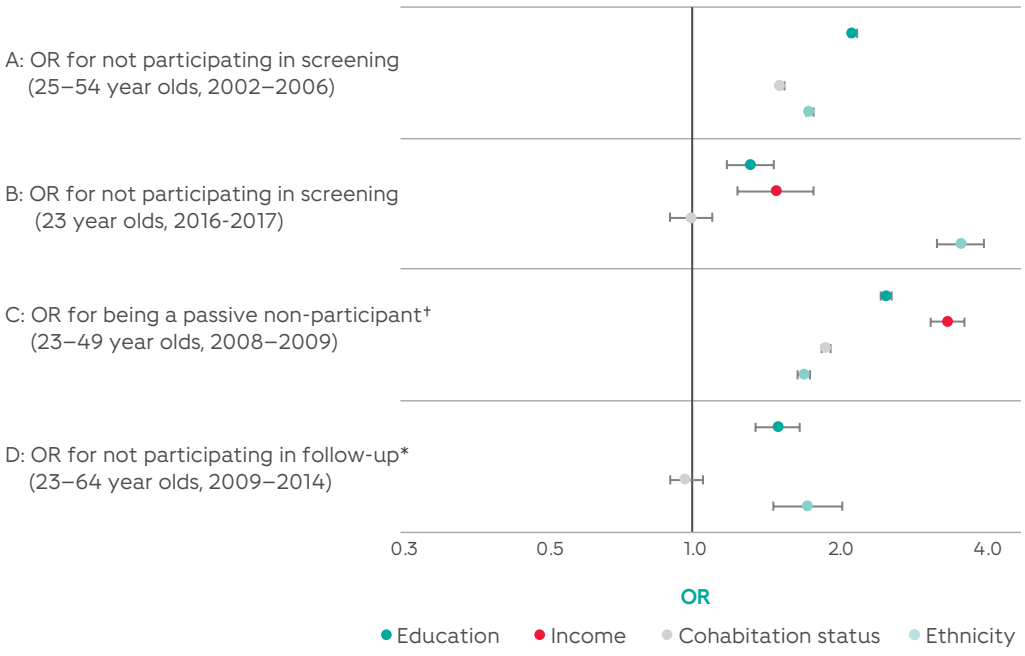


Figure 16
Odds ratio (OR) for different outcomes associated with cervical cancer screening, Denmark, 2002-2015

Comparison group
Education: short vs. medium (A) or long (B,C,D) education.
Income: low vs. high.
Cohabitation status: single vs. cohabiting or unmarried vs. married.
Ethnicity: Danes with minority background vs. ethnic Danes

Data source
A: Kristensson et al. (2014)[119]
B: Badre-Esfahani et al. (2019)[105]
C: Harder et al. (2018)[120]
D: Kristiansen et al. (2017)[121]

Note
* The estimate has been converted to illustrate trends,
+ OR has been adjusted for other socioeconomic indicators, which is likely to underestimate the association

SCREENING

In Denmark, national screening programmes have been introduced for cervical, breast and colorectal cancer. The aim of the screening programmes is to detect cancer at an early stage, including precancerous conditions that can often be treated more gently and effectively, reducing both morbidity and mortality.

Cervical cancer screening

All women aged 23 to 64 are invited for cervical cancer screening every three to five years. This screening programme was introduced in the 1960s and has gradually expanded since then, becoming a national service in 2006. Participation is lower among women with short education or low income, compared to women with long education or higher income (Figure 16).[105,119-122] There is a social gradient where participation increases with e.g. increasing levels of educational attainment or income (Figure 17).[105,119-122] In a report from the Danish Health Authority, the participation rate in 2017 was 55% for women with short education, and 67% and 73% for women with medium and long education, respectively (Figure 17).[122]

There is also markedly lower participation in cervical cancer screening among women with minority backgrounds, particularly among women with non-Western backgrounds.[119,120,123] The results are more ambiguous in terms of cohabitation status (Figure 16).[105,119-122] Similar inequalities have been observed in studies that examine participation in follow-up testing after an abnormal screening result.[121,124]

A tendency of increasing social inequality in cervical cancer screening has been observed over the period 2010-2017.[122] Furthermore, at the beginning of the COVID-19 pandemic (1 February-10 March 2020), screening participation decreased by 5% among women with low income, while it only decreased by 2% among women with high income.[125] For women with short education, screening participation decreased by 4% compared to 0% among women with long education.[125] For all groups, participation seems to have returned to the same level as before the COVID-19 pandemic, yet overall, a decrease in screening participation can be seen over the period 2015-2021.[125]

Breast cancer screening

Breast cancer screening was gradually introduced beginning in 1991, but it wasn't until the end of 2009 that all women in Denmark between the ages of 50 and 69 years received an invitation to participate in breast cancer screening. Women are invited to take part in a screening examination every two years. When considering who participates, the findings are ambiguous.

In the first screening rounds in Copenhagen and Funen from 1991 to 2001, participation was lower among women with long and short education, compared to women with medium education.[126,127] Participation was also lower among women who were self-employed or had a high-level job title, as well as among women who were unskilled or unemployed, compared to other white-collar workers.[128] The same trend was observed among women invited to the first screening round in the Central Denmark Region in 2008-2009.[129] For income, however, participation decreased systematically by decreasing income levels.[129] Participation among passive non-participants was primarily low for women with short education, low income, or a minority background.[129] This indicates that women with a high socioeconomic position were more likely to actively opt out of the screening programme.[129] In the period from 1992-2009, participation was generally lower among women with a minority background than among women with an ethnic Danish background.[127,129,130] Studies have also shown that participation decreases the further women live from the screening site.[129,131]

In a report from the Danish Health Authority, participation in the national screening round 5 (2016-2018) was lower for women with short education (78%) compared to women with medium (85%) or long education (85%) (Figure 17).[122]

Colorectal cancer screening

All women and men aged 50 to 74 are invited to colorectal cancer screening every two years. The national screening programme was launched in 2014, with a four-year implementation period from 2014-2017. Using a sample kit received by mail, participants take and return (by mail) a faecal sample themselves.

Research findings show clear evidence of social inequality throughout the screening process.[132-139] People with short education, low income, minority background, or who live alone:

I. Participate less in colorectal cancer screening[133-137]
II. More often have invalid screening results[139]
III. Participate less in follow-up examinations after abnormal screening results[134,135]
IV. More often have insufficient bowel preparation prior to colonoscopy and incomplete colonscopy.[138]

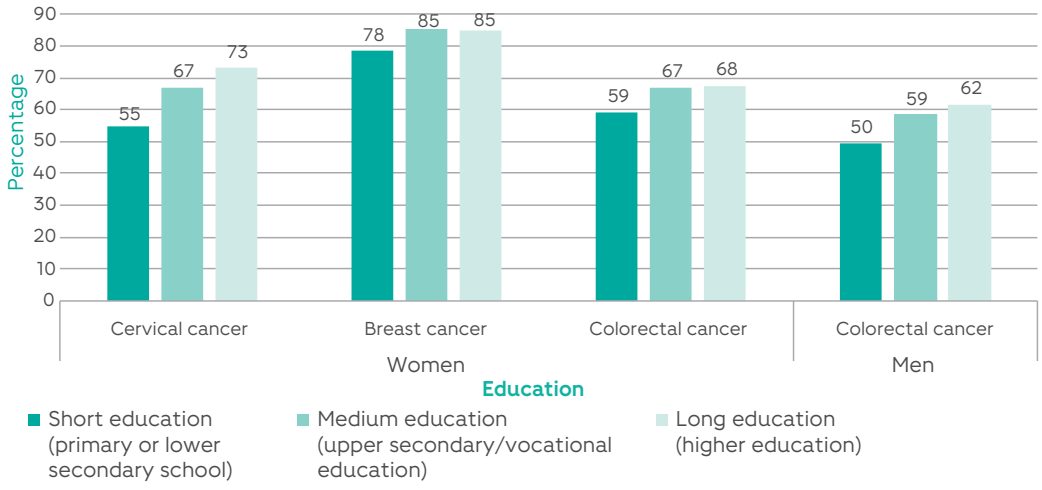
relative to people with long education, high income, a spouse/cohabiting partner or an ethnic Danish background.

According to a 2017 report from the Danish Health Authority, the participation rate was 59% among women with short education and 67% and 68% among women with medium and long education, respectively. Among men, the corresponding figures were 50%, 59% and 62%, respectively (Figure 17).[122]

Figure 17
Proportion attending screening for cervical, breast or colorectal cancer among those invited in 2017, according to gender and highest level of education completed

Data source
Social inequality in health and disease, Danish Health Authority (2020)[122]

Note
Percentages are not adjusted for age, but there is a statistically significant difference between short and long education when adjusted for age[122]



The impact of social inequality in cancer screening

In Denmark, few studies have investigated the impact of social inequality in screening participation on inequality in the subsequent cancer trajectory. For cervical cancer, a study shows that the observed social inequality in cervical cancer screening is related to the fact that women with a low socioeconomic position are more likely to be diagnosed with cervical cancer at a more advanced stage and thus have a poorer prognosis.[140] However, social inequality in screening participation does not explain all of the social inequality in stage at diagnosis, as marked social inequality in stage at diagnosis is still observed even when differences in age at diagnosis, comorbidity and time since last cervical cancer screening are taken into account (OR: 2.0 (1.3-3.0)).[140]

Home test for HPV

In a Danish intervention study, a home screening test for HPV was sent to women who had not participated in the national cervical cancer screening programme.[141] Compared with standard practice (mailed screening reminder), the intervention had a positive effect on overall screening participation.[141] Despite the fact that the test was submitted to a greater extent among women with long education (26%) than among women with a short (18%) education (OR 0.8 (0.7-0.9)) and among women with an ethnic Danish background (25%) than among women with a minority background (13%) (OR: 0.4 (0.4-0.5)),[141] the effect of the intervention on screening participation was approximately the same for all socioeconomic groups.[141] In another intervention, women from minority background benefited especially from being sent the test kit compared to receiving a letter stating that the test kit could be ordered.[142]

Reminder about follow-up after abnormal cervical cancer screening

In 2012, a national electronic system was implemented that sent reminders to a woman's GP if the woman had missed a follow-up examination after an abnormal cervical cancer screening result. After implementation, the proportion of women who did not attend a follow-up examination decreased significantly. The intervention had similar effects across education groups and ethnicities, and larger effects among people living alone compared to cohabiting individuals.[121]

Another intervention study examined the effect of messages sent directly to women instead. In the intervention group, participation in the subsequent follow-up examination was higher (85%) than in the control group (80%), and the intervention had similar effects across all socioeconomic groups, with a tendency towards greater effects among women living alone.[143]

Colorectal cancer screening reminder

In 2014, an electronic reminder was sent to any patients who had not participated in a colorectal cancer screening. Participation was lower among people with low compared to high income, both before (OR 0.5 (0.5;0.6)) and after the reminder (OR: 0.4 (0.4;0.5)). Before the reminder, 42% of people with low income and 46% of people with high income participated. After the reminder, a further 14% of people with low income and 22% of people with high income participated. Although the reminder led to an overall increase in participation, it also led to an increased social inequality.[135]

Decision aid for patients with low socioeconomic position (The LEAD trial)

An intervention targeting social inequality in colorectal cancer screening investigated the effects of a targeted decision-aid with a customised level of information. Although the intervention did not lead to greater knowledge about screening and thus informed choice, more favourable attitudes towards screening and a tendency towards higher participation in the intervention group were observed.[144]

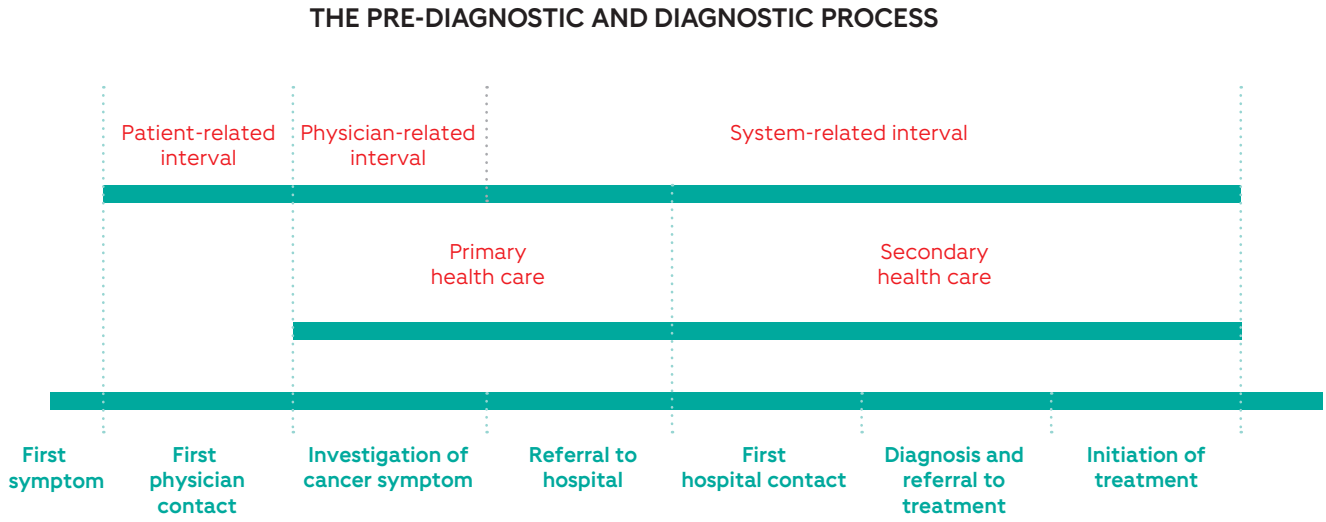


Figure 18
Patient-related, physician-related and system-related interval

Source
Translated and edited with inspiration from Hansen et al. (2008)[145]

FROM SYMPTOM TO TREATMENT

The time that elapses between the development of the first cancer cell and the diagnosis and treatment of the disease is crucial for the health consequences and prognosis of the disease. This period is characterised by many steps where social inequality can occur as a result of individual, cultural and structural factors.[146] The course of the disease depends on the symptoms experienced by the patient and the time that elapses between the detection of symptoms and the diagnosis and treatment of the disease. This time can be divided into patient-related interval (time from first symptom to first physician contact), and physician-related and system-related interval (time from first physician contact to diagnosis and treatment) (Figure 18).

Patient-related interval (time from first symptom to first physician contact)

Few studies address the patient-related interval, and they do not find clear socioeconomic differences in reported time from first symptom to first physician contact.[28,145,147] Studies of the patient-related interval are characterised by the need for patients to recall and report their experiences, which can often be difficult for individual patients. Furthermore, cancer symptoms vary widely for different types of cancer, and information about symptoms and symptom onset is rarely systematically recorded. This complicates the analysis and influences the interpretation of the results.

A number of studies have examined various mechanisms that may influence the length of the patient-related interval. There is a tendency for men and women who have short education, low income, no affiliation to the labour market, a minority background, or who live alone to be less aware of specific symptoms of cancer.[108,111] In addition, Seibæk et al. describe socioeconomic and cultural differences in bodily understanding, how people perceive and interpret a symptom and how long they live with a given symptom before seeking medical attention.[146] The latter issue is supported by studies showing that people with long education are more likely to seek medical care if they experience specific warning signs of cancer,[148] but there are no consistent socioeconomic differences in health-seeking behaviour.[148,149] Similarly, no clear socioeconomic differences have been observed in known barriers to seeking medical care.[150,151] However, there is a tendency for people with long education to report no barriers, or that they are too busy to seek medical care, compared to patients with short education.[150,151]

Physician and system-related interval (time from first physician contact to beginning of treatment)

The physician- and system-related interval refers to the period of time from when a patient contacts a physician reporting a given symptom of cancer, to when cancer is diagnosed and treatment begins.

Interval from first physician contact to investigation/referral

A few studies have observed that patients with short education, low income, or who live alone experience a longer interval from the first physician contact to referral for cancer screening, but no clear differences are observed across various socioeconomic indicators and cancer types.[28,145,147,152-154] Socioeconomic differences have been observed in healthcare utilisation related to cancer or cancer symptoms, however.[55,156113,114,155] Children under age 15 diagnosed with cancer whose parents had a low socioeconomic position had more frequent contact with the healthcare system in the three months prior to diagnosis than children whose parents had a high socioeconomic position.[156,157] Women with long education were almost twice as likely to have contact with a gynaecological specialist after reporting symptoms of gynaecological cancer to their GP (OR: 1.9 (1.2-3.0)) than women with short education.[155] Similarly, studies have shown that men with medium or long education are more likely to have a PSA test performed by their GP than men with short education,[113,114] including PSA tests performed without indication.[113]

Interval from referral to diagnosis or beginning of treatment

There is no clear social inequality observed in the interval from referral to diagnosis or beginning of treatment.[28,145,147,158] Among lung cancer patients diagnosed with cancer from 2001-2008, i.e. before the introduction of the cancer patient pathway programme, patients who had short education, low income, or who lived alone were more likely to have waited more than 28 days between referral and diagnosis.[158] In contrast, there were no statistically significant socioeconomic differences in the interval from referral to treatment among gynaecological cancer patients[147] or among patients with penile cancer.[28] In a regional questionnaire survey, newly diagnosed cancer patients with low income reported a longer interval from diagnosis to beginning of treatment, compared to patients with high income, while there were no statistically significant differences for education, cohabitation status or labour market affiliation.[145]

Health literacy and interaction between patients and healthcare professionals

An interview study among cervical cancer patients shows that socioeconomic factors influence both how a person experiences and interprets a symptom and how the perceived symptoms are presented and communicated to the doctor.[146]

A study found that cancer patients with short education who live alone and patients with minority backgrounds find it more difficult to engage with health professionals and understand their health messages, compared to people with long education, people who live with a partner and people with an ethnic Danish background.[159] Another study shows that a patient's health literacy impacts the length of both the physician-related and diagnostic interval.[152]

During the COVID-19 pandemic, the use of teleconsultations became more widespread as an alternative to outpatient visits to the cancer ward. A questionnaire survey showed that cancer patients with low health literacy felt less comfortable and confident about the use of teleconsultation, but no clear differences were observed according to patients' socioeconomic position.[160]

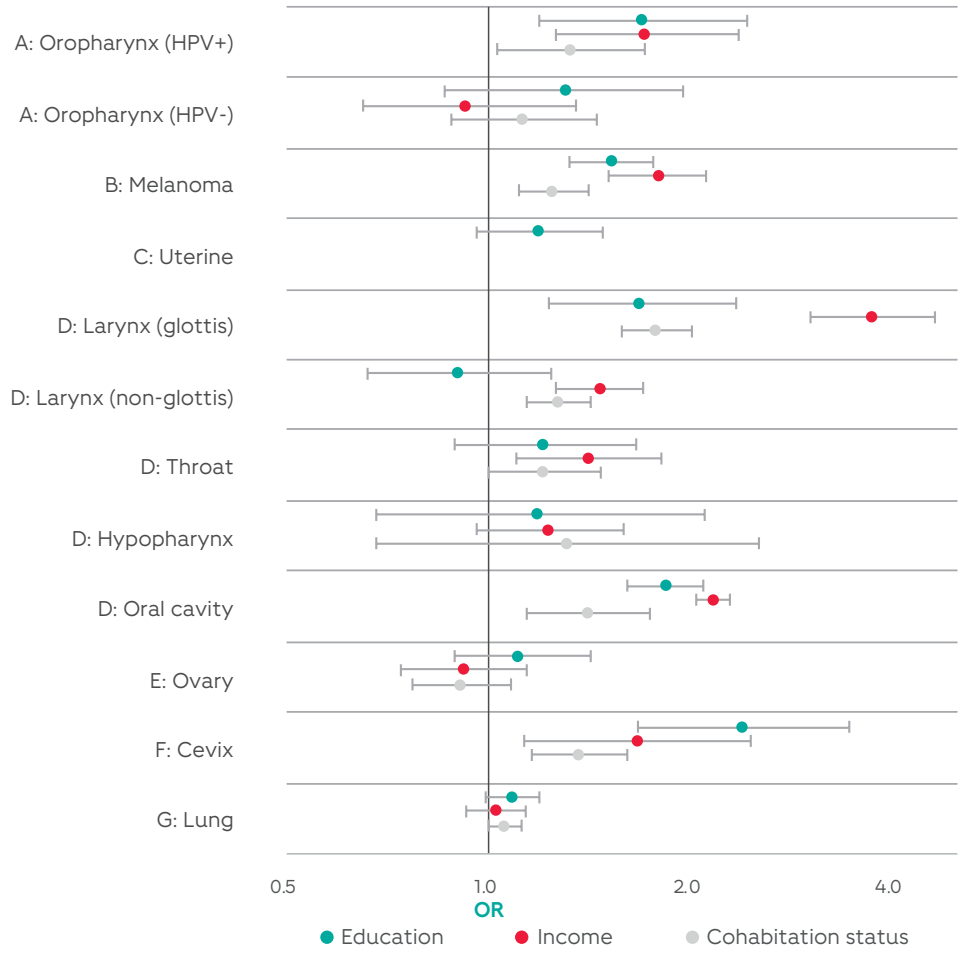
A qualitative interview and observation study describes socioeconomic differences in communication between newly diagnosed cancer patients and healthcare professionals in the cancer ward.[161] Socioeconomically advantaged patients who prepared many questions gained greater insight into how the disease and treatment could affect them, as well as how their close relatives could best support them.[161] At the same time, both physician and nurse gained greater insight into the individual challenges of socioeconomically advantaged patients, which provided better conditions for planning treatment, compared to patients who were more passive in the conversation. Another crucial factor in the conversation was whether the patient was accompanied by a relative, who often provided important information about the patient's condition and everyday life that may also have an impact on the planning of the treatment.[161] Thus, it seems that social differences can be reproduced in the interaction between patient and healthcare system.

SOCIAL INEQUALITY IN STAGE AT DIAGNOSIS

Figure 19
Odds ratio (OR) of being diagnosed with advanced stage at diagnosis, Denmark, 1992-2019

Data source
A: Olsen et al. (2022)[23]
B: Ibfelt et al. (2018)[162]
C: Seidelin et al. (2016)[37]
D: Olsen et al. (2015)[163]
E: Ibfelt et al. (2015)[39]
F: Ibfelt et al. (2012)[140]
G: Dalton et al. (2011)[158]

Comparison group
Education: short vs. long
Income: low vs. high



STAGE AT DIAGNOSIS

Disease stage at diagnosis determines the treatment that can be offered and for the patient's prognosis. The lower stage of disease at the time of diagnosis, the better the chances of recovery. In addition, the risk of late effects from the cancer and treatment is often lower for early-stage cancers, since the tumour burden is lower and treatment is sometimes less intensive.

Overall, people with short education, low income or who live alone are more likely to be diagnosed with cancer at an advanced stage, compared to people with long education, high income or who live with a partner (Figure 19).[23,37,39,140,158,162,163]

However, the extent of social inequality in stage at diagnosis varies for different cancers (Figure 19). There are clear social inequalities in stage at diagnosis for certain types of head and neck cancer[23,163], melanoma[162] and cervical cancer[140]. However, more moderate and statistically significant differences are seen for patients diagnosed with other types of head and neck cancer[23,163], lung cancer[158], endometrial cancer[37] and ovarian cancer[39] (Figure 19).

Other studies among patients diagnosed with sarcoma[29], non-Hodgkin lymphoma[164], colorectal cancer[165] and some cancers in children below 15 years of age[157] do not show clear socioeconomic differences in stage at diagnosis, the analyses in these studies are, however, adjusted for one or more mediators or other socioeconomic indicators, which may underestimate the differences.[29,157,164,165] A study of patients diagnosed with myelodysplastic syndrome (MDS) also found that patients who had short education or who lived alone were more dependent on transfusion at diagnosis and were more likely to be diagnosed with high-risk MDS.[24]

TUMOUR HISTOLOGY

The different main types of cancer can be categorised according to the type of tissue (histology), the tissue from which the cancer cells originate and the characteristics of the cancer cells. The aggressiveness of the disease, the effectiveness of treatment and the chances of survival vary according to the histology of the disease. Two studies have observed socioeconomic differences in histology, but these differences had only moderate impact on social inequality in stage at diagnosis for melanoma[162] (OR: went from 1.5 (1.3-1.7) to 1.4 (1.2-1.6) after adjusting for histology) and ovarian cancer survival (HR: went from 1.8 (1.1-2.9) to 1.6 (0.8-2.3) after adjusting for histology).[39]

COMORBIDITY

Many known risk factors for cancer, such as smoking, alcohol consumption and obesity, are also risk factors for other chronic diseases such as diabetes and cardiovascular disease. In cancer patients, comorbidity is defined as the presence of one or more other chronic diseases in addition to cancer.

A review of the literature concludes that cancer patients with comorbidity have poorer survival.[166] In some studies, the presence of comorbidity was associated with diagnosis at a more advanced stage; in other studies, comorbidity was associated with diagnosis at a less advanced stage.[166]

Comorbidity also affects potential cancer treatment, and patients with comorbidity are less likely to receive standard treatment compared to patients without comorbidity.[166]

Studies of comorbidity are often characterised by the fact that information on diseases is often available only from hospital registers, and thus these studies can only investigate the impact of serious diseases that required hospital contact. Many diseases do not require hospital contact, either due to minor severity or because diseases such as diabetes or depression are primarily managed in primary care.

Studies consistently show that cancer patients with short education, low income, or who live alone are more likely to have one or more other illnesses at the time of diagnosis compared to patients with education, high income, or those who live with a partner,[23,24,32,35-38,42,44,158,162,164,167-169] but few[23] provide estimates adjusted for gender and age. In the population as a whole, there is a general tendency for people with short education to be more likely to have multiple illnesses (multimorbidity) than patients with longer education (Figure 20).[59,170,171] Among people registered with a previous cancer diagnosis as of 1 January 2013, patients with short education were registered with an average of 4.0 other chronic diseases, while patients with long education were registered with an average of 3.4 other chronic diseases.[170] The same tendency has been observed among cancer survivors in other studies.[171,172,110]

SOCIAL INEQUALITY IN MULTIMORBIDITY

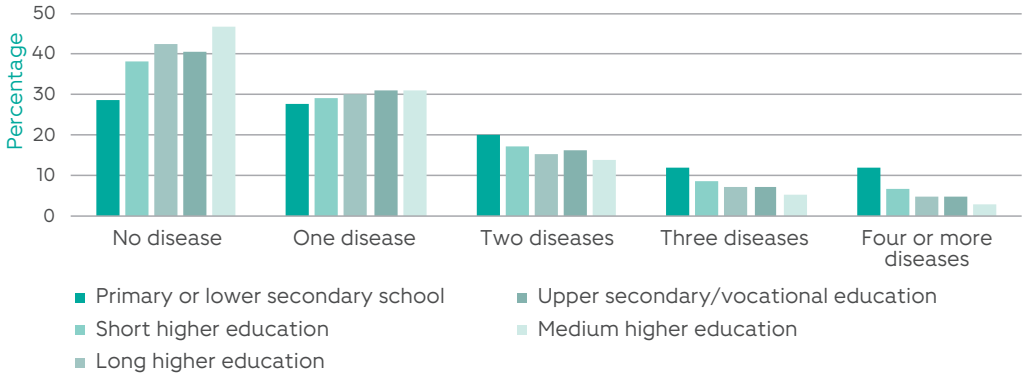


Figure 20
Proportion with zero to four or more of 19 selected diseases or health problems, according to education group, Denmark, 2021

Data source
Danish Health Authority, Health of the Danes – The National Health Profile 2021 (2022)[59]

TREATMENT

Disease-specific and patient-related factors (e.g. the stage of the disease and whether the patient has comorbidity) may influence whether a patient can receive treatment according to the treatment protocol or clinical guidelines.

Studies that have treatment as a separate outcome show a tendency for patients with short education, low income, or who live alone to receive standard treatment less frequently than patients with long education, high income, or who live with a partner.[32,35,40,42,173-175] This social inequality in treatment received is observed even when the analyses take into account differences in comorbidity and a range of clinical factors such as stage and performance status.[32,35,40,42,173-175] Figure 21 includes results from studies that provide estimates both with and without adjustment for various mediators (e.g. stage, comorbidity, BMI, smoking status, alcohol consumption) that may influence the treatment that can be offered. The figure shows that the observed social differences in these factors explain some – but not all – of the observed social inequality in treatment received (Figure 21).[32,35,40,175] Social inequality in treatment has also been observed among children diagnosed with acute lymphoblastic leukaemia who were prescribed lower doses of maintenance chemotherapy administered at home by their parents if their parents had short education or were not connected to the labour market, compared to children whose parents had long education or were employed.[173]

Patients below 65 years of age diagnosed with colorectal cancer, with short education, low income, or who live alone, had higher odds of undergoing emergency surgery compared to patients with long education, high income, or who live with a partner, even after adjusting for a wide range of clinical factors.[32] Among (mainly older) patients diagnosed with acute myeloid leukaemia, patients with short education or low income had lower odds of receiving intensive treatment and bone marrow transplantation.[35] Among patients diagnosed with non-Hodgkin lymphoma, patients with short education and low income were less likely to receive radiotherapy, and people living alone were less likely to receive radiotherapy, chemotherapy and immunotherapy.[42] Among lung cancer patients, patients with short education and/or low income had lower odds of receiving standard treatment regardless of disease stage at diagnosis, even in analyses that adjusted for overall differences in comorbidity (Figure 21).[40,175] For recurrence after having diffuse large B-cell lymphoma, patients living alone or who had low income were less likely to receive standard treatment.[174] In a study of patients diagnosed with myelodysplastic syndrome (MDS), patients with short education were less likely to receive stem cell transplantation compared with patients with long education (HR: (0.5 (0.3-0.8)).[24] In two studies of women who had a mastectomy after breast cancer, women with long education were more likely to have had breast reconstruction surgery.[176,177]

Photo: Colourbox

SOCIAL INEQUALITY IN TREATMENT

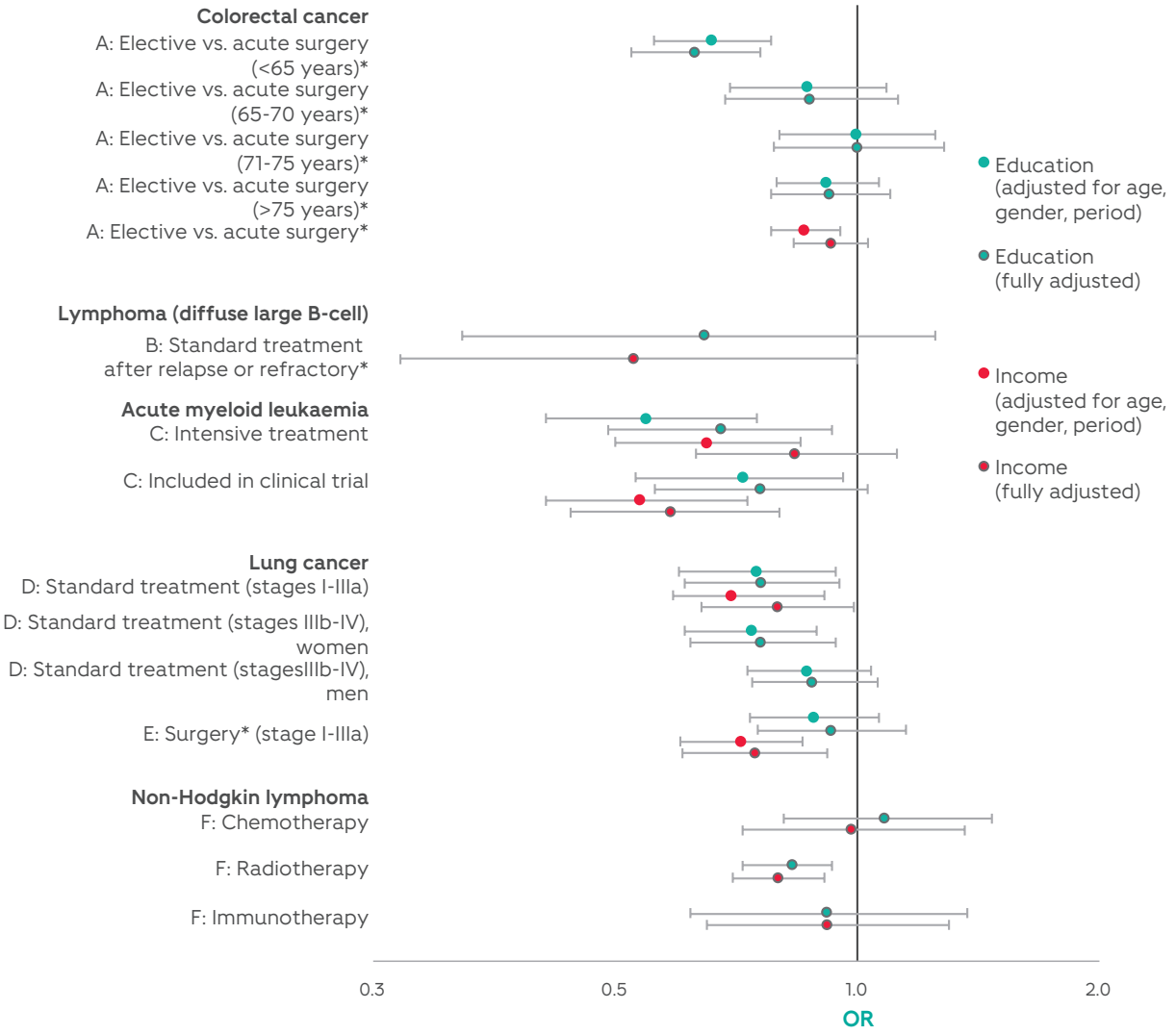


Figure 21
OR for treatment received, Denmark, 2000-2015

Data source
A: Degett et al. (2020)[32]
B: Arboe et al. (2019)[174]
C: Østgard et al. (2017)[35]
D: Dalton et al. (2015)[40]
E: Kaergaard et al. (2013)[175]
F: Frederiksen et al. (2012)[42]

Please note
* The estimate has been converted in order to illustrate trends. In addition to age, gender and period, covariates for the fully adjusted analyses vary (A: comorbidity, BMI, smoking, alcohol consumption, stage, tumour location. B: comorbidity, education C: white blood cell count, risk group, performance status, leukaemia type, comorbidity. C: comorbidity D: income, cohabitation status, hospital, comorbidity, interval from referral to diagnosis)

Comparison group
Education: short vs. long
Income: low vs. high

LIFESTYLE OF CANCER PATIENTS

Lifestyle factors such as smoking, alcohol consumption, exercise and diet before, during and after cancer treatment can have an impact on prognosis and on patients' physical and psychological well-being. Yet the lifestyle data for cancer patients available in e.g. clinical databases are typically collected in broad categories, and there is often a high degree of missing data.

A limited number of studies of cancer patients have social inequality in lifestyle factors as an endpoint.[23,178] In these, as well as in studies that are unadjusted for gender and age, there is a clear tendency for patients with short education, low income, or who live alone to be more likely to be daily smokers,[23,32,36-38,54,167,168,178] have a high BMI,[5,32,36-38,54,167] or be less physically active.[5,54,167] Alcohol consumption among the different socioeconomic groups varies across cancer types.[5,36,38,54,168]

Among cancer survivors in Denmark diagnosed from 1945-2012 who answered the "How are you feeling?" questionnaire for the 2013 National Health Profile, people who had short education had higher odds of smoking daily, having an inactive lifestyle and exhibiting unhealthy dietary habits compared to cancer survivors with longer education (Figure 22).[179] In contrast, cancer survivors with long education had higher odds of heavy alcohol consumption compared to cancer survivors with short education (Figure 22).[179] The social inequality in lifestyle habits among cancer survivors is thus very similar to the patterns seen in the general population (Figure 22).[179]

SOCIAL INEQUALITY IN THE LIFESTYLE OF CANCER PATIENTS AND CANCER-FREE DANES

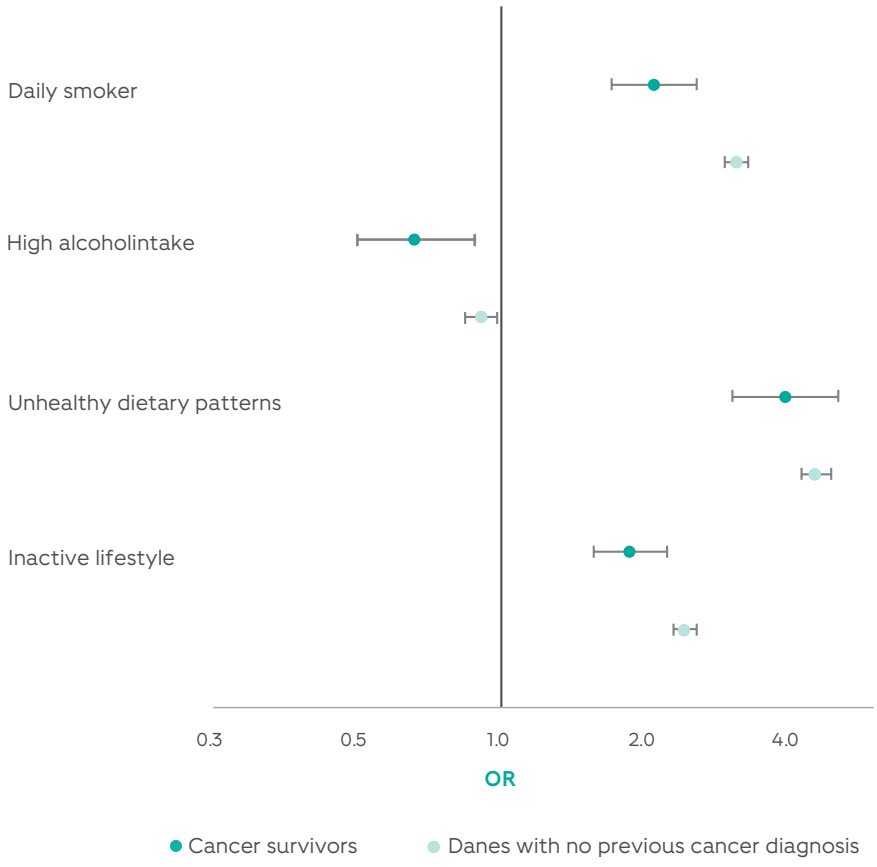


Figure 22
Odds ratio (OR) for lifestyle factors among 11,166 cancer survivors diagnosed with cancer in the period 1945-2012 and 151,117 Danes without previous cancer diagnosis who had answered the questionnaire: "How are you feeling?", Denmark, 2013

Data source
Friis et al. (2018)[179]

Note
The estimates are adjusted for age, gender, minority background, cohabitation status and multimorbidity, which is likely to underestimate the association.
As these are separate analyses, the estimates for cancer survivors and Danes without a previous cancer diagnosis are not directly comparable

Comparison group
Short vs. long education

Among patients diagnosed with laryngeal cancer, all of whom were daily smokers at the time of diagnosis, around 50% of patients continued to smoke during treatment and one year after treatment. Patients with low income had significantly higher odds of still being smokers during treatment and one year after diagnosis compared to patients with high income (OR: 2.2 (1.2-4.0) and 4.4 (2.2- 8.9), respectively).[178] There was no significant association for educational attainment.[178]

The importance of lifestyle factors for social inequality in cancer mortality

One study has looked at the impact of lifestyle factors on social inequality in cancer mortality. Social inequality in cancer mortality reflects both social inequality in incidence and social inequality in survival. The study found that smoking was a strong mediator in the association between educational attainment and cancer mortality. Differences in smoking behaviour between education groups (so-called differential exposure) were associated with 36% and 42% of the social inequality in cancer mortality in women and men with short vs. long education, respectively. In addition, differences in the effect of smoking on mortality across education groups (so-called differential susceptibility) could explain a further 18% and 26% respectively. Although it cannot be determined with certainty whether this is due to smoking per se or to other factors related to smoking behaviour, differences in smoking behaviour across educational groups appear to be a significant cause of social inequality in cancer mortality.[54]

THE IMPACT OF STAGE, COMORBIDITY, LIFESTYLE AND TREATMENT ON SURVIVAL AFTER CANCER

It is hypothesised that the above socioeconomic differences in stage at diagnosis, histology, comorbidity, treatment and lifestyle are responsible for much of the observed social inequality in cancer survival. However, these factors are difficult to investigate as many of them are related both to each other and to many other factors that may influence cancer progression, but for which information is not necessarily available.

Yet it is important to improve our knowledge of where in the cancer trajectory social differences arise in order to develop targeted interventions. A number of studies therefore try to assess the importance of various so-called intermediate factors. This is primarily done by comparing two analyses, one sub-analysis where these intermediate factors have not been adjusted for and one sub-analysis where they have been

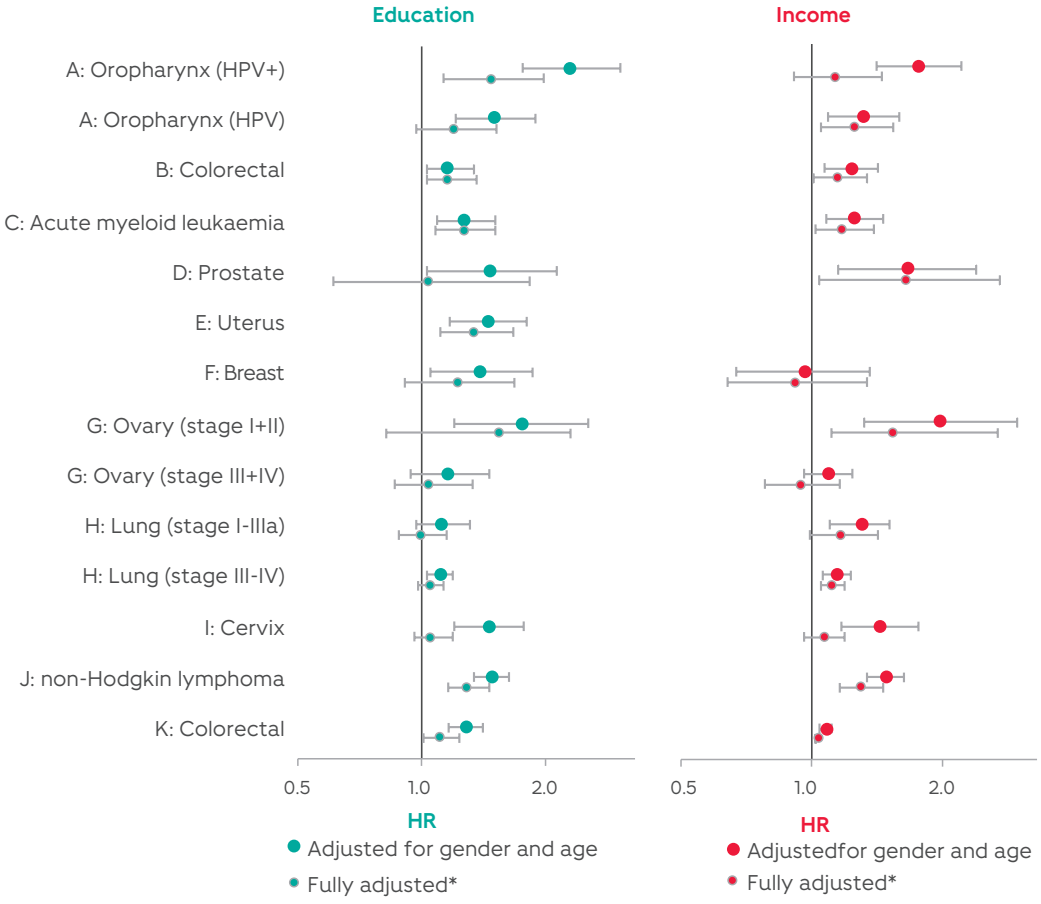


Figure 23
Hazard Ratio (HR) for death (all causes) according to level of education or income and type of cancer, Denmark

Data source
A: Olsen et al. (2022)[23]
B: Degett et al. (2020)[32]
C: Østgård et al. (2017)[35]
D: Larsen et al. (2017)[36]
E: Seidelin et al. (2016)[37]
F: Larsen et al. (2015)[38]
G: Ibfelt et al. (2015)[39]
H: Dalton et al. (2015)[40]
I: Ibfelt et al (2013)[41]
J: Frederiksen et al. (2012)[42]
K: Frederiksen et al (2009)[44]

Comparison group
Education: short vs. long
Income: low vs. high

Note
* Covariates in the fully adjusted analyses vary (A: stage, smoking, comorbidity, treatment intention. B: comorbidity, BMI, smoking, alcohol consumption, stage, tumour location. C: white blood cell count, risk group, functional level, cancer type, comorbidity, treatment. D: aggressiveness, comorbidity, treatment, BMI, hip measurement, diabetes. E: cohabitation status, BMI, smoking, comorbidity, stage. F: stage, malignancy grade, receptor status, comorbidity, BMI, hip measurement, diabetes, smoking, alcohol. G: comorbidity, ASA score, stage, histology. H: stage, treatment, comorbidity, performance status. I: comorbidity, stage. J: comorbidity, performance status, LDH level, K: alcohol, tobacco, BMI, comorbidity, stage, type of surgery)

adjusted for. The difference in the estimate for socioeconomic position in the two sub-analyses is interpreted as the indirect effect of the intermediate factors.[180,181], i.e. how much of the observed social inequality in cancer survival can be explained by the intermediate factors that are adjusted for (Figure 23). Among patients with HPV-associated oropharyngeal cancer, for example, the HR for survival for patients with short versus long education went from 2.3 before to 1.9 after adjustment for differences in smoking behaviour.[23] The HR thus moves significantly towards 1.0 (indicating no association) after adjustment. This is interpreted to mean that differences in smoking behaviour explain a significant part, but not all, of the association between education and survival. Using causal mediation analysis, differences in smoking behaviour were estimated to explain up to 30% of the social inequality in survival after HPV-associated oropharyngeal cancer.[23] Thus, there are strong indications that differences in smoking behaviour explains a substantial part of the observed large social inequality in survival seen for this patient group.[23]

Figure 23 shows that for most cancers studied, the estimate changes significantly towards 1.0 when adjusting for various intermediate factors (e.g. disease stage, smoking, BMI and comorbidity). In the studies, this is interpreted to mean that socioeconomic differences in these factors explain a substantial part of the observed association between education or income and survival after these cancers – it is through these factors that much of the social inequality in cancer survival arises. In two studies, analyses were stratified by stage at diagnosis.[39,40] For ovarian cancer, there was still marked social inequality in survival among women diagnosed at an early stage, but there was only a weak association for women diagnosed at an advanced stage (Figure 23, G).[39] For lung cancer, there was only a weak association between educational attainment and survival among patients diagnosed at an early stage (Figure 23, H).[40] However, for some cancers studied (oropharyngeal, colorectal, endometrial and non-Hodgkin lymphoma), significant social inequalities in survival are still observed, even after accounting for many potential intermediate factors. For other cancers (breast and cervical), these factors appear to explain a large part of the observed social inequality in survival.

The health discourse

Qualitative studies describe how the current health discourse – the way health, health promotion or treatment is discussed and written about – may contribute to creating or maintaining social inequalities in the cancer trajectory.[112,243,244]

The current health discourse largely encourages citizens to be proactive[243,244] and "consumers of health".[243] One study describes that this discourse is more successfully adopted by people with high socioeconomic positions and to some extent contradicts how health and illness are understood among people with lower socioeconomic positions.[243]

In addition, the current health discourse ignores the (lack of) opportunity for people with e.g. comorbid conditions and people in difficult circumstances to engage in proactive health care seeking behaviour. When and how people seek medical attention is a socially and contextually embedded behaviour, and there exist a simplistic assumption that people will seek medical attention if only their knowledge and awareness of cancer symptoms are increased.[243]

A study of the framework for the treatment for head and neck cancer also describes that it relies on a high degree of active participation by patients, with demands and co-responsibility for treatment, and that this discourse is both easier to comply with and more likely to be adopted by patients with a high socioeconomic position.[244]

Photo: Hans Bach

6

Social inequality in life after cancer

This chapter describes studies that address socioeconomic differences in life after cancer diagnosis and treatment.
Many cancer patients experience late effects of cancer and its treatment. The burden of late effects has impact on the ability to return to everyday life and, for those who are working, to work.
For patients with incurable cancer, timely access to appropriate palliative care and the fulfilment of their wishes regarding where to spend their last days are of great importance.

SUMMARY – SOCIAL INEQUALITY IN LIFE AFTER CANCER

Rehabilitation

» Cancer survivors with short education and low income are less likely to be referred to rehabilitation and less likely to participate in rehabilitation.

Late effects

» Studies point to higher odds of somatic complications such as cardiovascular disease, pain and disability among cancer survivors with short education, low income or who live alone.
» Cancer survivors with short education, low income or who live alone have higher odds of a range of psychological complications, such as anxiety and depression.
» Socioeconomic differences in the prevalence of comorbidity, smoking and obesity may be responsible for some of the social inequality in late effects after cancer.

Labour market affiliation

» Cancer patients with short education, low income or who live alone are more likely to be unemployed or recieve disability pension after a cancer diagnosis. The mechanisms behind this include differences in comorbidity, late effects and working conditions, such as how physically demanding and flexible work tasks are.

Recurrence

» A few studies have investigated and found no clear indications of social inequality in cancer recurrence or relapse.

Palliative Care

» Studies show a trend towards inequality in access to both specialised and basic palliative care.

REHABILITATION

Rehabilitation consists of a number of interventions that can help people who have, or have had, cancer, to e.g. maintain or regain the best possible functional ability, including interaction with society.[184] Cancer rehabilitation has a broad aim and covers physical, psychological and practical support and assistance in returning to everyday life.[185]

There are limited number of studies assessing social inequality in rehabilitation and these are based on older data (given that it was only in 2007 that municipalities became responsible for cancer rehabilitation, and the first pathway programme for rehabilitation and palliative care was published in 2012 and updated in 2018).[184] Despite the limited studies and ambiguous and not statistically significant results, there is a tendency for patients with short education, low income, or who live alone to have higher needs or more unmet needs for rehabilitation (A-C, Figure 24).[186,187]

There is also a tendency for this group of patients to report needing support in more areas than patients with long education, high income, or who live with a partner.[182]

Yet there is a tendency for this group to be less likely to be referred to, and willing or able to complete, a rehabilitation programme (D-F, Figure 24).[188-192] From 2010-2015, 19% of cancer patients living in Copenhagen Municipality were referred to rehabilitation, but women and men with long education were referred more frequently compared to women and men with short education (HR, women: 1.3 (1.2-1.5), men: 1.3 (1.1-1.6)).[190] Similarly, among those referred, more men and women with long education than short education participated (HR, men: 1.7 (1.4-2.2), women 1.6 (1.3-1.8)).[190] The same trend was observed in a national survey of 3,439 cancer survivors (Figure 24).[186] One study suggests that distance to the rehabilitation centre may have an impact on rehabilitation referral.[189] In addition, one study finds that people with short education or who live alone are less receptive to, and less willing to use, technology for physical rehabilitation.[193]

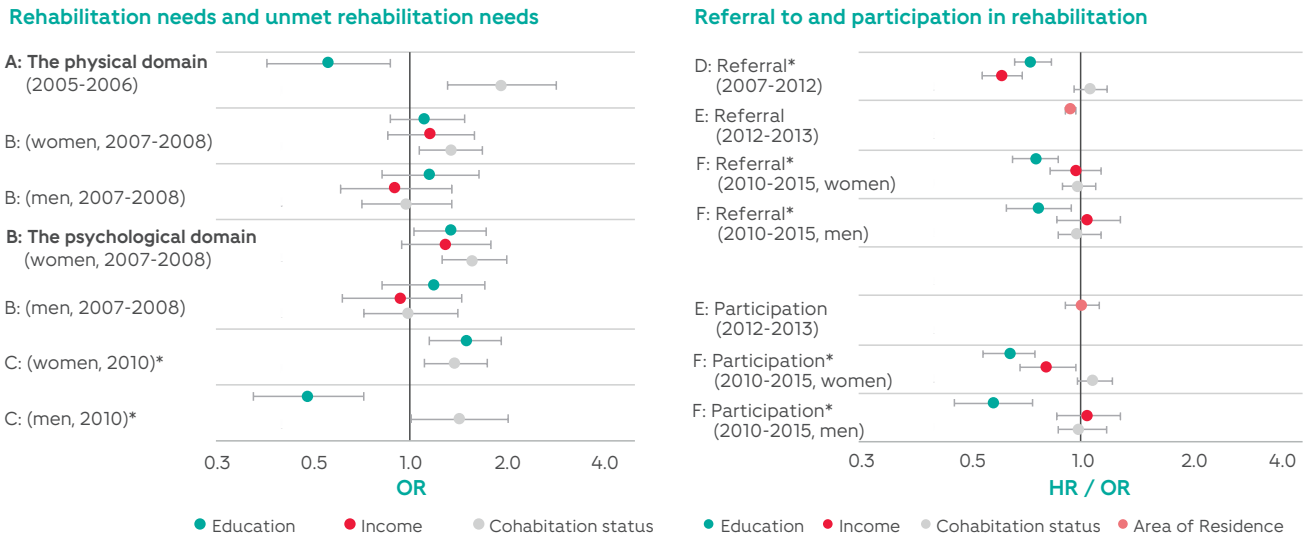


Figure 24
Socioeconomic differences in different outcomes associated with rehabilitation for cancer, Denmark, 2005-2015

Comparison group
Education: short vs. long
Income: low vs. high.
Cohabitation status: single/unmarried vs. cohabiting/married.
Area of residence: lowest vs. higher socioeconomic profile

Data source
A: Ross et al. (2012)[187]
B: Holm et al. (2013)[186]
C: Veloso et al. (2013)[194]
D: Moustsen et al. (2015)[188]
E: Hindhede et al. (2016)[189]
F: Dalton et al. (2019)[190]

Note
* Estimate converted to illustrate trends

Rehabilitation and palliative care for vulnerable cancer patients

One study summarises eight Danish practice-oriented development studies, all of which targeted social inequality and vulnerability in cancer rehabilitation and palliative care, as well as results from a workshop with experts and health professionals in the field.[192] The study highlights that addressing social inequality and vulnerability in this part of the cancer trajectory is practically and conceptually challenging. The study points to the importance of ensuring individualised support for vulnerable cancer patients and integrating rehabilitation and palliative care into standardised pathways. Rather than developing new initiatives, the authors of the study call for greater flexibility in existing programmes to accommodate the different needs and circumstances of cancer patients, so that more people can access and participate in rehabilitation and palliative care.[192]

LATE EFFECTS AND QUALITY OF LIFE

Late effects of cancer are health problems that occur during primary treatment and become chronic, or that occur and manifest themselves months or years after treatment has ended. Late effects include new primary cancer and physical, psychological or social changes resulting from the cancer and/or its treatment.[195]

Somatic late effects and health-related quality of life

A limited evidence base indicates that patients with short education, low income, or who live alone tend to report more late effects such as pain,[168,172,196] reduced functional ability,[168,172,197] reduced health-related quality of life,[168,197-199] and specific symptoms and diseases such as peripheral neuropathy[200] and cardiovascular disease.[183] Similarly, breast cancer survivors who had short education or who lived alone were less likely to report being well enough to do what they wanted to do compared to patients who had long education or a cohabiting partner.[201]

Psychological late effects

Studies among patients diagnosed with breast cancer[202-205] and prostate cancer[167,206,207] show a tendency for anxiety, depression and post-traumatic stress to be more prevalent among cancer survivors with short education, low income, or who live alone, compared to patients with long education, high income, or a cohabiting partner. Similarly, a study shows that cancer survivors diagnosed with cancer before the age of 20 are more likely to have used a prescription for antidepressant medication if their parents have short education or low household income than if they have long education or high household income.[208] A study across several different types of cancer finds no clear association between educational attainment and self-reported anxiety or depression symptoms, however.[169]

Despite the fact that cancer survivors with short education are more likely to experience psychological complications after cancer, they are less likely to have used subsidy-qualified treatment by a psychologist (HR: 0.5 (0.3-0.9)), compared to cancer survivors with long education.[209]

Mechanisms

The mechanisms behind the observed social inequality in late effects are poorly understood. There is a weak tendency for socioeconomic differences in comorbidity and clinical factors at the time of diagnosis to explain some, but not all, of the association between socioeconomic position and late effects after cancer.[168,172] In addition, social inequality in smoking and obesity after diagnosis may have an impact on the incidence and severity of late effects.[207]

RETURN TO EVERYDAY LIFE

Despite an older evidence base, a number of studies show that Danish cancer patients with have short education, low income, or who live alone are more likely to lose their affiliation to the labour market after a cancer diagnosis, both in terms of becoming unemployed[210-217] and receiving disability pension.[212,214-216,218-220] However, apart from a few studies among patients with haematological cancer,[218] head and neck cancer,[214] colorectal cancer[215,216] and cancer survivors overall,[217,220] these issues have primarily been studied for patients diagnosed with breast cancer.[210-213,215,219,221]

The studies observe a clear social gradient in labour market affiliation. For example, among patients diagnosed with breast cancer and colorectal cancer, the risk of being unemployed three years after diagnosis was significantly higher for patients with a short education (10 percentage points), compared to patients with a vocational (7 percentage points) or tertiary (4-5 percentage points) education.[215] This social inequality exists even if differences in labour market affiliation in the background population are taken into account. [215]

A cancer diagnosis can impact a patient's income level even many years after diagnosis. For example, women diagnosed with breast cancer have higher odds of experiencing stagnating income up to seven years after diagnosis.[221] The negative effect on income persisted for a longer period after the cancer diagnosis for people living with a partner and people who had long education, although for the latter there were no significant differences across groups.[221] Conversely, among women who were alive three years after being diagnosed with breast cancer, the decline in earnings was markedly higher for women with short education, particularly in the year after diagnosis.[215] This may reflect the higher risk of unemployment and early retirement. A larger decrease in income in the first three years after diagnosis was also found among colorectal cancer survivors with short education compared to survivors with long education.[215]

In addition to the impact on the patient, a cancer diagnosis also has a major impact on the patient's close relatives. One study found that partners of patients diagnosed with prostate cancer were more likely to redeem prescriptions of antidepressant medication if they had a short, compared to a long education.[223]

Mechanisms

In general, factors such as loose affiliation to the labour market (sickness absenteeism and short-term employment) and comorbidity are risk factors for labour market affiliation after cancer, as they are in the general population.[216,218] These factors are socially unevenly distributed. Differences in occupational status, comorbidity and income before breast cancer diagnosis explained approximately 50% of the observed social inequality in labour market affiliation after diagnosis.[211] In contrast, evidence suggests that differences in disease severity, such as stage at diagnosis, are less responsible for social inequality in labour market affiliation after cancer diagnosis.[211,214,215] The socioeconomic differences in labour market affiliation after cancer diagnosis were significantly smaller when differences in occupation type, e.g. the physical demand of occupations across different socioeconomic groups, were taken into account.[215] Breast cancer patients with low income had higher odds of self-reported work disability, even after adjusting for a range of health and work-related factors (OR: 2.6 (1.2-6.1)). Adjusting for these factors did, however, explain the association for education.[224] Breast cancer patients with a short education were more likely to stop working or change jobs due to late effects compared to those with a longer education.[201] This suggests that late effects of cancer and treatment may have a greater impact on labour market affiliation for people with a short education, who not only often have more physically demanding occupations, but also have more comorbidity even before cancer and are therefore more vulnerable to further loss of working capacity. This is supported by a Nordic study that found that the physical demands of the job were the most important reason for job change or change in occupational status after a cancer diagnosis.[225]

Vocational rehabilitation intervention

Resuming work during or after cancer treatment is an important target for cancer rehabilitaton. A controlled intervention study tested the effect of early, individualised vocational rehabilitation.[242] Patients diagnosed with a variety of cancers, all of whom were employed at the time of diagnosis, were randomly assigned to either usual practice or the intervention. The intervention consisted of motivational communication addressing various barriers, municipal cancer rehabilitation, and employer contact. The intervention did not have a significant effect on who returned to work for the overall patient group (RR: 1.08 (0.98-1.19)), but had a favourable effect among breast cancer patients (RR 1.12 (1.01-1.23)).[242] No differential effect was observed according to patients' socioeconomic position.[242]

RECURRENCE

The risk of cancer recurrence varies greatly across cancer sites.[226] Cancer recurrence or relapse have a major impact on the prognosis.

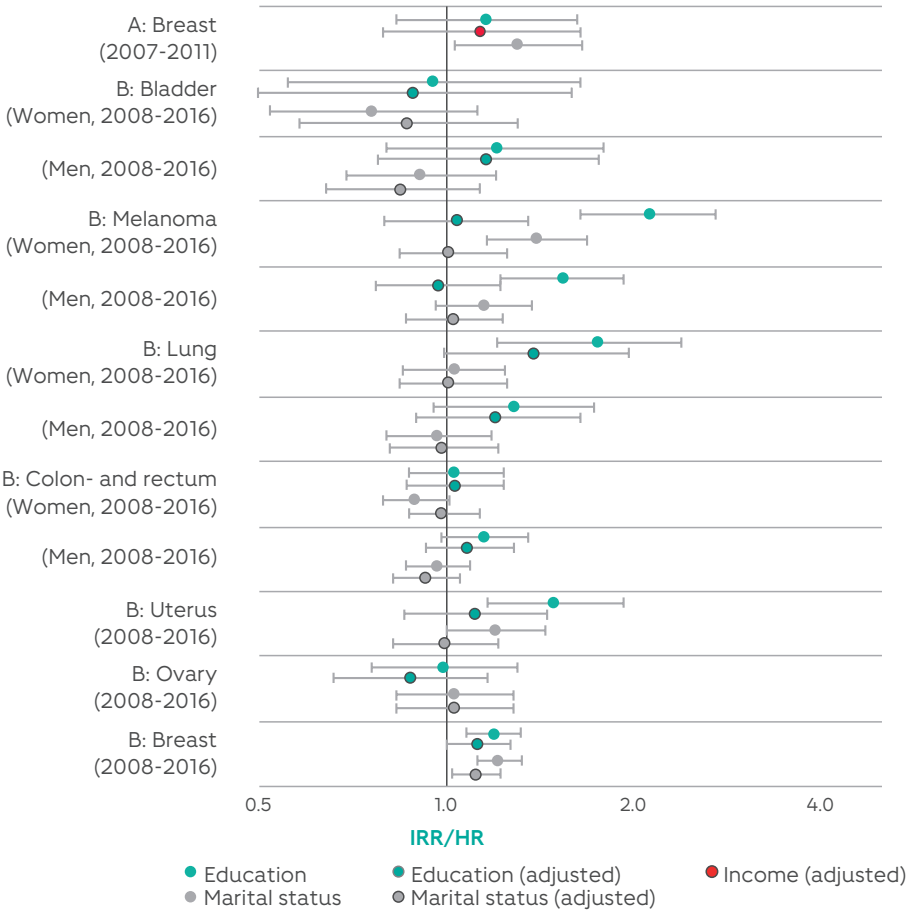
Recurrence or relapse is not systematically recorded for all cancers and only a few studies have investigated socioeconomic differences. This has been done using either records of recurrence in the clinical registries[26] or various hospital contacts and procedure codes.[226] These studies observe a tendency for patients with short education to experience recurrence more often than patients with long education (Figure 25).[26,226] However, there are large variations across and within the cancers studied, and for most cancers studied there is no clear social inequality in recurrence (Figure 25).[26,226] Among women diagnosed with uterine cancer, women outside the labour market had higher odds of recurrence (OR 1.8 (1.1-2.9)), compared to women in employment, while there were no significant differences across education groups in analyses adjusted for age, comorbidity, stage, histology and labour market affiliation, which are probably the most significant factors explaining any differences.[227] Among women with long education, recurrence of endometrial cancer was more likely detected by the woman herself seeking medical attention (77%), compared to women with short education (65%), where symptomatic recurrence was more likely detected by normal follow-up.[228] Treatment of recurrence can be initiated more quickly if the patient herself seeks medical attention with symptoms, compared to recurrence detected by follow-up. Among patients diagnosed with a subtype of non-Hodgkin lymphoma (diffuse large B-cell lymphoma), social inequality in survival after recurrence has been observed among patients with short education and low income (HR: 1.5 (1.0-2.2), 1.7 (1.3-2.5), respectively) and among recipients of social welfare benefits (OR up to 1.7 (1.2-2.6)), but no significant association for cohabitation status has been observed.[34]

Figure 25
Socioeconomic differences in recurrence, Denmark, 2007-2016

Comparison group
Education: short vs. long
Income: low vs. high.
Civil status: A: unmarried/divorced/widowed vs. married/registered marriage; B: living alone vs. cohabiting

Data source
A: Hjorth et al. (2021)[26]
B: Rasmussen et al. (2019)[226]

Note
The estimate for A, education is adjusted for age; A, income is adjusted for age, comorbidity, marital status, cohabitation status, education; A, marital status is adjusted for age. For B, unadjusted estimate and estimate adjusted for age, education/civil status, period, stage and adjuvant treatment are shown. The estimate for B has been converted to illustrate trends



PALLIATIVE CARE

The aim of palliative care is to alleviate a patient's suffering and promote the quality of life of the patient and their family in the event of life-threatening illness.

A limited evidence base indicates that among terminally ill cancer patients who died from cancer in 2006[229] or from 2010-2012,[230,231] patients who had short education, low income, or who lived alone were less likely to have had contact with specialised palliative care compared to patients who had long education, high income, or who lived with a partner (Figure 27). A study among cancer patients who died of cancer from 2006-2016 also observed a trend towards increasing inequality in hospital-based specialised palliative over time.[222] Conversely, women with a minority background were more likely to have had contact with specialised palliative care than women with an ethnic Danish background (Figure 27).[229] As a measure of basic palliative care, a study found that patients with low income were more likely to have consultations with or home visits by their GP in the last three months before death (Figure 27).[232] Another study, however, did not find socioeconomic differences in the use of general practice, home nurse, emergency room and hospital in thise phase.[222] Patients with low income and patients living alone tend to be less likely to receive reimbursements for medication given to terminally ill patients who spend their last days at home or in a hospice.[233] One study has also observed regional differences in drug reimbursement among terminally ill cancer patients, even after adjusting for differences in patients' socioeconomic position, disease-specific factors and structural differences across regions.[234] The majority of terminally ill cancer patients (64-81%) want to spend their last days at home.[235] There are no clear observed socioeconomic differences in the desire to die at home[235] or in who dies at home.[236,237]

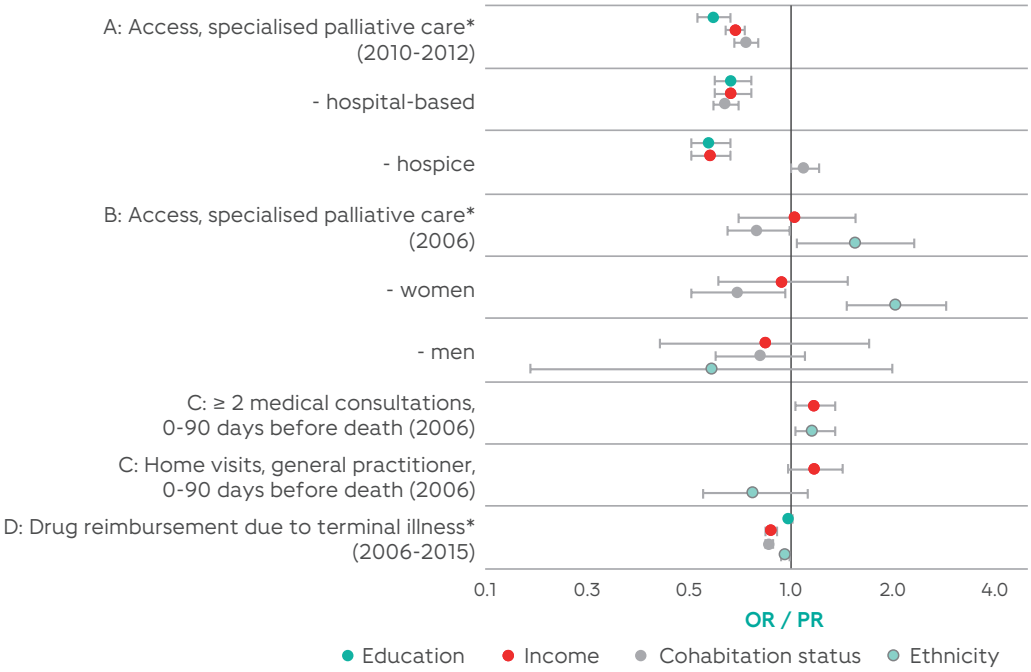


Figure 26
Socioeconomic differences in the palliative care pathway, Denmark, 2006-2015

Comparison group
Education: short vs. long
Income: low vs. high.
Cohabitation status: single/unmarried vs. cohabiting/married

Data source
A: Adsersen (2023)[231] & (2019)[230]
B: Neergaard (2013)[229]
C: Neergaard (2015)[232]
D: Daugaard (2019)[233]

Note
* Estimate has been converted to illustrate trends

Photo: Hans Bach

7

The wider perspective

This chapter contextualises the white paper's review of the evidence of social inequality in the cancer trajectory in Denmark and the identified causal mechanisms.

SUMMARY – THE WIDER PERSPECTIVE

- The white paper shows social inequality throughout the cancer trajectory in Denmark and identifies important knowledge gaps and areas of action in the work to reduce this inequality.
- Social inequality in smoking behaviour is responsible for much of the social inequality in the cancer trajectory. Major changes in inequality in smoking behaviour are needed in order to e.g. prevent a continuing rise in inequality in lung cancer incidence.
- In particular, it is in transitions between health care sectors that socioeconomic differences arise.
- There is limited knowledge about effective interventions addressing inequality in cancer outcomes, and about how to implement such interventions systematically.
- There should be ongoing monitoring of who uses and benefits from health initiatives.

"What the white paper emphasises as important for preventing inequality in cancer is thus not so different from what is important for preventing inequality in the burden of disease in general. The difficult part is identifying measures that can reduce inequality and ensuring the prerequisites for these measures to actually be implemented."

Finn Diderichsen

Translated quote from the expert opinion to the second edition of the White Paper Social Inequality in Cancer in Denmark[51]

This white paper illustrates substantial social inequality in the cancer trajectory in Denmark. Regardless of how socioeconomic position is measured, we see a general stepwise association between education, income or cohabitation status and the risk of getting cancer, as well as the transitioning through the stages of the cancer trajectory in the best possible way.

The literature review has also identified important knowledge gaps in the evidence that have led to a number of recommendations. These are itemised in the white paper's executive summary (Table 2). We point to a lack of knowledge about the impact of socioeconomic position on rare cancers and on outcomes before and after primary cancer treatment. In this second edition of the white paper, it is clear that the knowledge base in many areas is based on data that is more than 10 years old and does not necessarily reflect the current situation. We call for the prioritisation of continuous monitoring of the use and impact of health interventions in different socioeconomic groups.

There is still only limited evidence about interventions that can reduce social inequality in the cancer trajectory for Danish cancer patients. Since the first edition of the white paper was published in 2019, several initiatives and interventions aimed at reducing social inequality in the cancer trajectory have been launched, but data collection is still going on. Continued development and testing of targeted interventions is encouraged in regards to:

- The pre-diagnostic period
- Identification of vulnerable patients
- Navigation of the health care system
- Optimising lifestyle before, during and after treatment
- Managing comorbidity before, during and after treatment
- Treatment of late effects
- Utilisation of health care services

In addition, we encourage research into implementation of effective interventions so they reach everyone in the target group, and that ongoing evaluation of this is ensured.

COMPAS

The Danish Research Center for Equality in Cancer (COMPAS) was launched in 2019 at Zealand University Hospital and is one of 12 national research centres established in collaboration between the Danish Cancer Society, the health regions and the Danish Comprehensive Cancer Center. In COMPAS, clinical interventions that may benefit socioeconomically disadvantaged cancer patients are being developed and tested.[238]

The COMPAS collaboration is interdisciplinary and run by research institutions and hospitals across Denmark. Thus a Danish infrastructure for research on social inequality in cancer has been created.

Among other things, the ongoing studies conducted in COMPAS focus on:

- The clinical encounter between patient and health professional
- Identifying patients with limited health literacy, few resources and a fragile social network
- Developing needs-based support
- Optimising health and lifestyle before and during treatment
- Cross-sectoral collaboration in rehabilitation and palliation

PREVENTION AND HEALTH PROMOTION MUST REACH ALL DANES

Preventing cancer risk factors is the most important action in addressing social inequality in cancer incidence. Many risk factors are increasingly unequally distributed between social groups. This increasing social differentiation of who lives with one or more unfavourable lifestyle habits and environmental factors at work and at home will eventually lead to certain cancers increasingly becoming social diseases. Health care initiatives should take into account socioeconomic differences in health literacy and barriers for health promotion.

Several research findings suggest that smoking behaviour is responsible for much of the social inequality in cancer incidence,[8] cancer survival[23] and cancer mortality[54]. One study estimates future inequality in lung cancer incidence rates towards the year 2050 based on different scenarios of smoking behaviour in the population. The study shows that major changes in smoking behaviour are needed to change inequality in lung cancer (Figure 27).[8] If the socioeconomic differences in smoking from 2005 remain unchanged, lung cancer incidence will decrease overall, but social inequality will increase, since smoking prevalence was significantly higher among people with a low socioeconomic position, as it is today (Figure 27). If only half as many people started smoking and/or if 50% more people cease smoking, social inequality would still increase. Even if there were no inequality in smoking initiation and cessation in 2020, only a modest reduction in social inequality would occur by 2050.[8]

This emphasises the importance of ensuring that prevention and health promotion initiatives reach all socioeconomic groups. Levelling the social gradient in unfavourable lifestyle factors could not only influence the incidence of potentially preventable cancers, but also reduce social inequality in other major public health diseases. This in turn will affect both public health and inequality in health. A general reduction in social inequality in health could also – in theory – reduce the large social inequality seen among cancer patients suffering from other diseases, which has a major impact on cancer prognosis.

Figure 27
Age-adjusted risk of lung cancer (RR) among people with short versus long education, under different smoking behaviour scenarios, Denmark, 2005-2050

Data source
Menvielle et al. (2010)[8]

Smoking initiation changes
50% reduction in the number of new smokers by 2020

Smoking cessation changes
50% increase in smoking cessation by 2020.

Combined
50% reduction in new smokers by 2020 and 50% increase in cessation rates by 2020

Smoothing
People with short education will have the same smoking initiation and cessation rates in 2020 as people who had long education had in 2005

IMPACT OF SMOKING BEHAVIOUR CHANGE ON SOCIAL INEQUALITY IN LUNG CANCER

TRANSITIONS IN A COMPLEX HEALTHCARE SYSTEM – NAVIGATION

Although in principle everyone has free and equal access to the Danish healthcare system, we see systematic differences in prognosis for cancer patients. The literature shows that significant differences between patient groups can be described throughout the cancer trajectory. Especially in the transitions from one health sector to another, from one department to another, from treatment to rehabilitation and return to work, etc. there is a risk that patients with fewer resources fare less well than more socially advantaged cancer patients.

This does not mean that all cancer patients with short education fare poorly and vice versa, but when considering at cancer patients at the group level, strong and substantial differences are observed throughout the cancer trajectory.

It is important to realise that patients' prerequisites for understanding, relating to and completing a cancer treatment programme vary. Patients who have other comorbid conditions, a fragile network, who live far from the hospital, have no one to drive them, or have difficulty understanding what the doctor says (low health literacy) are more vulnerable in a highly specialised and highly efficient hospital system – but also more vulnerable in terms of navigating the transition between hospital departments and from hospital to municipality health care and GP.

There are a number of good initiatives in this area to support patients in these transitions, such as patient-centred care and ongoing needs assessment. It should be ensured that these measures – and other health initiatives – are implemented systematically, and that there is an ongoing evaluation of who uses and benefits from these intiatives, so that inequality in the cancer trajectory and in health in general does not continue to increase.

NAVIGATE: Individualised support for lung cancer care

The Danish randomised intervention study NAVIGATE is testing whether an individualised nursing intervention in combination with patient-reported symptoms and physical exercise can improve survival, treatment participation, symptoms and quality of life among vulnerable lung cancer patients. Vulnerable patients are identified using a screening instrument that incorporates both cancer-related and patient-reported social vulnerability factors. If the patient screens as vulnerable, participation in the randomised trial is offered. The intervention consists of support from a navigator nurse for 12 months, who will continuously help with symptom management and motivate the patient to complete the treatment and participate in an exercise programme supervised by a physiotherapist.[239] NAVIGATE is a COMPAS project.

Family navigator: Support for parents of children with cancer

A Danish intervention study of a family navigator aimed at supporting patients through their child's stem cell transplantation found four main issues for families: the emotional strain, reorganisation the family's daily life, the additional financial burden and navigation of the welfare system. Parents with short education, low income, minority background or who live alone had more difficulties coping with these issues and a greater need for intervention sessions.[240]

Identifying vulnerable patients

A pilot study has tested a screening tool that could identify vulnerable patients diagnosed with head and neck cancer. Among 212 patients, 35% were identified as potentially vulnerable, mainly because they lacked social support or needed extra help to communicate with health professionals. In a subsequent interview study, healthcare professionals felt that the screening tool helped them legitimise the need for the extra effort being made for these patients. Some described that the tool helped them to identify vulnerable patients they would not have otherwise self-assessed as vulnerable, while others were more critical of the need and impact of the screening tool. Furthermore, concerns were raised that the screening tool could lead to stigmatisation of patients and that the focus would shift from the system's shortcomings to the individual patient's.[241]

Photo: Lars Bertelsen

8

Literature & Appendices

BIBLIOGRAPHY

1. Kræftens Bekæmpelse (2022). *Kræft i Danmark 2022*. Kræftens Bekæmpelse.

2. de la Cour CD, Munk C, Aalborg GL, Kjaer SK. Base of tongue/tonsillar and laryngeal cancer in Denmark 1994-2018: Temporal trends in incidence according to education and age. *Oral Oncol.* 2022;128:105832.

3. Erikson MS, Petersen AC, Andersen KK, et al. National incidence and survival of patients with non-invasive papillary urothelial carcinoma: a Danish population study. *Scandinavian journal of urology.* 2018;52(5-6):364-370.

4. Meijer M, Bloomfield K, Engholm G. Neighbourhoods matter too: the association between neighbourhood socio-economic position, population density and breast, prostate and lung cancer incidence in Denmark between 2004 and 2008. *J Epidemiol Community Health.* 2013;67(1):6-13.

5. Hvidtfeldt UA, Lange T, Andersen I, et al. Educational differences in postmenopausal breast cancer—quantifying indirect effects through health behaviors, body mass index and reproductive patterns. *PLoS One.* 2013;8(10):e78690.

6. Larsen SB, Olsen A, Lynch J, et al. Socio-economic position and lifestyle in relation to breast cancer incidence among postmenopausal women: a prospective cohort study, Denmark, 1993-2006. *Cancer Epidemiol.* 2011;35(5):438-441.

7. Steding-Jessen M, Birch-Johansen F, Jensen A, Schuz J, Kjaer SK, Dalton SO. Socioeconomic status and non-melanoma skin cancer: a nationwide cohort study of incidence and survival in Denmark. *Cancer Epidemiol.* 2010;34(6):689-695.

8. Menvielle G, Soerjomataram I, de Vries E, et al. Scenarios of future lung cancer incidence by educational level: Modelling study in Denmark. *Eur J Cancer.* 2010;46(14):2625-2632.

9. Schmidt LS, Nielsen H, Schmiedel S, Johansen C. Social inequality and incidence of and survival from tumours of the central nervous system in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):2050-2057.

10. Roswall N, Olsen A, Christensen J, Rugbjerg K, Mellemkjaer L. Social inequality and incidence of and survival from Hodgkin lymphoma, non-Hodgkin lymphoma and leukaemia in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):2058-2073.

11. Marsa K, Johnsen NF, Bidstrup PE, Johannesen-Henry CT, Friis S. Social inequality and incidence of and survival from male genital cancer in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):2018-2029.

12. Jensen KE, Hannibal CG, Nielsen A, et al. Social inequality and incidence of and survival from cancer of the female genital organs in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):2003-2017.

13. Eriksen KT, Petersen A, Poulsen AH, Deltour I, Raaschou-Nielsen O. Social inequality and incidence of and survival from cancers of the kidney and urinary bladder in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):2030-2042.

14. Egeberg R, Halkjaer J, Rottmann N, Hansen L, Holten I. Social inequality and incidence of and survival from cancers of the colon and rectum in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):1978-1988.

15. Dalton SO, Steding-Jessen M, Engholm G, Schuz J, Olsen JH. Social inequality and incidence of and survival from lung cancer in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):1989-1995.

16. Carlsen K, Hoybye MT, Dalton SO, Tjonneland A. Social inequality and incidence of and survival from breast cancer in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):1996-2002.

17. Baastrup R, Sorensen M, Hansen J, Hansen RD, Wurtzen H, Winther JF. Social inequality and incidence of and survival from cancers of the oesophagus, stomach and pancreas in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):1962-1977.

18. Birch-Johansen F, Hvilsom G, Kjaer T, Storm H. Social inequality and incidence of and survival from malignant melanoma in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):2043-2049.

19. Andersen ZJ, Lassen CF, Clemmensen IH. Social inequality and incidence of and survival from cancers of the mouth, pharynx and larynx in a population-based study in Denmark, 1994-2003. *Eur J Cancer.* 2008;44(14):1950-1961.

20. Erdmann F, Hvidtfeldt UA, Dalton SO, Sørensen M, Raaschou-Nielsen O. Individual and neighbourhood socioeconomic measures and the risk of non-central nervous system solid tumours in children: A nationwide register-based case-control study in Denmark. *Cancer Epidemiol.* 2021;73:101947.

21. Erdmann F, Hvidtfeldt UA, Feychting M, Sørensen M, Raaschou-Nielsen O. Is the risk of childhood leukaemia associated with socioeconomic measures in Denmark? A nationwide register-based case-control study. *Int J Cancer.* 2021;148(9):2227-2240.

22. Erdmann F, Hvidtfeldt UA, Sørensen M, Raaschou-Nielsen O. Socioeconomic differences in the risk of childhood central nervous system tumors in Denmark: a nationwide register-based case-control study. *Cancer Causes Control.* 2020;31:915-929.

23. Olsen MH, Frederiksen K, Lassen P, et al. Association of Smoking, Comorbidity, Clinical Stage, and Treatment Intent With Socioeconomic Differences in Survival After Oropharyngeal Squamous Cell Carcinoma in Denmark. *JAMA network open.* 2022;5(12):e2245510.

24. Lauritsen TB, Østgård LSG, Grønbaek K, Dalton SO, Nørgaard JM. Socioeconomic position and clinical outcomes in patients with myelodysplastic syndromes: A population-based cohort study. *Hematol Oncol.* 2022;40(5):1056-1066.

25. Faber MT, Horsbøl TA, Baandrup L, Dalton SO, Kjaer SK. Trends in survival of epithelial ovarian/tubal cancer by histology and socioeconomic status in Denmark 1996-2017. *Gynecol Oncol.* 2022;164(1):98-104.

26. Hjorth CF, Damkier P, Ejlertsen B, Lash T, Sørensen HT, Cronin-Fenton D. Socioeconomic position and prognosis in premenopausal breast cancer: a population-based cohort study in Denmark. *BMC Med.* 2021;19:235.

27. Baandrup L, Dehlendorff C, Hertzum-Larsen R, Hannibal CG, Kjaer SK. Prognostic impact of socioeconomic status on long-term survival of non-localized epithelial ovarian cancer – The Extreme study. *Gynecol Oncol.* 2021;161(2):458-462.

28. Baekhøj Kortsen D, Predbjørn Krarup K, Jakobsen JK. DaPeCa-9 - cohabitation and socio-economic conditions predict penile cancer-specific survival in a national clinical study from Denmark. *Scandinavian journal of urology.* 2021;55(6):486-490.

29. Raedkjaer M, Maretty-Kongstad K, Baad-Hansen T, et al. The association between socioeconomic position and tumour size, grade, stage, and mortality in Danish sarcoma patients - A national, observational study from 2000 to 2013. *Acta Oncol.* 2020;59(2):127-133.

30. Mosgaard BJ, Meaidi A, Hogdall C, Noer MC. Risk factors for early death among ovarian cancer patients: a nationwide cohort study. *J Gynecol Oncol.* 2020;31(3):e30.

31. Engberg H, Steding-Jessen M, Øster I, Jensen JW, Fristrup CW, Møller H. Regional and socio-economic variation in survival after a pancreatic cancer diagnosis in Denmark. *Dan Med J.* 2020;67(2):A08190438.

32. Degett TH, Christensen J, Thomsen LA, Iversen LH, Gogenur I, Dalton SO. Nationwide cohort study of the impact of education, income and social isolation on survival after acute colorectal cancer surgery. *BJS Open.* 2020;4:133-144.

33. Dalton SO, Olsen MH, Johansen C, Olsen JH, Andersen KK. Socioeconomic inequality in cancer survival - changes over time. A population-based study, Denmark, 1987-2013. *Acta Oncol.* 2019;58(5):737-744.

34. Arboe B, Halgren Olsen M, Duun-Henriksen AK, et al. Prolonged hospitalization, primary refractory disease, performance status and age are prognostic factors for survival in patients with diffuse large B-cell lymphoma and transformed indolent lymphoma undergoing autologous stem cell transplantation. *Leuk Lymphoma.* 2018;59(5):1153-1162.

35. Ostgard LSG, Norgaard M, Medeiros BC, et al. Effects of Education and Income on Treatment and Outcome in Patients With Acute Myeloid Leukemia in a Tax-Supported Health Care System: A National Population-Based Cohort Study. *J Clin Oncol.* 2017;35(32):3678-3687.

36. Larsen SB, Brasso K, Christensen J, et al. Socioeconomic position and mortality among patients with prostate cancer: influence of mediating factors. *Acta Oncol.* 2017;56(4):563-568.

37. Seidelin UH, Ibfelt E, Andersen I, et al. Does stage of cancer, comorbidity or lifestyle factors explain educational differences in survival after endometrial cancer? A cohort study among Danish women diagnosed 2005-2009. *Acta Oncol.* 2016;55(6):680-685.

38. Larsen SB, Kroman N, Ibfelt EH, Christensen J, Tjonneland A, Dalton SO. Influence of metabolic indicators, smoking, alcohol and socioeconomic position on mortality after breast cancer. *Acta Oncol.* 2015;54(5):780-788.

39. Ibfelt EH, Dalton SO, Hogdall C, et al. Do stage of disease, comorbidity or access to treatment explain socioeconomic differences in survival after ovarian cancer? - A cohort study among Danish women diagnosed 2005-2010. *Cancer Epidemiol.* 2015;39(3):353-359.

40. Dalton SO, Steding-Jessen M, Jakobsen E, et al. Socioeconomic position and survival after lung cancer: Influence of stage, treatment and comorbidity among Danish patients with lung cancer diagnosed in 2004-2010. *Acta Oncol.* 2015;54(5):797-804.

41. Ibfelt EH, Kjaer SK, Hogdall C, et al. Socioeconomic position and survival after cervical cancer: influence of cancer stage, comorbidity and smoking among Danish women diagnosed between 2005 and 2010. *Br J Cancer.* 2013;109(9):2489-2495.

42. Frederiksen BL, Dalton SO, Osler M, Steding-Jessen M, de Nully Brown P. Socioeconomic position, treatment, and survival of non-Hodgkin lymphoma in Denmark - a nationwide study. *Br J Cancer.* 2012;106(5):988-995.

43. Frederiksen BL, Osler M, Harling H, Ladelund S, Jorgensen T. The impact of socioeconomic factors on 30-day mortality following elective colorectal cancer surgery: a nationwide study. *Eur J Cancer.* 2009;45(7):1248-1256.

44. Frederiksen BL, Osler M, Harling H, Ladelund S, Jorgensen T. Do patient characteristics, disease, or treatment explain social inequality in survival from colorectal cancer? *Soc Sci Med.* 2009;69(7):1107-1115.

45. Simony SB, Lund LW, Erdmann F, et al. Effect of socioeconomic position on survival after childhood cancer in Denmark. *Acta Oncol.* 2016;55(6):742-750.

46. Erdmann F, Winther JF, Dalton SO, et al. Survival from tumours of the central nervous system in Danish children: Is survival related to family circumstances? *Int J Cancer.* 2018;142(4):671-680.

47. Jensen A, Greisen G, Stensballe LG. Socioeconomic background affects mortality in Danish children with severe chronic disease. *Acta Paediatr.* 2022;111(12):2393-2399.

48. Dalton SO, Schuz J, Engholm G, et al. Social inequality in incidence of and survival from cancer in a population-based study in Denmark, 1994-2003: Summary of findings. *Eur J Cancer.* 2008;44(14):2074-2085.

49. Olsen MH, Kjær TK, Dalton SO (2019). *Hvidbog Social Ulighed I Kræft I Danmark*. Kræftens Bekæmpelse.

50. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 1). *J Epidemiol Community Health.* 2006;60(1):7-12.

51. Diderichsen F, (2022) *Responsum til 2. udgave af hvidbogen om social ulighed i kræft i Danmark*, Kræftens Bekæmpelse.

52. Diderichsen F, Andersen I, Manuel C et. al. (2012). "Health inequality-determinants and policies." Scand J Public Health. 2012;40(Suppl 8):12-105.

53. Diderichsen F, Hallqvist J, Whitehead M. Differential vulnerability and susceptibility: how to make use of recent development in our understanding of mediation and interaction to tackle health inequalities. *Int J Epidemiol.* 2018;48(1):268-274.

54. Nordahl H, Lange T, Osler M, et al. Education and cause-specific mortality: the mediating role of differential exposure and vulnerability to behavioral risk factors. *Epidemiology.* 2014;25(3):389-396.

55. Aaby A, Meldgaard M, Maindal HT (2022). *Sundhedskompetence i det danske sundhedsvæsen. En vej til mere lighed.* Sundhedsstyrelsen.

56. PubMed. https://pubmed.ncbi.nlm.nih.gov/. (lokaliseret 20. marts 2023).

57. Danmarks Statistik. Statistikbanken. Befolkningens højest fuldførte uddannelse (15-69 år). https://www.statistikbanken.dk/HFUDD11 (lokaliseret 20. marts 2023)

58. Tybjerg AJ, Friis S, Brown K, Nilbert MC, Morch L, Koster B. Updated fraction of cancer attributable to lifestyle and environmental factors in Denmark in 2018. *Sci Rep.* 2022;12(1):549.

59. Jensen HAR, Davidsen M, Møller SR, Ibáñez Román JE, Kragelund K, Christensen AI, Ekholm O (2022). *Danskernes sundhed – Den Nationale Sundhedsprofil 2021.* Sundhedsstyrelsen.

60. Hoffmann SH, Schramm S, Jarlstrup NS, Christensen AI (2018). *Danskernes rygevaner Udvikling fra 1994 til 2017.* Sundhedsstyrelsen.

61. Rosenwein SV, Jørgensen MB, Schramm S (2019). *Danskernes rygevaner årsrapport 2018.* Sundhedsstyrelsen.

62. Lund L, Bast LS (2021). *Danskernes Rygevaner 2020.* Sundhedsstyrelsen.

63. Jarlstrup NS, Pedersen MT, Bast LS (2023). *Danskernes rygevaner 2022.* Sundhedsstyrelsen.

64. Pedersen MT, Lund L, Bast LS (2022). *Brug af røgfri nikotinprodukter blandt unge.* Sundhedsstyrelsen.

65. Pisinger V, Thorsted A, Jezek AH, Jørgensen A, Christensen AI, Thygesen LC (2019). *UNG19 - Sundhed og trivsel på gymnasiale uddannelser 2019.* Statens Institut for Folkesundhed, SDU.

66. Ringgaard LW, Heinze C, Andersen BSA, Hansen GIL, Hjort AV, Klinker CD (2019). *UNG19 - Sundhed og trivsel på erhvervsuddannelser 2019.* Steno Diabetes Center Copenhagen, Hjerteforeningen og Kræftens Bekæmpelse.

67. Pedersen JE, Hansen J. Colorectal cancer and occupational exposure to solar ultraviolet B radiation in Denmark. *Environ Res.* 2022;215:114260.

68. Alfonso JH, Martinsen JI, Weiderpass E, et al. Occupation and cutaneous melanoma: a 45-year historical cohort study of 14·9 million people in five Nordic countries. *Br J Dermatol.* 2021;184(4):672-680.

69. Ugelvig Petersen K, Pukkala E, Martinsen JI, et al. Cancer incidence among seafarers and fishermen in the Nordic countries. *Scand J Work Environ Health.* 2020;46(5):461-468.

70. Volk J, Heck JE, Schmiegelow K, Hansen J. Risk of selected childhood cancers and parental employment in painting and printing industries: A register-based case–control study in Denmark 1968-2015. *Scand J Work Environ Health.* 2019;45(5):475-482.

71. Petersen KU, Pedersen JE, Bonde JP, Ebbehoej NE, Hansen J. Long-term follow-up for cancer incidence in a cohort of Danish firefighters. *Occup Environ Med.* 2018;75(4):263-269.

72. Ugelvig Petersen K, Volk J, Kaerlev L, Lyngbeck Hansen H, Hansen J. Cancer incidence among merchant seafarers: an extended follow-up of a Danish cohort. *Occup Environ Med.* 2018;75(8):582-585.

73. Hansen J. Night Shift Work and Risk of Breast Cancer. *Current environmental health reports.* 2017;4(3):325-339.

74. Heikkila K, Nyberg ST, Madsen IE, et al. Long working hours and cancer risk: a multi-cohort study. *Br J Cancer.* 2016;114(7):813-818.

75. Reijula J, Kjaerheim K, Lynge E, et al. Cancer incidence among waiters: 45 years of follow-up in five Nordic countries. *Scandinavian journal of public health.* 2015;43(2):204-211.

76. Hansen J, Lassen CF. Nested case-control study of night shift work and breast cancer risk among women in the Danish military. *Occup Environ Med.* 2012;69(8):551-556.

77. Parkin DM, Boyd L, Walker LC. 16. The fraction of cancer attributable to lifestyle and environmental factors in the UK in 2010. *Br J Cancer.* 2011;105(S2):S77-81.

78. Menvielle G, Boshuizen H, Kunst AE, et al. Occupational exposures contribute to educational inequalities in lung cancer incidence among men: Evidence from the EPIC prospective cohort study. *Int J Cancer.* 2010;126(8):1928-1935.

79. Hansen J, Stevens RG. Case-control study of shift-work and breast cancer risk in Danish nurses: impact of shift systems. *Eur J Cancer.* 2012;48(11):1722-1729.

80. Kjaerheim K, Martinsen JI, Lynge E, et al. Effects of occupation on risks of avoidable cancers in the Nordic countries. *Eur J Cancer.* 2010;46(14):2545-2554.

81. Pizzato M, Martinsen JI, Heikkinen S, et al. Socioeconomic status and risk of lung cancer by histological subtype in the Nordic countries. *Cancer medicine.* 2022;11:1850-1859.

82. Hansen J, Tinggaard M, Mikkelsen P, et al. (2010) *Kortlægning af risiko for kræft (1970-2003) blandt ansatte i Danmark.* Institut for Epidemiologisk Kræftforskning, Kræftens Bekæmpelse.

83. IARC. Europæisk Kodeks Mod Kræft. http://cancer-code-europe.iarc.fr/index.php/da/ (Lokaliseret 20. marts 2023).

84. Raaschou-Nielsen O, Andersen ZJ, Beelen R, et al. Air pollution and lung cancer incidence in 17 European cohorts: prospective analyses from the European Study of Cohorts for Air Pollution Effects (ESCAPE). *The Lancet Oncology.* 2013;14(9):813-822.

85. Raaschou-Nielsen O, Bak H, Sorensen M, et al. Air pollution from traffic and risk for lung cancer in three Danish cohorts. *Cancer Epidemiol Biomarkers Prev.* 2010;19(5):1284-1291.

86. Darby S, Hill D, Auvinen A, et al. Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies. *BMJ.* 2005;330:223.

87. Raaschou-Nielsen O, Taj T, Poulsen AH, et al. Air pollution at the residence of Danish adults, by socio-demographic characteristics, morbidity, and address level characteristics. *Environ Res.* 2022;208:112714.

88. Brauner EV, Andersen CE, Sorensen M, et al. Residential radon and lung cancer incidence in a Danish cohort. *Environ Res.* 2012;118:130-136.

89. Meyer MKH, Christensen ASP, Tolstrup JS, Dalum P, Koster B. Association between sunburn and demographic factors and health behaviour among Danish students. *Prev Med.* 2019;118:92-97.

90. Koster B, Meyer M, Andersson T, Engholm G, Dalum P. Development in sunburn 2007-2015 and skin cancer projections 2007-2040 of campaign results in the Danish population. *Medicine.* 2018;97(41):e12738.

91. Meyer MKH, Koster B, Juul L, et al. Sunbed use among 64,000 Danish students and the associations with demographic factors, health-related behaviours, and appearance-related factors. *Prev Med.* 2017;100:17-24.

92. Koster B, Thorgaard C, Clemmensen IH, Philip A. Sunbed use in the Danish population in 2007: a cross-sectional study. *Prev Med.* 2009;48(3):288-290.

93. Meyer MKH, Lundgaard PB, Lund S (2021). *Danskernes solvaner i sommerferien 2020.* Kræftens Bekæmpelse og TryghedsGruppen smba (TryghedsGruppen smba).

94. Meyer MKH, Lundgaard PB, Køster B (2021). *Danskernes solarievaner 2020.* Kræftens Bekæmpelse og TrygFonden smba (TryghedsGruppen smba).

95. Grandahl K, Ibler KS, Laier GH, Mortensen OS. Skin cancer risk perception and sun protection behavior at work, at leisure, and on sun holidays: a survey for Danish outdoor and indoor workers. *Environ Health Prev Med.* 2018;23:47.

96. Holm M, Olsen A, Kyro C, Overvad K, Kroman N, Tjonneland A. The Influence of Menopausal Hormone Therapy and Potential Lifestyle Interactions in Female Cancer Development-a Population-Based Prospective Study. *Horm Cancer.* 2018;9(4):254-264.

97. Johansen LL, Thinggaard M, Hallas J, Osler M, Christensen K. Postmenopausal hormone therapy and mortality before and after the Women's Health Initiative study. *Sci Rep.* 2023;13(1):539.

98. Nielsen A, Munk C, Jorgensen HO, Winther JF, van den Brule AJ, Kjaer SK. Multiple-type human papillomavirus infection in younger uncircumcised men. *Int J STD AIDS.* 2013;24(2):128-133.

99. Rosenstock SJ, Andersen LP, Rosenstock CV, Bonnevie O, Jorgensen T. Socioeconomic factors in Helicobacter pylori infection among Danish adults. *Am J Public Health.* 1996;86(11):1539-1544.

100. Sundhedsstyrelsen (2022). *Statusrapport Børnevaccinationsprogrammet 2019-2021.* Sundhedsstyrelsen.

101. Badre-Esfahani S, Larsen MB, Seibæk L, Petersen LK, Blaakær J, Andersen B. Low attendance by non-native women to human papillomavirus vaccination and cervical cancer screening - A Danish nationwide register-based cohort study. *Preventive medicine reports.* 2020;19:101106.

102. Hertzum-Larsen R, Thomsen LT, Frederiksen K, Kjaer SK. Human papillomavirus vaccination in immigrants and descendants of immigrants in Denmark. *Eur J Cancer Prev.* 2020;29(2):149-156.

103. Bollerup S, Baldur-Felskov B, Dehlendorff C, Kjaer SK. Socioeconomic predictors of human papillomavirus vaccination in Danish men - A nationwide study. *Papillomavirus Res.* 2017;3:8-23.

104. Slattelid Schreiber SM, Juul KE, Dehlendorff C, Kjaer SK. Socioeconomic predictors of human papillomavirus vaccination among girls in the Danish childhood immunization program. *J Adolesc Health.* 2015;56(4):402-407.

105. Badre-Esfahani S, Larsen MB, Seibæk L, et al. Non-Adherence To Childhood HPV Vaccination Is Associated With Non-Participation In Cervical Cancer Screening - A Nationwide Danish Register-Based Cohort Study. *Clin Epidemiol.* 2019;11:969-980.

106. Voss SS, Nørgaard SK, Chaine M, Valentiner-Branth P (2021). *Hvilke grupper af børn har behov for en målrettet vaccinationsindsats? Determinanter for lav dækning af vacciner omfattet af det danske børnevaccinationsprogram.* Statens Serum Institut.

107. Suppli CH, Dreier JW, Rasmussen M, et al. Sociodemographic predictors are associated with compliance to a vaccination-reminder in 9692 girls age 14, Denmark 2014-2015. *Preventive medicine reports.* 2018;10:93-99.

108. Hvidberg L, Pedersen AF, Wulff CN, Vedsted P. Cancer awareness and socio-economic position: results from a population-based study in Denmark. *BMC Cancer.* 2014;14:581.

109. Thomsen KL, Christensen ASP, Meyer MKH. Awareness of alcohol as a risk factor for cancer: A population-based cross-sectional study among 3000 Danish men and women. *Preventive medicine reports.* 2020;19:101156.

110. Lourenço S, Lund S, Lundgaard PB, Christensen ASP, Hejgaard T, Nielsen KA, Iken MK, Thybo T, Lind M, Selberg N (2021). *Danskernes viden om og holdninger til overvægt og sundhed 2021.* Kræftens Bekæmpelse, Sundhedsstyrelsen, Diabetesforeningen og Hjerteforeningen

111. Hajdarevic S, Hvidberg L, Lin Y, et al. Awareness of sunburn in childhood, use of sunbeds and change of moles in Denmark, Northern Ireland, Norway and Sweden. *Eur J Public Health.* 2016;26(1):29-35.

112. Merrild CH, Andersen RS, Risor MB, Vedsted P. Resisting "Reason": A Comparative Anthropological Study of Social Differences and Resistance toward Health Promotion and Illness Prevention in Denmark. *Med Anthropol Q.* 2017;31(2):218-236.

113. Karlsen RV, Larsen SB, Christensen J, et al. PSA testing without clinical indication for prostate cancer in relation to sociodemographic and clinical characteristics in the Danish Diet, Cancer and Health Study. *Acta Oncol.* 2013;52(8):1609-1614.

114. Lerhmann-Lerche CS, Larsen SB, Andersen I, et al. Educational level and first-time PSA testing in general practice. *Scandinavian journal of urology.* 2019;53(5):275-281.

115. Nordsborg RB, Meliker JR, Ersboll AK, Jacquez GM, Poulsen AH, Raaschou-Nielsen O. Space-time clusters of breast cancer using residential histories: a Danish case-control study. *BMC Cancer.* 2014;14:255-255.

116. Rod NH, Lange T, Andersen I, Marott JL, Diderichsen F. Additive interaction in survival analysis: use of the additive hazards model. *Epidemiology.* 2012;23(5):733-737.

117. Sondergaard G, Mortensen LH, Andersen AM, Andersen PK, Dalton SO, Osler M. Social inequality in breast, lung and colorectal cancers: a sibling approach. *BMJ open.* 2013;3:e002114.

118. Madsen M, Andersen PK, Gerster M, Nybo Andersen AM, Christensen K, Osler M. Does the association of education with breast cancer replicate within twin pairs? A register-based study on Danish female twins. *Br J Cancer.* 2011;104(3):520-523.

119. Kristensson JH, Sander BB, von Euler-Chelpin M, Lynge E. Predictors of non-participation in cervical screening in Denmark. *Cancer Epidemiol.* 2014;38(2):174-180.

120. Harder E, Juul KE, Jensen SM, Thomsen LT, Frederiksen K, Kjaer SK. Factors associated with non-participation in cervical cancer screening - A nationwide study of nearly half a million women in Denmark. *Prev Med.* 2018;111:94-100.

121. Kristiansen BK, Andersen B, Bro F, Svanholm H, Vedsted P. Impact of GP reminders on follow-up of abnormal cervical cytology: a before-after study in Danish general practice. *Br J Gen Pract.* 2017;67(661):e580-e587.

122. Udesen CH, Skaarup C, Petersen MNS, Ersbøll AK (2020). *Social ulighed i sundhed og sygdom - Udviklingen i Danmark i perioden 2010–2017.* Sundhedsstyrelsen.

123. Hertzum-Larsen R, Kjær SK, Frederiksen K, Thomsen LT. Participation in cervical cancer screening among immigrants and Danish-born women in Denmark. *Prev Med.* 2019;123:55-64.

124. Hertzum-Larsen R, Kjær SK, Frederiksen K, Thomsen LT. Follow-up after abnormal cervical cancer screening in immigrants compared with Danish-born women - A nationwide register study. *Prev Med.* 2021;153:106776.

125. Olesen TB, Jensen H, Møller H, Jensen JW, Waldstrøm M, Andersen B. Participation in the nationwide cervical cancer screening programme in Denmark during the COVID-19 pandemic: An observational study. *eLife.* 2023;12.

126. von Euler-Chelpin M, Olsen AH, Njor S, et al. Does educational level determine screening participation? *Eur J Cancer Prev.* 2008;17(3):273-278.

127. von Euler-Chelpin M, Olsen AH, Njor S, Vejborg I, Schwartz W, Lynge E. Socio-demographic determinants of participation in mammography screening. *Int J Cancer.* 2008;122(2):418-423.

128. Kjellen M, von Euler-Chelpin M. Socio-economic status as determinant for participation in mammography screening: assessing the difference between using women's own versus their partner's. *International journal of public health.* 2010;55(3):209-215.

129. Jensen LF, Pedersen AF, Andersen B, Vedsted P. Identifying specific non-attending groups in breast cancer screening - population-based registry study of participation and socio-demography. *BMC Cancer.* 2012;12:518-518.

130. Kristiansen M, Thorsted BL, Krasnik A, von Euler-Chelpin M. Participation in mammography screening among migrants and non-migrants in Denmark. *Acta Oncol.* 2012;51(1):28-36.

131. Jensen LF, Pedersen AF, Andersen B, Fenger-Gron M, Vedsted P. Distance to screening site and non-participation in screening for breast cancer: a population-based study. *J Public Health.* 2014;36(2):292-299.

132. Frederiksen BL, Jorgensen T, Brasso K, Holten I, Osler M. Socioeconomic position and participation in colorectal cancer screening. *Br J Cancer.* 2010;103(10):1496-1501.

133. Pallesen AVJ, Herrstedt J, Westendorp RGJ, Mortensen LH, Kristiansen M. Differential effects of colorectal cancer screening across sociodemographic groups in Denmark: a register-based study. *Acta Oncol.* 2021;60(3):323-332.

134. Deding U, Henig AS, Hindersson P, Torp-Pedersen C, Bøggild H. Determinants of non-participation in colon examination following positive stool sample in colorectal cancer screening. *Eur J Public Health.* 2019;29(6):1118-1124.

135. Deding U, Henig AS, Torp-Pedersen C, Bøggild H. The effects of reminders for colorectal cancer screening: participation and inequality. *Int J Colorectal Dis.* 2019;34(1):141-150.

136. Larsen MB, Mikkelsen EM, Rasmussen M, et al. Sociodemographic characteristics of nonparticipants in the Danish colorectal cancer screening program: a nationwide cross-sectional study. *Clin Epidemiol.* 2017;9:345-354.

137. Deding U, Henig AS, Salling A, Torp-Pedersen C, Boggild H. Sociodemographic predictors of participation in colorectal cancer screening. *Int J Colorectal Dis.* 2017;32(8):1117-1124.

138. Skau B, Deding U, Kaalby L, Baatrup G, Kobaek-Larsen M, Al-Najami I. Odds of Incomplete Colonoscopy in Colorectal Cancer Screening Based on Socioeconomic Status. *Diagnostics.* 2022;12:171.

139. Deding U, Torp-Pedersen C, Boggild H. The association between immigration status and ineligible stool samples for colorectal cancer screening. *Cancer Epidemiol.* 2018;57:74-79.

140. Ibfelt E, Kjær SK, Johansen C, et al. Socioeconomic position and stage of cervical cancer in Danish women diagnosed 2005 to 2009. *Cancer Epidemiology Biomarkers and Prevention.* 2012;21(5):835-842.

141. Harder E, Thomsen LT, Hertzum-Larsen R, et al. Determinants for participation in human papillomavirus self-sampling among non-attenders to cervical cancer screening in Denmark. *Cancer Epidemiol Biomarkers Prev.* 2018(11). 1342-1351

142. Tranberg M, Bech BH, Blaakaer J, Jensen JS, Svanholm H, Andersen B. HPV self-sampling in cervical cancer screening: the effect of different invitation strategies in various socioeconomic groups - a randomized controlled trial. *Clin Epidemiol.* 2018;10:1027-1036.

143. Kristiansen BK, Andersen B, Bro F, Svanholm H, Vedsted P. Direct notification of cervical cytology results to women improves follow-up in cervical cancer screening - A cluster-randomised trial. *Preventive medicine reports.* 2019;13:118-125.

144. Gabel P, Edwards A, Kirkegaard P, Larsen MB, Andersen B. The LEAD trial-The effectiveness of a decision aid on decision making among citizens with lower educational attainment who have not participated in FIT-based colorectal cancer screening in Denmark: A randomised controlled trial. *Patient Educ Couns.* 2020;103(2):359-368.

145. Hansen RP, Olesen F, Sorensen HT, Sokolowski I, Sondergaard J. Socioeconomic patient characteristics predict delay in cancer diagnosis: a Danish cohort study. *BMC Health Serv Res.* 2008;8:49.

146. Seibaek L, Petersen LK, Blaakaer J, Hounsgaard L. Symptom interpretation and health care seeking in ovarian cancer. *BMC Womens Health.* 2011;11:31.

147. Robinson KM, Christensen KB, Ottesen B, Krasnik A. Socio-demographic factors, comorbidity and diagnostic delay among women diagnosed with cervical, endometrial or ovarian cancer. *European Journal of Cancer Care.* 2011;20(5):653-661.

148. Balasubramaniam K, Elnegaard S, Rasmussen S, et al. Lifestyle, socioeconomic status and healthcare seeking among women with gynaecological cancer alarm symptoms: a combined questionnaire-based and register-based population study. *BMJ open.* 2018;8(7):e021815.

149. Svendsen RP, Jarbol DE, Larsen PV, Stovring H, Hansen BL, Soendergaard J. Associations between health care seeking and socioeconomic and demographic determinants among people reporting alarm symptoms of cancer: a population-based cross-sectional study. *Fam Pract.* 2013;30(6):655-665.

150. Hvidberg L, Wulff CN, Pedersen AF, Vedsted P. Barriers to healthcare seeking, beliefs about cancer and the role of socioeconomic position. A Danish population-based study. *Prev Med.* 2015;71:107-113.

151. Sætre LMS, Rasmussen S, Balasubramaniam K, Søndergaard J, Jarbøl DE. A population-based study on social inequality and barriers to healthcare-seeking with lung cancer symptoms. *NPJ primary care respiratory medicine.* 2022;32(1):48.

152. Petersen GS, Laursen SGW, Jensen H, et al. Patients' health literacy is associated with timely diagnosis of cancer-A cross-sectional study in Denmark. *Eur J Cancer Care.* 2022;31(1):e13532.

153. Guldbrandt LM, Fenger-Gron M, Rasmussen TR, Jensen H, Vedsted P. The role of general practice in routes to diagnosis of lung cancer in Denmark: a population-based study of general practice involvement, diagnostic activity and diagnostic intervals. *BMC Health Serv Res.* 2015;15:21.

154. Virgilsen LF, Pedersen AF, Vedsted P, Petersen GS, Jensen H. Alignment between the patient's cancer worry and the GP's cancer suspicion and the association with the interval between first symptom presentation and referral: a cross-sectional study in Denmark. *BMC Fam Pract.* 2021;22:129.

155. Balasubramaniam K, Ravn P, Christensen RD, Sondergaard J, Jarbol DE. Gynecological cancer alarm symptoms: is contact with specialist care associated with lifestyle and socioeconomic status? A population-based study. *Acta Obstet Gynecol Scand.* 2016;95:976-983.

156. Friis Abrahamsen C, Ahrensberg JM, Vedsted P. Utilisation of primary care before a childhood cancer diagnosis: do socioeconomic factors matter?: A Danish nationwide population-based matched cohort study. *BMJ open.* 2018;8(8):e023569.

157. Pedersen LH, Erdmann F, Aalborg GL, et al. Socioeconomic position and prediagnostic health care contacts in children with cancer in Denmark: a nationwide register study. *BMC Cancer.* 2021;21:1104.

158. Dalton SO, Frederiksen BL, Jacobsen E, et al. Socioeconomic position, stage of lung cancer and time between referral and diagnosis in Denmark, 2001-2008. *Br J Cancer.* 2011;105(7):1042-1048.

159. Friis K, Lasgaard M, Osborne RH, Maindal HT. Gaps in understanding health and engagement with healthcare providers across common long-term conditions: a population survey of health literacy in 29,473 Danish citizens. *BMJ open.* 2016;6(1):e009627.

160. Kjeldsted E, Lindblad KV, Bødtcher H, et al. A population-based survey of patients' experiences with teleconsultations in cancer care in Denmark during the COVID-19 pandemic. *Acta Oncol.* 2021;60(10):1352-1360.

161. Dencker A, Tjørnhøj-Thomsen T, Pedersen PV. A qualitative study of mechanisms influencing social inequality in cancer communication. *Psychooncology.* 2021;30(11):1965-1972.

162. Ibfelt EH, Steding-Jessen M, Dalton SO, Lundstrom SL, Osler M, Holmich LR. Influence of socioeconomic factors and region of residence on cancer stage of malignant melanoma: a Danish nationwide population-based study. *Clin Epidemiol.* 2018;10:799-807.

163. Olsen MH, Bøje CR, Kjær TK, et al. Socioeconomic position and stage at diagnosis of head and neck cancer - A nationwide study from DAHANCA. *Acta Oncol.* 2015;54(5):759–766.

164. Frederiksen BL, Brown Pde N, Dalton SO, Steding-Jessen M, Osler M. Socioeconomic inequalities in prognostic markers of non-Hodgkin lymphoma: analysis of a national clinical database. *Eur J Cancer.* 2011;47(6):910-917.

165. Frederiksen BL, Osler M, Harling H, Jorgensen T. Social inequalities in stage at diagnosis of rectal but not in colonic cancer: a nationwide study. Br *J Cancer.* 2008;98(3):668-673.

166. Sogaard M, Thomsen RW, Bossen KS, Sorensen HT, Norgaard M. The impact of comorbidity on cancer survival: a review. *Clin Epidemiol.* 2013;5(Suppl 1):3-29.

167. Friberg AS, Rask Moustsen I, Benzon Larsen S, et al. Educational level and the risk of depression after prostate cancer. *Acta Oncol.* 2019;58(5):722-729.

168. Kjaer TK, Johansen C, Andersen E, et al. Influence of social factors on patient-reported late symptoms: Report from a controlled trial among long-term head and neck cancer survivors in Denmark. *Head Neck.* 2016;38:E1713-1721.

169. Hovaldt HB, Andersen I, Sandager M, et al. The role of social position in anxiety and depressive symptoms among Danish cancer survivors. *Acta Oncol.* 2015;54(5):693-703.

170. Hvidberg MF, Frølich A, Lundstrøm SL, Kamstrup-Larsen N. Catalogue of multimorbidity mean based severity and associational prevalence rates between 199+ chronic conditions-A nationwide register-based population study. *PLoS One.* 2022;17(9):e0273850.

171. Hovaldt HB, Suppli NP, Olsen MH, et al. Who are the cancer survivors? A nationwide study in Denmark, 1943-2010. *Br J Cancer.* 2015;112(9):1549-1553.

172. Winther D, Nygaard TK, Horsbol TA, et al. Associations between education and physical functioning and pain in adult Danish cancer survivors. *Acta Oncol.* 2017;56(2):348-353.

173. Pedersen LH, Østergaard A, Bank V, et al. Socioeconomic position and maintenance therapy in children with acute lymphoblastic leukemia: A national cohort study. *Pediatr Blood Cancer.* 2022;69(7):e29508.

174. Arboe B, Olsen MH, Gorlov JS, et al. Treatment intensity and survival in patients with relapsed or refractory diffuse large B-cell lymphoma in Denmark: a real-life population-based study. *Clin Epidemiol.* 2019;11:207-216.

175. Kaergaard Starr L, Osler M, Steding-Jessen M, et al. Socioeconomic position and surgery for early-stage non-small cell lung cancer: A population-based study in Denmark. *Lung Cancer.* 2013;79(3):262-269.

176. Bodilsen A, Christensen S, Christiansen P, Damsgaard TE, Zachariae R, Jensen AB. Socio-demographic, clinical, and health-related factors associated with breast reconstruction - A nationwide cohort study. *Breast* (Edinburgh, Scotland). 2015;24:560-567.

177. Hvilsom GB, Holmich LR, Frederiksen K, Steding-Jessen M, Friis S, Dalton SO. Socioeconomic position and breast reconstruction in Danish women. *Acta Oncol.* 2011;50(2):265-273.

178. Moller PK, Tolstrup JS, Olsen MH, Dalton SO, Overgaard J, Johansen J. Predictors of continuous tobacco smoking in a clinical cohort study of Danish laryngeal cancer patients smoking before treated with radiotherapy. *Acta Oncol.* 2015;54(5):685-692.

179. Friis K, Larsen FB, Nielsen CV, Momsen AH, Stapelfeldt CM. Social inequality in cancer survivors' health behaviours-A Danish population-based study. *European Journal of Cancer Care.* 2018;27(3):e12840.

180. Lange T, Hansen KW, Sorensen R, Galatius S. Applied mediation analyses: a review and tutorial. E*pidemiol Health.* 2017;39:e2017035.

181. VanderWeele TJ. Mediation Analysis: A Practitioner's Guide. *Annu Rev Public Health.* 2016;37:17-32.

182. Hindhede, A. L., et al. (2016). "How do socio-economic factors and distance predict access to prevention and rehabilitation services in a Danish municipality?" *Primary Health Care Research & Development* 17(6): 578-585.

183. Moustsen, I. R., et al. (2019). "Risk of cardiovascular events in men treated for prostate cancer compared with prostate cancer-free men." *British Journal of Cancer* 120(11): 1067-1074.

184. Sundhedsstyrelsen (2018). *Forløbsprogram for rehabilitering og palliation i forbindelse med kræft.* Sundhedsstyrelsen.

185. Kristiansen M, Adamsen L, Piil K, Halvorsen I, Nyholm N, Hendriksen C. A three-year national follow-up study on the development of community-level cancer rehabilitation in Denmark. *Scandinavian journal of public health.* 2019;47(5):511-518.

186. Holm LV, Hansen DG, Larsen PV, et al. Social inequality in cancer rehabilitation: a population-based cohort study. *Acta Oncol.* 2013;52(2):410-422.

187. Ross L, Petersen MA, Johnsen AT, Lundstrom LH, Groenvold M. Are different groups of cancer patients offered rehabilitation to the same extent? A report from the population-based study "The Cancer Patient's World". *Support Care Cancer.* 2012;20(5):1089-1100.

188. Moustsen IR, Larsen SB, Vibe-Petersen J, et al. Social position and referral to rehabilitation among cancer patients. *Acta Oncol.* 2015;54(5):720-726.

189. Hindhede AL, Bonde A, Schipperijn J, Scheuer SH, Sorensen SM, Aagaard-Hansen J. How do socio-economic factors and distance predict access to prevention and rehabilitation services in a Danish municipality? *Prim Health Care Res Dev.* 2016;17(6):578-585.

190. Oksbjerg SO, Olsen MH, Moustsen IR, Andersen CW, Vibe-Petersen J, Johansen C. Socioeconomic position, referral and attendance to rehabilitation after a cancer diagnosis: A population-based study in Copenhagen, Denmark 2010-2015. *Acta Oncol.* 2019;58(5):730-736.

191. Sampedro Pilegaard M, Knold Rossau H, Lejsgaard E, et al. Rehabilitation and palliative care for socioeconomically disadvantaged patients with advanced cancer: a scoping review. *Acta Oncol.* 2021;60(1):112-123.

192. Nissen N, Rossau HK, Pilegaard MS, la Cour K. Cancer rehabilitation and palliative care for socially vulnerable patients in Denmark: an exploration of practices and conceptualisations. *Palliative care and social practice.* 2022;16:1-14.

193. Rossen S, Kayser L, Vibe-Petersen J, Ried-Larsen M, Christensen JF. Technology in exercise-based cancer rehabilitation: a cross-sectional study of receptiveness and readiness for e-Health utilization in Danish cancer rehabilitation. *Acta Oncol.* 2019;58(5):610-618.

194. Veloso AG, Sperling C, Holm LV, et al. Unmet needs in cancer rehabilitation during the early cancer trajectory - a nationwide patient survey. *Acta Oncol.* 2013;52(2):372-381.

195. Kjær TK, karlsen R, Dalton SO, Levinsen AK, Johansen C (2017). *Vidensopsamling på senfølger efter kræft hos voksne.* Sundhedsstyrelsen.

196. Johannsen M, Christensen S, Zachariae R, Jensen AB. Socio-demographic, treatment-related, and health behavioral predictors of persistent pain 15 months and 7-9 years after surgery: a nationwide prospective study of women treated for primary breast cancer. *Breast Cancer Res Treat.* 2015;152(3):645-658.

197. Johnsen AT, Tholstrup D, Petersen MA, Pedersen L, Groenvold M. Health related quality of life in a nationally representative sample of haematological patients. *Eur J Haematol.* 2009;83(2):139-148.

198. Larsen FB, Sørensen JB, Nielsen CV, Momsen AH, Friis K, Stapelfeldt CM. Population differences in health-related quality of life between cancer survivors and controls: Does low educational attainment widen the gap? *Scandinavian journal of public health.* 2021;49(8):821-832.

199. Levinsen AKG, Dalton SO, Andersen I, et al. Association between Health-Related Quality of Life and Completion of First-Line Treatment among Lung Cancer Patients. *Cancers (Basel).* 2022;14:3343.

200. Nielsen SW, Eckhoff L, Ruhlmann CHB, Herrstedt J, Dalton SO. The prevalence, distribution and impact of peripheral neuropathy among Danish patients with cancer - a population-based cross-sectional study. *Acta Oncol.* 2022;61(3):363-370.

201. Peuckmann V, Ekholm O, Sjogren P, et al. Health care utilisation and characteristics of long-term breast cancer survivors: nationwide survey in Denmark. *Eur J Cancer.* 2009;45(4):625-633.

202. Bidstrup PE, Christensen J, Mertz BG, Rottmann N, Dalton SO, Johansen C. Trajectories of distress, anxiety, and depression among women with breast cancer: Looking beyond the mean. *Acta Oncol.* 2015;54(5):789-796.

203. Christensen S, Zachariae R, Jensen AB, et al. Prevalence and risk of depressive symptoms 3-4 months post-surgery in a nationwide cohort study of Danish women treated for early stage breast-cancer. *Breast Cancer Res Treat.* 2009;113:339-355.

204. O'Connor M, Christensen S, Jensen AB, Moller S, Zachariae R. How traumatic is breast cancer? Post-traumatic stress symptoms (PTSS) and risk factors for severe PTSS at 3 and 15 months after surgery in a nationwide cohort of Danish women treated for primary breast cancer. *Br J Cancer.* 2011;104(3):419-426.

205. Suppli NP, Johansen C, Christensen J, Kessing LV, Kroman N, Dalton SO. Increased risk for depression after breast cancer: a nationwide population-based cohort study of associated factors in Denmark, 1998-2011. *J Clin Oncol.* 2014;32(34):3831-3839.

206. Friberg AS, Brasso K, Larsen SB, et al. Risk of depression after diagnostic prostate cancer workup - A nationwide, registry-based study. *Psychooncology.* 2021;30(11):1939-1947.

207. Dieperink KB, Hansen S, Wagner L, Johansen C, Andersen KK, Hansen O. Living alone, obesity and smoking: important factors for quality of life after radiotherapy and androgen deprivation therapy for prostate cancer. *Acta Oncol.* 2012;51(6):722-729.

208. Lund LW, Winther JF, Cederkvist L, et al. Increased risk of antidepressant use in childhood cancer survivors: a Danish population-based cohort study. *Eur J Cancer.* 2015;51(5):675-684.

209. von Heymann-Horan AB, Bidstrup PE, Kristiansen LC, et al. Equity in the use of publicly subsidized psychotherapy among elderly Danish cancer patients - a register-based cohort study. *Acta Oncol.* 2013;52(2):355-363.

210. Kolodziejczyk C, Heinesen E. Labour market participation after breast cancer for employees from the private and public sectors: Educational and sector gradients in the effect of cancer. *Econ Hum Biol.* 2016;21:33-55.

211. Thielen K, Kolodziejczyk C, Andersen I, Heinesen E, Diderichsen F. Cancer stage, comorbidity, and socioeconomic differences in the effect of cancer on labour market participation: a danish register-based follow-up study. *PLoS One.* 2015;10(6):e0128621.

212. Lindbohm ML, Kuosma E, Taskila T, et al. Early retirement and non-employment after breast cancer. *Psychooncology.* 2014;23(6):634-641.

213. Carlsen K, Ewertz M, Dalton SO, Badsberg JH, Osler M. Unemployment among breast cancer survivors. *Scandinavian journal of public health.* 2014;42(3):319-328.

214. Kjaer T, Boje CR, Olsen MH, et al. Affiliation to the work market after curative treatment of head-and-neck cancer: a population-based study from the DAHANCA database. *Acta Oncol.* 2013;52(2):430-439.

215. Heinesen E, Kolodziejczyk C. Effects of breast and colorectal cancer on labour market outcomes-average effects and educational gradients. *J Health Econ.* 2013;32(6):1028-1042.

216. Carlsen K, Harling H, Pedersen J, Christensen KB, Osler M. The transition between work, sickness absence and pension in a cohort of Danish colorectal cancer survivors. *BMJ open.* 2013;3(2):e002259.

217. Carlsen K, Dalton SO, Diderichsen F, Johansen C. Risk for unemployment of cancer survivors: A Danish cohort study. *Eur J Cancer.* 2008;44(13):1866-1874.

218. Horsboel TA, Nielsen CV, Andersen NT, Nielsen B, de Thurah A. Risk of disability pension for patients diagnosed with haematological malignancies: a register-based cohort study. *Acta Oncol.* 2014;53(6):724-734.

219. Damkjaer LH, Deltour I, Suppli NP, et al. Breast cancer and early retirement: Associations with disease characteristics, treatment, comorbidity, social position and participation in a six-day rehabilitation course in a register-based study in Denmark. *Acta Oncol.* 2011;50(2):274-281.

220. Carlsen K, Oksbjerg Dalton S, Frederiksen K, Diderichsen F, Johansen C. Cancer and the risk for taking early retirement pension: a Danish cohort study. *Scandinavian journal of public health.* 2008;36(2):117-125.

221. Jensen LS, Overgaard C, Boggild H, et al. The long-term financial consequences of breast cancer: a Danish registry-based cohort study. *BMC Public Health.* 2017;17:853-853.

222. Vestergaard, A. H. S., et al. (2022). "Socioeconomic Disparity Trends in End-of-Life Care for Cancer and Non-Cancer Patients: Are We Closing the Gap?" *Clinical Epidemiology* 14: 653-664.

223. Dengsø KE, Thomsen T, Andersen EW, et al. The psychological symptom burden in partners of pancreatic cancer patients: a population-based cohort study. *Support Care Cancer.* 2021;29(11):6689-6699.

224. Carlsen K, Jensen AJ, Rugulies R, et al. Self-reported work ability in long-term breast cancer survivors. A population-based questionnaire study in Denmark. *Acta Oncol.* 2013;52(2):423-429.

225. Lindbohm ML, Kuosma E, Taskila T, et al. Cancer as the cause of changes in work situation (a NOCWO study). *Psychooncology.* 2011;20(8):805-812.

226. Rasmussen LA, Jensen H, Virgilsen LF, Falborg AZ, Møller H, Vedsted P. Time from incident primary cancer until recurrence or second primary cancer: Risk factors and impact in general practice. *Eur J Cancer Care.* 2019;28(5):e13123.

227. Jeppesen MM, Jensen PT, Gilsa Hansen D, Iachina M, Mogensen O. The nature of early-stage endometrial cancer recurrence-A national cohort study. *Eur J Cancer.* 2016;69:51-60.

228. Jeppesen MM, Mogensen O, Hansen DG, Iachina M, Korsholm M, Jensen PT. Detection of recurrence in early stage endometrial cancer - the role of symptoms and routine follow-up. *Acta Oncol.* 2017;56(2):262-269.

229. Neergaard MA, Jensen AB, Olesen F, Vedsted P. Access to outreach specialist palliative care teams among cancer patients in Denmark. *J Palliat Med.* 2013;16(8):951-957.

230. Adsersen M, Thygesen LC, Neergaard MA, et al. Cohabitation Status Influenced Admittance to Specialized Palliative Care for Cancer Patients: A Nationwide Study from the Danish Palliative Care Database. *J Palliat Med.* 2019;22(2):164-172.

231. Adsersen M, Thygesen LC, Neergaard MA, et al. Higher Admittance to Specialized Palliative Care for Patients with High Education and Income: A Nationwide Register-Based Study. *J Palliat Med.* 2023;26(1):57-66.

232. Neergaard MA, Olesen F, Sondergaard J, Vedsted P, Jensen AB. Are Cancer Patients' Socioeconomic and Cultural Factors Associated with Contact to General Practitioners in the Last Phase of Life? *Int J Family Med.* 2015;2015:952314.

233. Daugaard C, Neergaard MA, Vestergaard AHS, Nielsen MK, Johnsen SP. Socioeconomic inequality in drug reimbursement during end-of-life care: a nationwide study. *J Epidemiol Community Health.* 2019;73(5):435-442.

234. Daugaard C, Neergaard MA, Vestergaard AHS, Nielsen MK, Goodman DC, Johnsen SP. Geographical variation in palliative cancer care in a tax-based healthcare system: drug reimbursement in Denmark. *Eur J Public Health.* 2020;30(2):223-229.

235. Schou-Andersen M, Ullersted MP, Jensen AB, Neergaard MA. Factors associated with preference for dying at home among terminally ill patients with cancer. *Scand J Caring Sci.* 2016;30(3):466-476.

236. Neergaard MA, Jensen AB, Sokolowski I, Olesen F, Vedsted P. Socioeconomic position and place of death of cancer patients. *BMJ supportive & palliative care.* 2012;2:133-139.

237. Wolff SL, Christiansen CF, Johnsen SP, et al. Inequality in place-of-death among children: a Danish nationwide study. *Eur J Pediatr.* 2022;181(2):609-617.

238. Dansk Forskningscenter for lighed i kræft (COMPAS) https://www.compas.dk/ (Lokaliseret 20. marts 2023).

239. Langballe R, Dalton SO, Jakobsen E, et al. NAVIGATE: improving survival in vulnerable patients with lung cancer through nurse navigation, symptom monitoring and exercise - study protocol for a multicentre randomised controlled trial. *BMJ open.* 2022;12(10):e060242.

240. Larsen HB, Heilmann C, Johansen C, Adamsen L. Socially disadvantaged parents of children treated with allogeneic haematopoietic stem cell transplantation (HSCT): report from a supportive intervention study, Denmark. *Eur J Oncol Nurs.* 2013;17(3):302-310.

241. Johnsen AT, Flink CE, Winther KP, et al. Promoting health equity in the healthcare system: How can we identify potentially vulnerable patients? *Scandinavian journal of public health.* 2022;50(7):903-907.

242. Stapelfeldt CM, Momsen AH, Jensen AB, Andersen NT, Nielsen CV. Municipal return to work management in cancer survivors: a controlled intervention study. *Acta Oncol.* 2021;60(3):370-378.

243. Merrild CH, Risor MB, Vedsted P, Andersen RS. Class, Social Suffering, and Health Consumerism. *Med Anthropol.* 2016;35(6):517-528.

244. Mondahl J, Thomsen TG, Hellesø R, Frederiksen K. A critical discourse analysis of the influence of organisational structures on inequality in head and neck cancer treatment in Denmark. *Scand J Caring Sci.* 2023.37(1):291-300.

245. Dalton SO, Steding-Jessen M, Gislum M, Frederiksen K, Engholm G, Schuz J. Social inequality and incidence of and survival from cancer in a population-based study in Denmark, 1994-2003: Background, aims, material and methods. *Eur J Cancer.* 2008;44(14):1938-1949.

246. Williams DR, Priest N, Anderson NB. Understanding associations among race, socioeconomic status, and health: Patterns and prospects. *Health Psychol.* 2016;35(4):407-411.

APPENDIX 1
INDICATORS OF SOCIOECONOMIC POSITION

Educational attainment
This white paper uses educational attainment as the primary indicator of socioeconomic position. A person's educational attainment reflects the transition from childhood (the social circumstances in which one was raised) to adulthood (one's own social position), and educational attainment has a strong impact on future job opportunities and income levels. Educational attainment is impacted by parents' socioeconomic position, early cognitive development and structural conditions in society and the neighbourhood. Thus, educational attainment embodies socioeconomic position over a long life course. In addition, educational attainment reflects cognitive skills, which has implications for understanding information about risk factors and health in general, but also for the ability to communicate with health professionals and navigate the healthcare system.[50]

Occupational status
Education has a direct impact on labour market opportunities. In addition, occupational status reflects how a person has managed to transform their education into a job. Occupational status has an impact on material living standards and status in society in general. In addition, the working environment has a major impact on exposure to risk factors such as particulate matter, passive smoking, and radiation, and can thus directly affect health. Conversely, health also has an important impact on employment opportunities. Causality goes therefore in two directions: Occupational status matters for health, but health also matters for occupational status. The timing of which occupational status is measured is therefore crucial for the interpretation of the result.

Income
Income levels reflect material living standards, the lifestyle and private healthcare services available to people and the environmental factors to which they are exposed. Income level is strongly associated with educational attainment and occupational status, and thus also includes the effects of these. Income is the indicator that varies most across the course of a person's life.[50] Young people in education and training typically have a low income, which increases as they complete their education and gain more work experience. People without employment often have a very low income involuntarily, whereas other people may choose a lower income, e.g. by working part-time. Furthermore, the causality between income and health goes both ways: Income impacts health, but health also impacts income levels. The timing of which the patient's income was measured is therefore crucial for the interpretation of the result.

Cohabitation status vs. marital status
Whether a person lives with a partner or alone affects their lifestyle, access to social support and how they navigate in the health care system. Some studies use marital status (whether the person is married, widowed, divorced or unmarried). The disadvantage of this definition is that it does not take into account the fact that around 20% of cohabiting couples are not married. Thus it is not possible to measure the health effects shared by married and cohabiting couples compared to people living alone. For this reason, other studies use cohabitation status instead. Cohabitation status is defined, for example, as: living alone, or being married to/living at the same address with one person of the opposite gender aged 16 or over, with a maximum age difference of 15 years. The disadvantage of this definition is that cohabiting, unmarried homosexual couples and couples with more than 15 years in age difference are misclassified as 'living alone', although it is assumed that this is a small proportion of the Danish population.[245]

Ethnicity
Ethnicity has an impact on all aspects of the socioeconomic spectrum. Danes with a minority background are more likely to have shorter education, higher unemployment rates and lower income levels. In addition, ethnicity is relevant regarding lifestyle factors, understanding of disease, health behaviour, understanding of health messages, use of health services, communication with health professionals and navigation in the health system, and Danes with a minority background generally have a different disease pattern than ethnic Danes. Even within the same socioeconomic groups, ethnicity is relevant to risk factors and health outcomes.[246]

Area of residence
Area of residence reflects a number of contextual factors in the neighbourhood. Although individual socioeconomic conditions such as educational attainment, occupational status, income level and ethnic composition vary across municipal boundaries, there are still large variations in, for example, cancer incidence in the different municipalities of residence, after taking into account differences in citizens' socioeconomic status.[4] Furthermore, access to health services varies in the different municipalities of residence, both in terms of distance to and availability of specific health services.

APPENDIX 2
LITERATURE SEARCH

SOCIAL	STATUS		INEQUALITY		CANCER		DENMARK	
socioeconomic	class	OR	inequality	OR	cancer	OR	Denmark	OR
socio-economic	classes	OR	inequalities	OR	cancers	OR	Danish	OR
social	factor	OR	inequity	OR	tumors	OR	Danes	
income	factors	OR	inequities	OR	tumor	OR		
education	standard	OR	disparity	OR	tumour	OR		
educational	standards	OR	disparities		tumours	OR		
high-income	population	OR			carcinoma	OR		
high income	populations	OR			carcinomas	OR		
low income	indicator	OR			neoplasia	OR		
low-income	indicators	OR			neoplasias	OR		
employment	level	OR			neoplasm	OR		
occupation	levels	OR			neoplasms	OR		
occupations	area	OR			malignant	OR		
living	areas	OR			malignancy	OR		
residence	characteristic	OR			malignancies	OR		
geography	characteristics	OR			SCC			
ethnic	position	OR						
ethnicity	positions	OR						
SEP	status							
SES								

The purpose of this white paper is to provide a comprehensive, systematic overview of social inequality in cancer in Denmark.