Title: Trends in cancer survival in the Nordic countries 1990-2016: the NORDCAN survival studies

Running title: The NORDCAN survival studies 1990-2016

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Keywords

Cancer survival, comparison, Nordic cancer registries, NORDCAN

Funding

This work was supported by the Swedish Cancer Society (Cancerfonden) under Grants 18-0689 and 2018/744 and the Swedish Research Council (Vetenskapsrådet) under Grant 2017-01591.

Disclosure of interest

The authors report no conflicts of interest.

Abstract

Background

Differences in cancer survival between the Nordic countries have previously been reported. The aim of this study was to examine whether these differences in outcome remain, based on updated information from five national cancer registers.

Materials and methods

The data used for the analysis was from the NORDCAN database focusing on nine common cancers diagnosed 1990-2016 in Denmark, Finland, Iceland, Norway and Sweden with maximum follow-up through 2017. Relative survival (RS) was estimated at 1 and 5 years using flexible parametric relative survival models, and percentage point differences between the earliest and latest years available were calculated.

Results

A consistent improvement in both 1- and 5-year RS was found for most studied sites across all countries. Previously observed differences between the countries have been attenuated. The improvements were particularly pronounced in Denmark that now has cancer survival similar to the other Nordic countries.

Conclusion

The reasons for the observed improvements in cancer survival are likely multifactorial, including earlier diagnosis, improved treatment options, implementation of national cancer plans, uniform national cancer care guidelines and standardized patient pathways. The previous survival disadvantage in Denmark is no longer present for most sites. Continuous monitoring of cancer survival is of importance to assess the impact of changes in policies and the effectiveness of health care systems.

Introduction

Marked differences in cancer incidence and survival between countries and jurisdictions have been documented in several reports, as well as differences in temporal trends across countries and calendar time [1–4]. A series of 13 articles published in 2010 comparing time trends in cancer incidence and outcomes in the five Nordic countries 1964-2003 (https://www.ancr.nu/cancer-data/cancer-survival/acta-oncologica-2010) confirmed earlier findings of both similarities and differences in cancer survival, with notable poorer outcomes observed in Denmark. At that time, one conclusion was that cancer plans initiated in Denmark in 2000 and in Norway in 1997, appeared to not yet have had an impact on cancer incidence, mortality or survival [5]. A more recent study which compared cancer survival in Europe 1999-2007, EUROCARE-5, also reported a survival disadvantage in Danish patients [3].

With more than ten years of additional data available, it is now possible to investigate if concerted national efforts to improve early detection and quality of cancer care have had detectable effects, and if differences in cancer survival between the Nordic countries still persist. Since the 2010 comprehensive Nordic comparison, efforts to improve cancer care have been made in each Nordic country. These efforts include implementing and updating national cancer plans and guidelines, changes in screening programs, centralization of cancer treatment, accelerated cancer patient pathways and improved access to new cancer therapies.

This study utilizes data on nine common cancers diagnosed between 1990 and 2016 from the NORDCAN database [6], which is a collaboration between the cancer registries of Denmark, Finland, Iceland, Norway and Sweden [7]. Summary incidence, mortality and survival figures from NORDCAN are published online [8]. The aim of this Nordic collaborative study is three-fold. First, to study possible changes in both short and long-term survival over this time period by estimating overall and conditional cancer survival. Second, to investigate whether previously observed differences in cancer survival between the Nordic countries remain. Third, to put these results into context, we also present trends in cancer incidence and mortality.

Methods

Data

We obtained individual-level data for nine common cancer from Denmark, Finland, Iceland, Norway and Sweden from the NORDCAN database, which includes information from the national cancer registries in each country [6–8]. All individuals diagnosed with the following cancers between 1990 and 2016 were included: primary cancers of the colon (including appendix, International Classification of Diseases version 10 [ICD10]: C18), rectum (C19-C20), lung and trachea (C33-C34), malignant melanoma of skin (C43), kidney (C64), breast (C50), uterus (corpus uteri, C54), ovary (including fallopian tubes and uterine ligaments, C56-C57.4) and prostate (C61). Follow-up for death and emigration was to the end of 2017 for all countries, except for Finland where follow-up ended in 2016. Emigration information was unavailable for Iceland.

We excluded cases diagnosed only on the basis of a death certificate (DCO) or through incidental autopsy findings. We also excluded childhood cancers (patients aged <18 years at diagnosis), breast cancer in men and subsequent primary tumors at the same site in the same patient (Supplementary Table 1).

Population-based expected mortality rates in each country, stratified by age, sex and calendar year were obtained from each country's national statistics office.

Statistical Analysis

We estimated marginal relative survival (RS) to quantify survival in the absence of death from other causes. We present 1-year and 5-year RS, and 5-year RS conditional on survival to 1 year post diagnosis for women and men, across countries and calendar time. We adopted a modelling approach to estimate RS using flexible parametric relative survival models fitting separate models to each cancer site for each country. The models incorporated age at diagnosis, calendar year and sex (for relevant sites). After fitting the model, age-standardized estimates of relative survival were obtained using regression standardization stratified by calendar year and sex [9]. We used an adapted version of the International Cancer Survival Standard 1 (ICSS1) age-standard weights for all cancer sites by 10-year age groups, except for melanoma where the adapted ICSS2 weights were used (Supplementary Table 2).

Flexible parametric relative survival models use restricted cubic splines to model the baseline excess hazard over time since diagnosis [10,11]. The models incorporate the expected mortality rates for each country. In the analyses, 5 degrees of freedom (df) were used to model the log cumulative baseline excess hazard with sex as a binary covariate. Age and calendar year at diagnosis were included as continuous variables allowing for non-linear effects by using restricted cubic splines with 3 df. Two-way interactions between age and calendar year, age and sex, and calendar year and sex were included. The proportional excess hazards assumption was relaxed by incorporating time-dependent effects for calendar year, age, sex, and their interaction terms (3-way interactions), with 3 df for each time-dependent effect.

Due to the small population size, simpler models were used for Iceland. These excluded the 3-way interactions and used 2 df for time-dependent effects. For cancers of the uterus, ovary and melanoma in Iceland, there were few cancer cases and/or deaths. For that reason a modelling approach was not adopted and estimates were obtained using the non-parametric Pohar Perme approach in five-year groups of calendar year at diagnosis [12], incorporating relative weights [13]. To improve model stability for the very young and elderly, 96% of the age distribution was modelled continuously while individuals outside the 2^{nd} and 98^{th} percentile of age had their age reassigned to those percentile limits and were assumed to have the same relative survival (i.e. winsorizing) [14]. As a validation of our models, we compared the parametric estimates to Pohar Perme estimates and found them to be in good agreement.

Absolute survival differences, as measured by percentage point (pp) differences in 5-year RS between 1990 and 2010, and 1-year RS between 1990 and 2015, were estimated with 95% confidence intervals (CI) from the models. The corresponding differences for cancers of the uterus, ovary and melanoma in Iceland were calculated from the latest and earliest non-parametric estimates.

As improvements in 5-year survival often reflect improvements in early survival (e.g. within a year of diagnosis), the 5-year RS conditional on surviving one year captures the 1 to 5 year survival experience of the patients. This is important in order to disentangle the early and later survival improvements over the first five years since diagnosis.

In addition to modelling trends over time, a period analysis model was used to obtain up-to-date estimates where only follow-up time during a period window was included in the analysis. The period window was 2013-2017 for Denmark, Norway, Sweden, 2012-2017 for Iceland and 2013-2016 for Finland. These models were essentially the same as above, without the need to incorporate calendar year. For melanoma in Denmark and kidney cancer in Norway, the models were simplified by using 2 df for time-dependent effects due to convergence issues. Non-parametric estimates were calculated for cancers of the uterus, ovary and melanoma in Iceland.

Incidence and mortality rates were estimated using three year diagnoses windows. Rates were age standardized using the Nordic population distribution in the year 2000 (Supplementary Table 3).

All the analyses were performed in Stata/IC 16.0 (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC). The commands `stpm2` and `standsurv` were used for obtaining parametric estimates, and `strs` for non-parametric estimates [15,16].

Ethical approval for this study was granted by the Swedish Ethical Review Authority (ethical approval 2017/641-31/1, amendment 2019-01913) and study permission from the National Institute of Health and Welfare in Finland (approval THL/870/5.05.00/2014, amendment 2019)..

Results

In total, the cohorts from the five Nordic countries included 1,032,846 cancers in women and 1,006,836 cancers in men for nine tumor sites diagnosed between 1990 and 2016. The number of cases and exclusions by sex, site and country are presented in Supplementary Table 1. Breast, lung and colon cancer were the three most common sites among women, while prostate, lung and colon cancer were the most common sites among men.

Colon cancer

Period estimates of 5-year relative survival (RS) for colon cancer ranged from 62% (Iceland) to 69% (Norway) in women and from 63% (Sweden) to 67% (Denmark) in men (Table 1). Survival improved over the study period in all Nordic countries for both women (Figure 1a) and men (Figure 1b). The lower 1- and 5-year RS in Denmark in the early 1990s improved over time and was in line with the other Nordic countries at the end of the study period. The change in 5-year RS between 1990 and 2010 was +16 pp in Danish women and +17 pp in men (Table 2). There

was also an improvement in 5-year RS conditional on survival one year in both women and men (Figure 2). The incidence of colon cancer increased in both sexes over the study period, while there was a slight decrease in mortality (Supplementary Figure 1a, 1b).

Rectal cancer

For rectal cancer, the period estimates of 5-year RS ranged from 68% (Sweden) to 78% (Iceland) in women and between 65% (Finland, Sweden) and 69% (Denmark, Norway) in men (Table 1). Survival improved in all Nordic countries for both women (Figure 1a) and men (Figure 1b), with particularly pronounced improvements in women in Denmark and Iceland. The change in 5-year RS was +28 pp in Icelandic women and +22 pp in both Danish women and men from 1990 to 2010 (Table 2). There was also an improvement in 5-year RS conditional on surviving one year in both women and men (Figure 2). During the period under study, the rectal cancer incidence remained constant in both sexes, while mortality decreased (Supplementary Figure 1a, 1b).

Lung cancer

Among individuals with lung cancer, the period estimates of 5-year RS ranged from 19% (Finland) to 26% (Iceland, Norway) in women and between 13% (Finland) and 20% (Iceland) in men (Table 1). One-year RS improved markedly over the study period in all countries for both women (Figure 1a) and men (Figure 1b), in particular in the 2000s. The change in 1-year RS from 1990 to 2015 was +30 pp in Danish, +25 pp in Swedish and +22 pp in Norwegian women, while in men the corresponding numbers were +23 pp, +20 pp and +18 pp (Table 2). Improvements in 1-year RS were less pronounced in Finland (+12 pp in women and +5 pp in men) and Iceland (+19 pp in women and +12 pp in men) (Table 2). In all Nordic countries, improvements in 1-year RS were more marked than improvement in 5-year RS. There was, however, an improvement in 5-year RS conditional on survival one year in both women and men, especially after 2005 (Figure 2). Lung cancer incidence and mortality in women increased over time while decreasing in men (Supplementary Figure 1a, 1b).

Melanoma of skin

For melanoma, the period estimates of 5-year RS ranged from 93% (Norway) to 97% (Iceland) in women and from 86% (Iceland) to 91% (Denmark, Sweden) in men (Table 1). Despite high survival in the 1990s, further improvements were observed in both men and women in all countries (Figure 1a, 1b). There was also improvement in 5-year RS conditional on surviving one year (Figure 2). There was a rapid increase in the melanoma incidence in both sexes in all countries (except Iceland where incidence has decreased in the later years). The mortality remained fairly stable with the exception of Norway, where there was a slight increase (Supplementary Figure 1a, 1b).

Kidney cancer

For kidney cancer, the period estimates of 5-year RS ranged from 68% (Finland) to 75% (Norway, Sweden) in women and between 65% (Finland, Iceland) and 74% (Sweden) in men (Table 1). Survival improved in all Nordic countries for both women (Figure 1a) and men (Figure 1b), in particular for Denmark, but less so for Finland. The change in 5-year RS from 1990 to

2010 was just over 20-23 pp in both women and men in all countries except in Finland where the change was +13 pp (women) and +12 pp (men) (Table 2). The improvement in 5-year RS conditional on surviving one year was largest in Denmark for both women and men (Figure 2). The incidence of kidney cancer was mainly stable over the study period and countries in women, while the incidence increased in Danish and Norwegian men (Supplementary Figure 1a, 1b). Mortality decreased somewhat in all countries.

Breast cancer

For breast cancer, the period estimates of 5-year RS estimates ranged from 87% (Denmark, Iceland) to 90% (Finland, Sweden) (Table 1). During the study period, both 1- and 5-year RS improved in all countries (Figure 1a), in particular in Denmark with a +16 pp change in 5-year RS from 1990 to 2010 (Table 2). Improvements were also observed in 5-year RS conditional on surviving one year (Figure 2). Breast cancer incidence increased in all countries, with the highest incidence in Denmark and lowest in Norway, while mortality decreased (Supplementary Figure 1a).

Uterine cancer

For uterine cancer, the period estimates of 5-year RS estimates ranged from 82% (Denmark) to 84% (Finland, Iceland, Norway, Sweden) (Table 1). In all countries, there were only small improvements in both 1- and 5-year RS over the study period (Figure 1a), with the largest increase in Iceland. The change in 5-year RS ranged from +5 to +19 pp across countries from 1990 to 2010 (Table 2). The incidence trend of uterine cancer varied between countries, with an increase in Norway and only minor increases in the other countries (Supplementary Figure 1a). While mortality remained stable in Finland, Sweden and Iceland, there was evidence of a decrease in Denmark and Norway (Supplementary Figure 1a).

Ovarian cancer

For ovarian cancer, the period estimates of 5-year RS estimates ranged from 42% (Denmark) to 51% (Sweden) (Table 1). Over the study period, both 1- and 5-year RS improved in all countries (Figure 1a). The change in 1-year RS from 1990 to 2015 was +7 pp in Iceland and ranged from +14 pp to +20 pp in the other countries (Table 2). The change in 5-year RS varied between +8 pp (Iceland) and +15 pp (Finland) (Table 2). The improvements in 5-year RS conditional on surviving one year were less pronounced (Figure 2). The incidence and mortality of ovarian cancer decreased in all Nordic countries (Supplementary Figure 1a).

Prostate cancer

For prostate cancer, the period estimates of 5-year RS estimates ranged from 87% (Denmark) to 94% (Finland) (Table 1). Both 1- and 5-year RS improved in all Nordic countries (Figure 1b), in particular in Denmark where the improvement was most pronounced for men diagnosed between 2000 and 2010. The change in 1- and 5-year RS was +15 pp and +51 pp, respectively, in Danish men from 1990 to 2015/2010 (Table 2). Similar patterns of improvement were also observed in 5-year RS conditional on surviving one year (Figure 2). Prostate cancer incidence increased in all

countries, although the increase in Denmark occurred later. Prostate cancer mortality decreased across all countries (Supplementary Figure 1b).

Supplementary material

Point estimates of 1- and 5-year RS for every 5th calendar year, with 95% confidence intervals, are presented in Supplementary Tables 4 and 5. The corresponding estimates of 5-year RS conditional on surviving one year after diagnosis are presented in Supplementary Table 6.

Discussion

Including more than 2 million men and women diagnosed with cancer, we found general and consistent improvements in both short- and long-term cancer survival across nine major cancer sites in the Nordic countries between 1990 and 2017. The previously observed survival disadvantage in Denmark up until 2006 [5] is no longer present for most sites, with improvements in both 1-year and 5-year survival. Although the survival trends in general are consistent over the Nordic countries, an exception is in Finland where lung and kidney cancer survival have improved less over time.

Reasons for the observed improvement in cancer survival are likely to be multifactorial involving major changes over the last 30 years not only in diagnostic and treatment options, but also in policies and resource allocation. Similar improvements have also been seen in countries outside the Nordic region [1,2]. From the early 2000's, national cancer plans or strategies were implemented in the Nordic countries aiming to improve early detection and delivery of cancer care, starting in Denmark (2000), in Norway (2006), Sweden (2011) and very recently in Iceland (2019). Similar efforts have been undertaken in Finland. The national cancer plans have been developed with a focus on the patient perspective and include components such as uniform national cancer care guidelines, contact nurses, multidisciplinary treatment decisions, individualized management plans, centralization of treatment to fewer centra, structured care processes and standardized pathways aiming to reduce waiting times.

Other recent changes include the introduction of new diagnostic methods allowing for targeted treatments, new oncological treatments and refined surgical techniques. Novel diagnostic tools have led not only to more precise tumor characterization and staging, but also to an increased incidence of early stage tumors and incidental findings [17]. There have also been efforts to improve early detection by public campaigns to increase awareness of signs and symptoms of cancer, implementation of organized colorectal cancer screening and increased participation in existing screening programs for breast cancer (Supplementary Table 7).

The improvements in cancer survival were particularly pronounced in Denmark that now has a cancer survival similar to the other Nordic countries. Denmark was the first Nordic country to launch a national cancer plan in 2000 followed by several updates, including a 2007 policy decision to designate cancer as an acute life-threatening disease with a focus on accelerated cancer patient pathways to reduce waiting times. Denmark was early in implementing accelerated cancer pathways 2007-2009 [18]. Changes in Denmark have also included structural reforms with

healthcare provided by five administrative healthcare regions from 2007 and marked increases in health care expenditures including earmarked investments in resources for cancer care, for example computed tomography (CT) and radiation therapy.

It is also possible that changes over time in comorbidity burden and life-style factors such as smoking could have played a role for the marked improvements observed in Denmark. Smoking is associated with a higher comorbidity burden, which in turn may affect cancer treatment options and survival. Smoking prevalence has historically been high in Denmark, but has decreased markedly over time and is since the end of 1990s more similar to the other Nordic countries [5].

Although there have been general improvements in survival across sites, there are some exceptions. It is unclear why the improvement in survival for lung and kidney cancer was less pronounced in Finland than in the other countries. The observed differences in both 1-year and 5-year conditional survival could reflect varying diagnostic pathways and routines. There are observed differences in treatment protocols and patient pathways, implementation and frequency of updates of lung cancer related national guidelines and smoking cessation advice between the Nordic countries [19]. However, it is important to investigate further why improvements in survival have been less pronounced in Finland and if there are for example differences in lung cancer subtypes between countries.

The substantial improvement observed for prostate cancer survival is likely to be partly explained by an increased use of prostate specific antigen (PSA) testing (which is also reflected in a corresponding sharp increase in prostate cancer incidence), in addition to more men receiving treatment with curative intent. Although routine PSA testing now are discouraged in all Nordic countries, testing of asymptomatic men is still performed at a varying degree at patients' request.

The incidence of melanoma of the skin has increased rapidly in both men and women in all Nordic countries with the exception of Iceland were the incidence has decreased, possibly as an effect of awareness campaigns and regulations for use of sunbeds introduced in 2003 [20]. There has been no corresponding increase in melanoma mortality, suggesting that the increase in incidence reflects detection of early stage melanomas.

The Nordic countries have a population of over 27 million with low out-of-pocket-cost care available to all residents via similar tax funded national healthcare systems. The NORDCAN database collaboration has facilitated data collection, reporting and coding practices of cancer cases. The NORDCAN database is population-based, mature and essentially complete including more than 2 million cancer patients and represents an important resource for cancer comparisons. Complete follow-up for death and migration is provided by record linkages to the Total Population Registers in each country except Iceland where migration information is unavailable. Also, traceback systems to supplement information on the time of diagnosis on cancers with only death certificate notifications to the cancer registryis undertaken in all Nordic countries except Sweden [7]. For many cancer sites, non-inclusion of death certificate initiated cases (DCI) will lead to a slight overestimation of survival, whereas including these cases will slightly underestimate survival [21]. Taken together, these biases could impact the comparisons of

survival between countries, in particular for cancer sites with short survival time, such as lung cancer, or in the elderly. Limitations of our study also include the low numbers for some cancer sites, particularly for Iceland, and one year less follow-up in Finland.

Conclusions

There have been general improvements in cancer survival across nine major cancer sites in the Nordic countries. Although some differences in cancer survival remain, previously observed marked differences between countries have been attenuated over time. Of special note is that the previous survival disadvantage in Denmark is no longer present for most sites. The reasons for these improvements are multifactorial, including concerted efforts to improve cancer care by means of national cancer plans, earlier diagnosis and improvements in treatment. Cancer registration is essential to continue monitoring cancer survival and assess the impact of changes in policies and quality of care. In addition, data from cancer registers enable quantification and understanding of national as well as international trends and differences in cancer survival, incidence, and mortality. With the increasing availability and completeness of treatment and disease specific information (e.g. stage and histological subtype), more detailed comparisons will be possible to further improve the understanding of the reasons for survival differences between countries.

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Tables

Table 1. Period estimates of 5-year relative survival with 95% confidence intervals, by sex, site and country in the latest available 5-year period, the NORDCAN survival studies

Women						
Site	**ICD-10**	**Denmark**	**Finland**	**Iceland**	**Norway**	**Sweden**
Colon	C18	68 (67-69)	68 (66-70)	62 (57-68)	69 (68-71)	65 (64-67)
Rectum	C19-C20	71 (70-73)	69 (67-72)	78 (70-88)	71 (69-73)	68 (66-69)
Lung	C33-C34	23 (22-24)	19 (17-20)	26 (22-31)	26 (25-27)	24 (23-25)
Melanoma	C43	95 (94-96)	94 (93-95)	97 (87-99)[a]	93 (92-94)	94 (94-95)
Kidney	C64	69 (66-72)	68 (66-71)	73 (64-82)	75 (72-78)	75 (73-78)
Breast	C50	87 (87-88)	90 (90-91)	87 (84-90)	89 (88-90)	90 (89-90)
Uterus	C54	82 (81-84)	84 (82-85)	84 (73-91)[a]	84 (83-86)	84 (83-85)
Ovary	C56-C57.4	42 (40-44)	44 (42-46)	46 (35-56)[a]	47 (45-50)	51 (49-52)
Men						
Site	**ICD-10**	**Denmark**	**Finland**	**Iceland**	**Norway**	**Sweden**
Colon	C18	67 (65-68)	66 (64-68)	66 (60-72)	65 (64-67)	63 (62-65)
Rectum	C19-C20	69 (67-71)	65 (63-67)	67 (59-76)	69 (68-71)	65 (64-66)
Lung	C33-C34	17 (16-18)	13 (12-14)	20 (17-25)	19 (18-20)	19 (18-20)
Melanoma	C43	91 (90-92)	87 (86-89)	86 (76-91)[a]	87 (86-89)	91 (90-92)
Kidney	C64	67 (65-69)	65 (62-67)	65 (58-73)	72 (70-74)	74 (72-76)
Prostate	C61	87 (86-87)	94 (93-95)	89 (86-91)	93 (92-94)	91 (91-92)

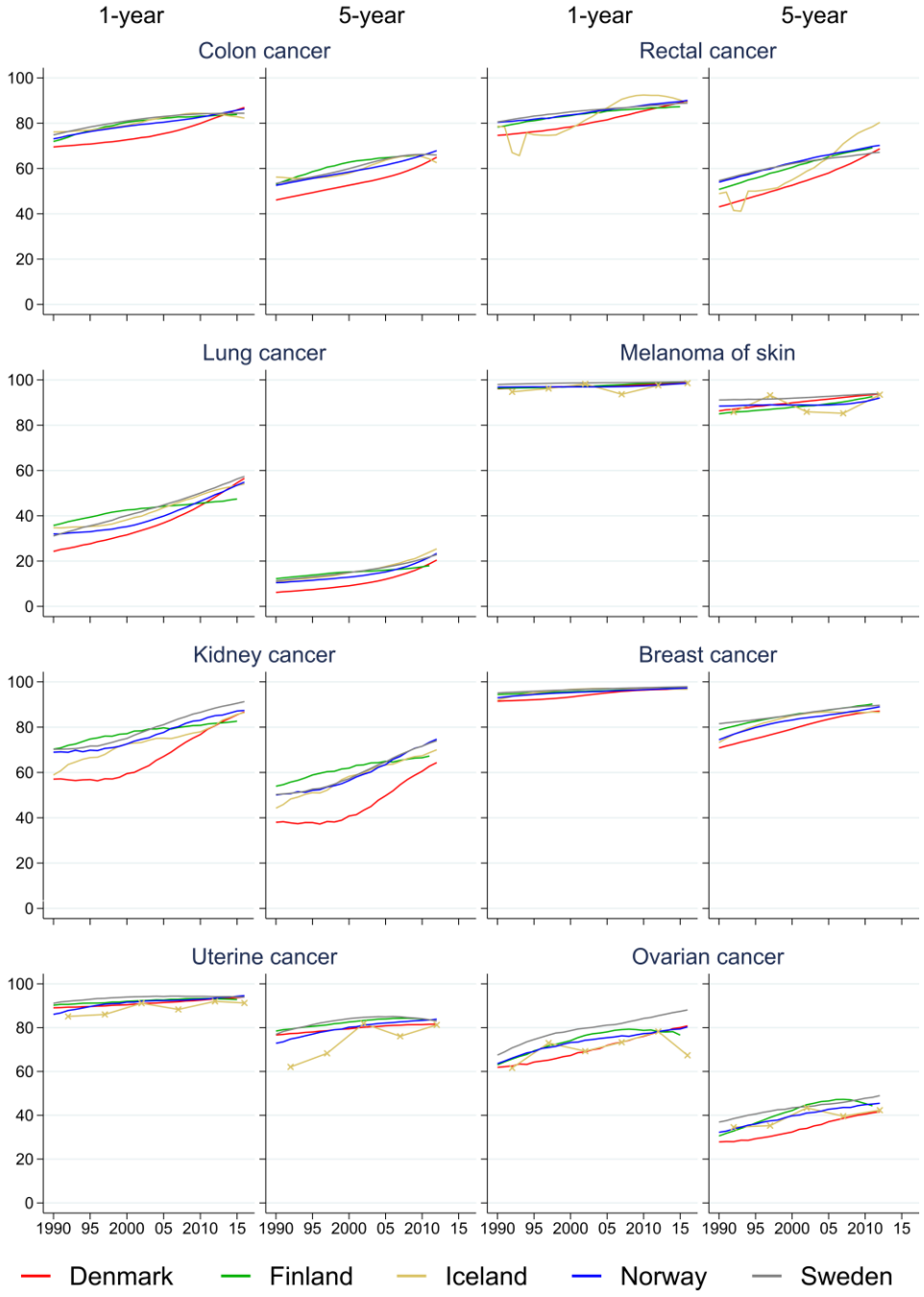
Follow-up window for Denmark, Norway and Sweden: 2013-2017; Finland: 2013-2016; Iceland: 2012-2017.
[a] Age-standardized Pohar Perme estimates over 5-year intervals of calendar year.

Table 2. Percentage point change in 1- and 5-year relative survival since 1990 with 95% confidence intervals, by sex, site and country, the NORDCAN survival studies

Change in 1-year relative survival between 1990 to 2015					
Women					
Site	**Denmark**	**Finland**	**Iceland**	**Norway**	**Sweden**
Colon	16 (15 to 18)	12 (10 to 14)	7 (-2 to 15)	13 (11 to 14)	10 (8 to 11)
Rectum	14 (12 to 17)	9 (6 to 12)	11 (0 to 23)	9 (7 to 11)	8 (6 to 10)
Lung	30 (29 to 32)	12 (9 to 14)	19 (11 to 26)	22 (19 to 24)	25 (23 to 27)
Melanoma	3 (2 to 4)	3 (1 to 4)	4 (-3 to 11)[a]	2 (1 to 2)	1 (1 to 2)
Kidney	28 (25 to 32)	12 (9 to 16)	27 (11 to 43)	18 (15 to 22)	20 (18 to 23)
Breast	5 (5 to 6)	3 (2 to 4)	5 (1 to 9)	4 (3 to 5)	3 (2 to 3)
Uterus	5 (3 to 7)	3 (1 to 5)	6 (-5 to 18)[a]	8 (6 to 10)	3 (2 to 4)
Ovary	18 (15 to 21)	14 (11 to 17)	6 (-14 to 25)[a]	16 (13 to 19)	20 (18 to 22)
Men					
Site	**Denmark**	**Finland**	**Iceland**	**Norway**	**Sweden**
Colon	20 (18 to 22)	12 (9 to 14)	8 (0 to 17)	14 (12 to 16)	12 (10 to 13)
Rectum	17 (15 to 19)	10 (8 to 13)	1 (-12 to 13)	12 (10 to 14)	10 (8 to 11)
Lung	23 (22 to 24)	5 (3 to 7)	12 (5 to 19)	18 (16 to 20)	20 (18 to 21)
Melanoma	5 (4 to 7)	2 (0 to 4)	-5 (-19 to 10)[a]	4 (3 to 6)	3 (2 to 3)
Kidney	27 (23 to 30)	12 (9 to 16)	17 (4 to 30)	19 (16 to 23)	22 (19 to 25)
Prostate	15 (13 to 17)	10 (9 to 12)	6 (2 to 11)	9 (7 to 10)	8 (7 to 9)
Change in 5-year relative survival between 1990 to 2010					
Women					
Site	**Denmark**	**Finland**	**Iceland**	**Norway**	**Sweden**
Colon	16 (13 to 18)	13 (10 to 16)	9 (-2 to 20)	13 (11 to 15)	13 (11 to 15)
Rectum	22 (19 to 25)	18 (14 to 21)	28 (12 to 44)	15 (12 to 18)	12 (9 to 14)
Lung	11 (10 to 12)	5 (3 to 7)	12 (7 to 16)	10 (8 to 11)	10 (8 to 11)
Melanoma	7 (5 to 9)	7 (4 to 10)	8 (-5 to 21)[b]	2 (0 to 4)	3 (1 to 4)
Kidney	23 (18 to 27)	13 (9 to 16)	23 (6 to 40)	22 (17 to 26)	21 (18 to 25)
Breast	16 (14 to 17)	11 (9 to 12)	13 (6 to 20)	13 (12 to 15)	8 (7 to 9)
Uterus	5 (2 to 7)	5 (3 to 8)	19 (1 to 37)[b]	10 (7 to 13)	7 (5 to 9)
Ovary	13 (10 to 15)	15 (12 to 18)	8 (-8 to 24)[b]	13 (10 to 15)	11 (9 to 13)
Men					
Site	**Denmark**	**Finland**	**Iceland**	**Norway**	**Sweden**
Colon	17 (15 to 20)	13 (10 to 17)	9 (-3 to 21)	14 (12 to 17)	12 (10 to 14)
Rectum	22 (20 to 25)	17 (13 to 20)	20 (1 to 39)	18 (15 to 21)	14 (11 to 16)
Lung	7 (6 to 8)	2 (1 to 4)	7 (2 to 12)	7 (6 to 8)	7 (6 to 8)
Melanoma	14 (11 to 17)	9 (5 to 12)	16 (-7 to 39)[b]	5 (3 to 8)	5 (3 to 7)
Kidney	23 (19 to 27)	12 (8 to 16)	21 (7 to 34)	20 (16 to 24)	22 (19 to 25)
Prostate	51 (49 to 53)	41 (39 to 44)	21 (12 to 29)	36 (34 to 39)	31 (30 to 33)

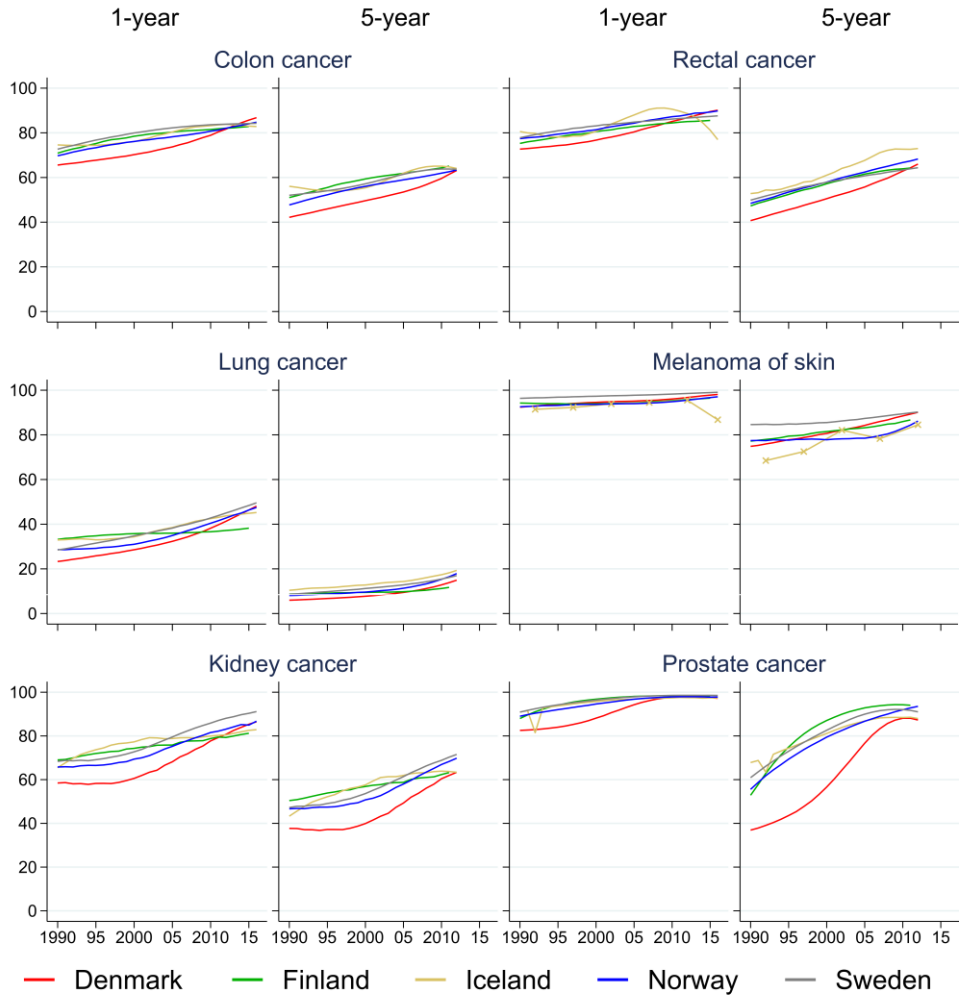
[a] Based on age-standardized Pohar Perme estimates from diagnosis years 1990-1994 and 2015-2016.
[b] Based on age-standardized Pohar Perme estimates from diagnosis years 1990-1994 and 2010-2014.

Figure 1a. Trends over time in 1- and 5-year relative survival 1990-2016, women, the NORDCAN survival studies



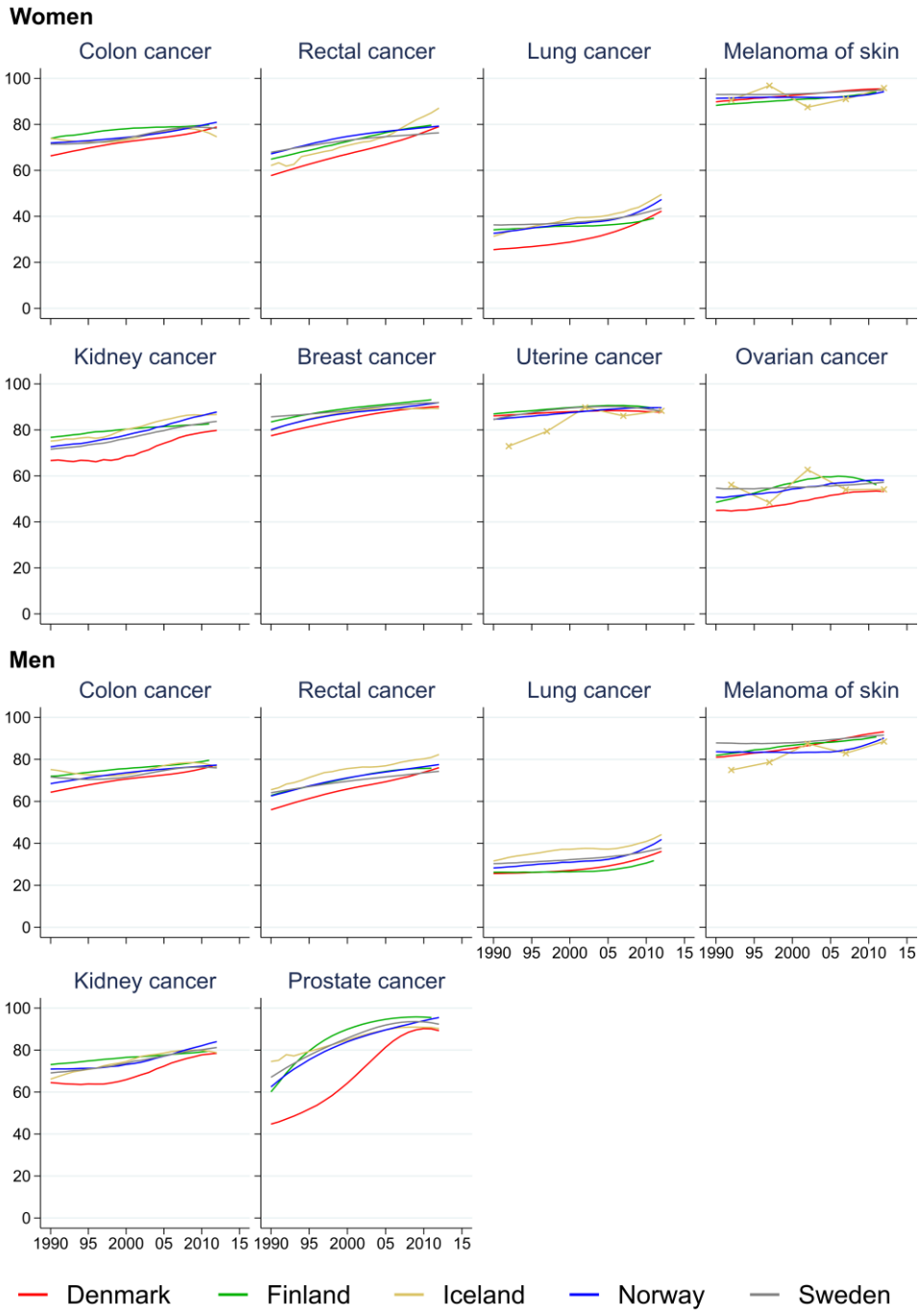
Age-standardized Pohar Perme estimates over 5-year intervals of calendar year presented for melanoma, ovarian and uterine cancer in Iceland. Crosses mark the center of each interval.

Figure 1b. Trends over time in 1- and 5-year relative survival 1990-2016, men, the NORDCAN survival studies



Age-standardized Pohar Perme estimates over 5-year intervals of calendar year presented for melanoma in Iceland. Crosses mark the center of each interval.

Figure 2. Trends in 5-year relative survival conditional on surviving 1 year, 1990-2012, the NORDCAN survival studies



Age-standardized Pohar Perme estimates over 5-year intervals of calendar year presented for melanoma, uterine and ovarian cancer in Iceland. Crosses mark the center of each interval.

Supplementary tables

Supplementary table 1. Number of cancer cases and exclusions by sex, site and country 1990-2016, the NORDCAN survival studies

Sex	Country	Cancer site	Cases	DCO		Incidental autopsy finding		Patient <18 y		Subsequent tumor at same site		Included in analyses
			n	n	%[a]	n	%[a]	n	%[a]	n	%[a]	n
Women	Denmark	Colon	35,003	179	0.51	371	1.06	21	0.06	40	0.11	34,392
Women	Finland	Colon	21,659	202	0.93	413	1.91	90	0.42	30	0.14	20,924
Women	Iceland	Colon	1,118	6	0.54	15	1.34	0	0.00	1	0.09	1,096
Women	Norway	Colon	32,348	386	1.19	87	0.27	29	0.09	52	0.16	31,794
Women	Sweden	Colon	48,327	0	0.00	908	1.88	7	0.01	12	0.02	47,400
Women	Denmark	Rectum	15,501	34	0.22	124	0.80	0	0.00	0	0.00	15,343
Women	Finland	Rectum	10,848	84	0.77	97	0.89	0	0.00	4	0.04	10,663
Women	Iceland	Rectum	390	0	0.00	0	0.00	0	0.00	0	0.00	390
Women	Norway	Rectum	13,312	64	0.48	21	0.16	1	0.01	5	0.04	13,221
Women	Sweden	Rectum	21,294	0	0.00	225	1.06	3	0.01	6	0.03	21,060
Women	Denmark	Lung	47,392	419	0.88	855	1.80	8	0.02	101	0.21	46,009
Women	Finland	Lung	17,576	464	2.64	757	4.31	9	0.05	24	0.14	16,322
Women	Iceland	Lung	1,959	3	0.15	19	0.97	0	0.00	14	0.71	1,923
Women	Norway	Lung	25,001	458	1.83	133	0.53	7	0.03	152	0.61	24,251
Women	Sweden	Lung	39,579	0	0.00	1,414	3.57	9	0.02	136	0.34	38,020
Women	Denmark	Melanoma	21,232	9	0.04	8	0.04	82	0.39	0	0.00	21,133
Women	Finland	Melanoma	11,710	6	0.05	13	0.11	39	0.33	0	0.00	11,652
Women	Iceland	Melanoma	663	0	0.00	0	0.00	7	1.06	0	0.00	656
Women	Norway	Melanoma	17,286	4	0.02	3	0.02	46	0.27	7	0.04	17,226
Women	Sweden	Melanoma	29,339	0	0.00	6	0.02	66	0.22	0	0.00	29,267
Women	Denmark	Kidney	6,479	38	0.59	251	3.87	99	1.53	4	0.06	6,087
Women	Finland	Kidney	9,156	195	2.13	438	4.78	122	1.33	0	0.00	8,401
Women	Iceland	Kidney	462	0	0.00	18	3.90	2	0.43	0	0.00	442
Women	Norway	Kidney	5,907	121	2.05	107	1.81	108	1.83	0	0.00	5,571
Women	Sweden	Kidney	10,839	0	0.00	639	5.90	224	2.07	0	0.00	9,976
Women	Denmark	Breast	108,082	235	0.22	156	0.14	2	0.00	44	0.04	107,645
Women	Finland	Breast	99,521	210	0.21	168	0.17	0	0.00	87	0.09	99,056
Women	Iceland	Breast	4,390	2	0.05	9	0.21	0	0.00	3	0.07	4,376
Women	Norway	Breast	70,421	221	0.31	21	0.03	3	0.00	85	0.12	70,091
Women	Sweden	Breast	166,018	0	0.00	221	0.13	0	0.00	29	0.02	165,768
Women	Denmark	Uterus	18,370	12	0.07	45	0.24	1	0.01	16	0.09	18,296
Women	Finland	Uterus	19,803	56	0.28	117	0.59	1	0.01	4	0.02	19,625
Women	Iceland	Uterus	711	1	0.14	1	0.14	0	0.00	1	0.14	708
Women	Norway	Uterus	16,353	39	0.24	21	0.13	1	0.01	12	0.07	16,280
Women	Sweden	Uterus	34,569	0	0.00	150	0.43	1	0.00	0	0.00	34,418
Women	Denmark	Ovary	15,701	66	0.42	119	0.76	48	0.31	60	0.38	15,408
Women	Finland	Ovary	13,621	156	1.15	223	1.64	45	0.33	6	0.04	13,191
Women	Iceland	Ovary	528	1	0.19	3	0.57	4	0.76	1	0.19	519
Women	Norway	Ovary	12,845	116	0.90	28	0.22	65	0.51	43	0.33	12,593
Women	Sweden	Ovary	22,127	0	0.00	351	1.59	110	0.50	13	0.06	21,653
Men	Denmark	Colon	32,368	101	0.31	280	0.87	15	0.05	20	0.06	31,952
Men	Finland	Colon	18,650	124	0.66	372	1.99	53	0.28	26	0.14	18,075
Men	Iceland	Colon	1,274	3	0.24	12	0.94	2	0.16	1	0.08	1,256

Men	Norway	Colon	28,394	220	0.77	103	0.36	12	0.04	39	0.14	28,020
Men	Sweden	Colon	46,024	0	0.00	895	1.94	10	0.02	14	0.03	45,105
Men	Denmark	Rectum	22,159	30	0.14	148	0.67	1	0.00	2	0.01	21,978
Men	Finland	Rectum	13,638	61	0.45	142	1.04	2	0.01	5	0.04	13,428
Men	Iceland	Rectum	488	2	0.41	1	0.20	0	0.00	0	0.00	485
Men	Norway	Rectum	17,595	45	0.26	29	0.16	1	0.01	16	0.09	17,504
Men	Sweden	Rectum	29,330	0	0.00	349	1.19	2	0.01	8	0.03	28,971
Men	Denmark	Lung	58,377	480	0.82	1,243	2.13	6	0.01	105	0.18	56,543
Men	Finland	Lung	45,105	957	2.12	2,241	4.97	9	0.02	64	0.14	41,834
Men	Iceland	Lung	1,935	8	0.41	30	1.55	1	0.05	14	0.72	1,882
Men	Norway	Lung	37,648	609	1.62	212	0.56	10	0.03	212	0.56	36,605
Men	Sweden	Lung	48,893	0	0.00	2,321	4.75	12	0.02	148	0.30	46,412
Men	Denmark	Melanoma	17,530	8	0.05	23	0.13	49	0.28	0	0.00	17,450
Men	Finland	Melanoma	12,214	5	0.04	26	0.21	36	0.29	0	0.00	12,147
Men	Iceland	Melanoma	442	0	0.00	0	0.00	4	0.90	0	0.00	438
Men	Norway	Melanoma	16,326	0	0.00	2	0.01	28	0.17	14	0.09	16,282
Men	Sweden	Melanoma	29,044	0	0.00	8	0.03	42	0.14	0	0.00	28,994
Men	Denmark	Kidney	10,725	42	0.39	468	4.36	98	0.91	2	0.02	10,115
Men	Finland	Kidney	11,710	173	1.48	725	6.19	116	0.99	0	0.00	10,696
Men	Iceland	Kidney	774	0	0.00	62	8.01	7	0.90	0	0.00	705
Men	Norway	Kidney	10,178	153	1.50	265	2.60	77	0.76	0	0.00	9,683
Men	Sweden	Kidney	16,220	0	0.00	1,110	6.84	190	1.17	0	0.00	14,920
Men	Denmark	Prostate	80,024	250	0.31	558	0.70	1	0.00	6	0.01	79,209
Men	Finland	Prostate	100,980	328	0.32	783	0.78	0	0.00	13	0.01	99,856
Men	Iceland	Prostate	4,888	7	0.14	88	1.80	0	0.00	3	0.06	4,790
Men	Norway	Prostate	96,016	939	0.98	538	0.56	5	0.01	14	0.01	94,520
Men	Sweden	Prostate	219,391	0	0.00	2,394	1.09	1	0.00	15	0.01	216,981

[a] % of initial number of cases.

Supplementary table 2. Cancer population weights used for age standardizing survival, adapted from International Cancer Survival Standard (ICSS) weights

Age group	All sites except melanoma (from ICSS 1)	Melanoma (from ICSS 2)
18-49 years	0.11906	0.36283
50-59 years	0.16735	0.18611
60-69 years	0.27593	0.22098
70-79 years	0.28897	0.16262
80+ years	0.14869	0.06746

Supplementary table 3. Population weights used for age standardizing incidence and mortality rates, Nordic age distribution in 2000 as used in NORDCAN

Age group	Weight
0-4 years	5900
5-9 years	6600
10-14 years	6200
15-19 years	5800
20-24 years	6100
25-29 years	6800
30-34 years	7300
35-39 years	7300
40-44 years	7000
45-49 years	6900
50-54 years	7400
55-59 years	6100
60-64 years	4800
65-69 years	4100
70-74 years	3900
75-79 years	3500
80-84 years	2400
85+ years	1900

Supplementary table 4. Trends in 1-year relative survival 1990-2015 with 95% confidence intervals, the NORDCAN survival studies

Sex	Country	Site	1990	1995	2000	2005	2010	2015
Women	Denmark	Colon	70 (68-71)	71 (70-72)	73 (72-73)	75 (75-76)	80 (79-81)	86 (85-87)
Women	Finland	Colon	72 (70-74)	77 (76-78)	80 (80-81)	82 (81-83)	83 (82-84)	84 (83-85)
Women	Iceland	Colon	76 (69-84)	77 (73-81)	79 (75-83)	83 (80-86)	84 (82-87)	83 (79-87)
Women	Norway	Colon	73 (72-75)	76 (76-77)	79 (78-79)	80 (80-81)	83 (82-83)	86 (85-87)
Women	Sweden	Colon	75 (74-76)	78 (78-79)	81 (80-82)	83 (82-84)	84 (84-85)	84 (84-85)
Women	Denmark	Rectum	75 (73-77)	76 (75-77)	78 (77-79)	81 (81-82)	85 (85-86)	89 (88-90)
Women	Finland	Rectum	78 (76-81)	81 (80-82)	83 (82-84)	85 (84-86)	86 (85-87)	87 (86-89)
Women	Iceland	Rectum	79 (69-90)	75 (69-82)	78 (72-84)	87 (83-91)	92 (89-96)	90 (85-96)
Women	Norway	Rectum	80 (78-82)	82 (81-83)	84 (83-85)	86 (85-87)	88 (87-89)	90 (88-91)
Women	Sweden	Rectum	81 (79-82)	83 (82-84)	85 (84-86)	86 (86-87)	87 (87-88)	89 (88-90)
Women	Denmark	Lung	24 (23-25)	28 (27-28)	32 (31-32)	37 (36-38)	45 (44-45)	55 (54-55)
Women	Finland	Lung	36 (34-38)	39 (38-41)	43 (41-44)	44 (43-45)	46 (45-47)	47 (46-49)
Women	Iceland	Lung	35 (29-41)	35 (32-39)	38 (35-42)	44 (41-47)	49 (46-52)	53 (49-58)
Women	Norway	Lung	32 (30-34)	33 (32-34)	35 (34-36)	40 (39-41)	46 (46-47)	54 (52-55)
Women	Sweden	Lung	31 (30-33)	36 (35-36)	40 (39-41)	45 (44-45)	50 (49-51)	56 (55-57)
Women	Denmark	Melanoma	96 (95-97)	97 (96-97)	97 (97-98)	97 (97-98)	98 (97-98)	99 (98-99)
Women	Finland	Melanoma	96 (95-98)	97 (96-97)	97 (96-98)	98 (97-98)	98 (98-99)	99 (99-99)
Women	Iceland	Melanoma[a]	95 (83-98)	96 (87-99)	98 (85-100)	94 (87-97)	98 (90-99)	99 (86-100)
Women	Norway	Melanoma	97 (96-98)	97 (96-97)	97 (96-97)	97 (97-97)	97 (97-98)	98 (98-99)
Women	Sweden	Melanoma	98 (97-99)	98 (98-99)	99 (98-99)	99 (99-99)	99 (99-99)	99 (99-99)
Women	Denmark	Kidney	57 (54-61)	57 (55-59)	60 (58-62)	67 (65-69)	77 (75-78)	85 (84-87)
Women	Finland	Kidney	70 (67-73)	75 (73-76)	77 (76-78)	80 (78-81)	81 (80-82)	83 (81-84)
Women	Iceland	Kidney	59 (46-76)	67 (60-74)	73 (66-79)	75 (70-81)	78 (73-84)	86 (79-93)
Women	Norway	Kidney	69 (66-72)	70 (68-72)	73 (71-74)	78 (76-79)	83 (82-84)	87 (85-89)
Women	Sweden	Kidney	70 (68-73)	72 (70-73)	75 (74-76)	81 (80-82)	87 (86-88)	91 (89-92)
Women	Denmark	Breast	91 (91-92)	92 (92-92)	93 (93-94)	95 (95-95)	96 (96-97)	97 (97-97)
Women	Finland	Breast	94 (94-95)	95 (95-95)	96 (95-96)	96 (96-96)	97 (96-97)	97 (97-98)
Women	Iceland	Breast	92 (88-96)	95 (94-97)	97 (95-98)	97 (96-98)	97 (96-98)	97 (95-98)
Women	Norway	Breast	93 (92-94)	94 (94-95)	95 (95-96)	96 (96-96)	97 (96-97)	97 (97-98)
Women	Sweden	Breast	95 (95-96)	96 (96-96)	97 (96-97)	97 (97-97)	97 (97-98)	98 (98-98)
Women	Denmark	Uterus	89 (87-91)	90 (89-90)	90 (90-91)	91 (91-92)	93 (92-93)	94 (93-95)
Women	Finland	Uterus	90 (89-92)	91 (90-92)	92 (91-93)	93 (92-93)	93 (93-94)	93 (92-94)
Women	Iceland	Uterus[a]	85 (73-92)	86 (77-92)	91 (83-95)	88 (80-93)	92 (83-96)	91 (81-96)
Women	Norway	Uterus	86 (84-88)	90 (89-91)	92 (91-92)	92 (92-93)	93 (92-94)	94 (93-95)
Women	Sweden	Uterus	91 (90-92)	93 (92-93)	94 (94-94)	94 (94-95)	94 (94-95)	94 (93-95)
Women	Denmark	Ovary	62 (60-64)	64 (63-65)	67 (66-68)	72 (71-73)	76 (75-77)	80 (79-82)
Women	Finland	Ovary	63 (61-66)	69 (68-71)	74 (73-75)	78 (77-79)	79 (78-80)	77 (75-78)
Women	Iceland	Ovary[a]	62 (50-71)	73 (62-81)	69 (58-78)	73 (61-82)	78 (67-86)	67 (48-81)
Women	Norway	Ovary	64 (61-66)	69 (68-70)	73 (72-74)	75 (74-77)	77 (76-78)	79 (78-81)
Women	Sweden	Ovary	67 (66-69)	75 (74-76)	79 (78-80)	81 (80-82)	84 (83-85)	87 (86-89)
Men	Denmark	Colon	66 (64-67)	68 (67-69)	70 (69-71)	74 (73-74)	79 (78-80)	86 (85-86)
Men	Finland	Colon	71 (69-73)	75 (74-76)	78 (77-79)	80 (80-81)	82 (81-82)	83 (82-84)
Men	Iceland	Colon	75 (67-83)	74 (70-79)	76 (72-80)	80 (77-83)	83 (80-86)	83 (79-87)
Men	Norway	Colon	70 (68-72)	73 (72-74)	76 (75-77)	78 (77-79)	81 (80-81)	84 (83-85)
Men	Sweden	Colon	73 (71-74)	77 (76-77)	80 (79-81)	82 (82-83)	84 (83-84)	84 (83-85)

Men	Denmark	Rectum	73 (71-75)	74 (73-75)	77 (76-78)	80 (80-81)	85 (84-86)	90 (89-90)
Men	Finland	Rectum	75 (73-78)	78 (77-79)	81 (79-82)	83 (82-84)	84 (83-85)	86 (84-87)
Men	Iceland	Rectum	81 (71-92)	78 (72-85)	81 (75-87)	88 (84-92)	91 (87-94)	81 (75-88)
Men	Norway	Rectum	77 (76-79)	79 (78-80)	81 (80-82)	84 (83-85)	87 (86-88)	89 (88-90)
Men	Sweden	Rectum	78 (76-79)	81 (80-82)	83 (82-84)	85 (84-85)	86 (86-87)	87 (86-88)
Men	Denmark	Lung	23 (22-24)	26 (25-26)	29 (28-29)	32 (32-33)	38 (38-39)	46 (45-47)
Men	Finland	Lung	33 (32-35)	35 (34-35)	36 (35-37)	36 (35-37)	37 (36-37)	38 (37-40)
Men	Iceland	Lung	33 (28-39)	33 (30-36)	34 (31-38)	39 (36-42)	42 (39-46)	45 (40-50)
Men	Norway	Lung	29 (27-30)	29 (29-30)	31 (30-32)	35 (34-36)	40 (40-41)	46 (45-48)
Men	Sweden	Lung	28 (27-30)	32 (31-32)	35 (34-36)	38 (38-39)	43 (42-44)	48 (47-50)
Men	Denmark	Melanoma	92 (91-94)	94 (93-94)	95 (94-95)	95 (95-96)	96 (96-97)	98 (97-98)
Men	Finland	Melanoma	94 (93-96)	94 (93-95)	94 (93-95)	94 (94-95)	95 (95-96)	96 (96-97)
Men	Iceland	Melanoma[a]	91 (73-98)	92 (80-97)	94 (86-97)	94 (87-98)	96 (88-98)	87 (73-94)
Men	Norway	Melanoma	93 (91-94)	93 (92-94)	94 (93-94)	94 (93-95)	95 (94-95)	97 (96-97)
Men	Sweden	Melanoma	96 (95-97)	97 (96-97)	97 (97-98)	98 (97-98)	98 (98-99)	99 (99-99)
Men	Denmark	Kidney	58 (55-62)	58 (57-60)	61 (59-62)	68 (67-70)	78 (76-79)	85 (84-87)
Men	Finland	Kidney	69 (66-72)	72 (71-73)	74 (73-76)	76 (75-77)	79 (78-80)	81 (80-83)
Men	Iceland	Kidney	65 (55-78)	74 (69-79)	77 (72-83)	79 (74-83)	80 (75-85)	83 (76-89)
Men	Norway	Kidney	66 (63-69)	67 (65-68)	69 (68-71)	75 (74-77)	82 (80-83)	85 (83-87)
Men	Sweden	Kidney	68 (66-71)	69 (68-70)	73 (71-74)	80 (78-81)	86 (85-87)	90 (89-91)
Men	Denmark	Prostate	83 (81-84)	84 (83-85)	88 (88-89)	94 (94-95)	98 (97-98)	97 (97-98)
Men	Finland	Prostate	88 (86-90)	94 (94-95)	97 (97-97)	98 (98-98)	98 (98-99)	98 (98-99)
Men	Iceland	Prostate	91 (87-95)	94 (92-96)	96 (94-97)	97 (96-98)	97 (97-98)	97 (96-99)
Men	Norway	Prostate	89 (88-90)	92 (92-92)	95 (94-95)	97 (97-97)	98 (98-98)	98 (97-98)
Men	Sweden	Prostate	91 (90-92)	94 (94-94)	96 (96-97)	98 (98-98)	99 (98-99)	99 (98-99)

[a] Age-standardized Pohar Perme estimates over 5-year intervals of calendar year. The column year is the start of each interval.

Supplementary table 5. Trends in 5-year relative survival 1990-2010 and period estimates for the latest available 5-year period with 95% confidence intervals, the NORDCAN survival studies

Sex	Country	Site	1990	1995	2000	2005	2010	Period[a]
Women	Denmark	Colon	46 (44-48)	49 (48-50)	53 (52-54)	56 (55-57)	62 (61-63)	68 (67-69)
Women	Finland	Colon	53 (51-56)	59 (57-60)	63 (61-64)	65 (64-66)	66 (65-67)	68 (66-70)
Women	Iceland	Colon	56 (47-68)	56 (50-62)	58 (53-64)	64 (59-69)	65 (61-70)	62 (57-68)
Women	Norway	Colon	53 (50-55)	56 (55-57)	58 (57-60)	61 (60-63)	66 (65-67)	69 (68-71)
Women	Sweden	Colon	53 (52-55)	56 (55-57)	60 (59-61)	64 (63-65)	66 (65-67)	65 (64-67)
Women	Denmark	Rectum	43 (40-46)	48 (46-49)	53 (51-54)	58 (57-59)	65 (64-67)	71 (70-73)
Women	Finland	Rectum	51 (48-54)	56 (54-57)	60 (59-62)	65 (64-67)	68 (67-70)	69 (67-72)
Women	Iceland	Rectum	49 (36-66)	50 (42-60)	55 (47-65)	65 (58-73)	77 (71-84)	78 (70-88)
Women	Norway	Rectum	54 (51-57)	58 (57-60)	63 (61-64)	66 (65-68)	69 (68-71)	71 (69-73)
Women	Sweden	Rectum	55 (52-57)	59 (58-60)	62 (61-63)	64 (63-66)	66 (65-67)	68 (66-69)
Women	Denmark	Lung	6 (6-7)	7 (7-8)	9 (9-10)	12 (12-12)	17 (17-18)	23 (22-24)
Women	Finland	Lung	12 (11-14)	14 (13-15)	15 (14-16)	16 (15-17)	17 (17-18)	19 (17-20)
Women	Iceland	Lung	11 (8-16)	13 (10-15)	15 (13-18)	18 (15-20)	22 (20-26)	26 (22-31)
Women	Norway	Lung	10 (9-12)	12 (11-12)	13 (12-14)	15 (15-16)	20 (19-21)	26 (25-27)
Women	Sweden	Lung	11 (10-12)	13 (12-14)	15 (14-16)	17 (17-18)	21 (20-22)	24 (23-25)
Women	Denmark	Melanoma	86 (84-88)	88 (87-89)	90 (89-91)	92 (91-92)	93 (93-94)	95 (94-96)
Women	Finland	Melanoma	85 (82-88)	87 (85-88)	88 (87-89)	90 (88-91)	92 (91-93)	94 (93-95)
Women	Iceland	Melanoma[b]	86 (70-94)	93 (79-98)	86 (68-94)	85 (74-92)	93 (83-98)	97 (87-99)
Women	Norway	Melanoma	88 (87-90)	89 (88-90)	89 (88-90)	89 (88-90)	90 (90-91)	93 (92-94)
Women	Sweden	Melanoma	91 (90-93)	91 (91-92)	92 (91-93)	93 (92-93)	94 (93-94)	94 (94-95)
Women	Denmark	Kidney	38 (34-42)	38 (36-40)	41 (39-43)	50 (48-52)	61 (59-63)	69 (66-72)
Women	Finland	Kidney	54 (51-58)	59 (57-61)	62 (60-64)	65 (63-67)	67 (65-68)	68 (66-71)
Women	Iceland	Kidney	44 (31-63)	51 (44-60)	58 (51-66)	63 (57-71)	67 (61-74)	73 (64-82)
Women	Norway	Kidney	50 (46-54)	52 (50-54)	56 (54-59)	63 (61-66)	72 (70-74)	75 (72-78)
Women	Sweden	Kidney	50 (47-53)	53 (51-54)	57 (55-59)	65 (63-66)	72 (70-73)	75 (73-78)
Women	Denmark	Breast	71 (69-72)	75 (74-76)	79 (79-80)	84 (83-84)	86 (86-87)	87 (87-88)
Women	Finland	Breast	79 (77-80)	83 (82-83)	85 (85-86)	88 (87-88)	90 (89-90)	90 (90-91)
Women	Iceland	Breast	73 (67-80)	81 (78-84)	85 (82-88)	87 (85-89)	86 (84-89)	87 (84-90)
Women	Norway	Breast	74 (73-76)	80 (79-81)	83 (82-84)	85 (85-86)	88 (87-89)	89 (88-90)
Women	Sweden	Breast	82 (81-82)	83 (83-84)	85 (85-86)	88 (87-88)	89 (89-90)	90 (89-90)
Women	Denmark	Uterus	77 (74-79)	78 (77-79)	79 (78-81)	81 (80-82)	81 (80-83)	82 (81-84)
Women	Finland	Uterus	78 (76-81)	81 (79-82)	83 (81-84)	84 (83-85)	84 (83-85)	84 (82-85)
Women	Iceland	Uterus[b]	62 (47-74)	68 (57-77)	82 (69-90)	76 (65-84)	81 (65-90)	84 (73-91)
Women	Norway	Uterus	73 (70-76)	77 (76-78)	80 (79-82)	82 (81-83)	83 (82-85)	84 (83-86)
Women	Sweden	Uterus	77 (75-79)	81 (80-82)	84 (83-85)	85 (84-86)	84 (83-85)	84 (83-85)
Women	Denmark	Ovary	28 (26-30)	29 (28-31)	32 (31-34)	37 (36-38)	41 (39-42)	42 (40-44)
Women	Finland	Ovary	31 (28-33)	36 (35-38)	42 (41-44)	47 (45-48)	45 (44-47)	44 (42-46)
Women	Iceland	Ovary[b]	35 (24-45)	35 (24-46)	43 (33-54)	40 (28-51)	42 (30-54)	46 (35-56)
Women	Norway	Ovary	32 (30-35)	36 (35-37)	40 (38-41)	43 (41-44)	45 (43-46)	47 (45-50)
Women	Sweden	Ovary	37 (35-39)	41 (39-42)	43 (42-45)	45 (44-46)	48 (47-49)	51 (49-52)
Men	Denmark	Colon	42 (40-44)	46 (45-47)	50 (48-51)	53 (52-55)	60 (59-61)	67 (65-68)
Men	Finland	Colon	51 (48-54)	56 (54-57)	59 (58-61)	62 (61-63)	64 (63-66)	66 (64-68)
Men	Iceland	Colon	56 (46-68)	54 (49-60)	55 (50-61)	62 (58-67)	65 (61-70)	66 (60-72)
Men	Norway	Colon	48 (45-50)	52 (51-53)	56 (55-57)	59 (58-60)	62 (61-63)	65 (64-67)

Men	Sweden	Colon	52 (50-54)	54 (53-55)	57 (56-58)	61 (61-62)	64 (63-65)	63 (62-65)
Men	Denmark	Rectum	41 (38-43)	46 (44-47)	51 (49-52)	56 (54-57)	63 (62-64)	69 (67-71)
Men	Finland	Rectum	47 (44-51)	52 (51-54)	57 (55-59)	62 (60-63)	64 (62-66)	65 (63-67)
Men	Iceland	Rectum	53 (37-75)	56 (47-66)	61 (53-70)	68 (61-75)	73 (66-80)	67 (59-76)
Men	Norway	Rectum	48 (46-51)	53 (52-55)	58 (56-59)	62 (61-64)	67 (65-68)	69 (68-71)
Men	Sweden	Rectum	50 (48-52)	54 (53-55)	58 (57-59)	61 (60-62)	63 (62-64)	65 (64-66)
Men	Denmark	Lung	6 (5-7)	7 (6-7)	8 (7-8)	9 (9-10)	13 (12-13)	17 (16-18)
Men	Finland	Lung	9 (8-10)	9 (9-10)	9 (9-10)	10 (9-10)	11 (11-12)	13 (12-14)
Men	Iceland	Lung	10 (7-15)	12 (10-14)	13 (11-16)	14 (12-17)	17 (15-20)	20 (17-25)
Men	Norway	Lung	8 (7-9)	9 (8-9)	10 (9-10)	11 (11-12)	15 (15-16)	19 (18-20)
Men	Sweden	Lung	9 (8-9)	10 (9-10)	11 (11-12)	13 (12-13)	15 (15-16)	19 (18-20)
Men	Denmark	Melanoma	75 (72-78)	78 (76-79)	81 (79-82)	84 (83-85)	88 (88-89)	91 (90-92)
Men	Finland	Melanoma	77 (74-81)	79 (78-81)	81 (80-83)	83 (82-85)	86 (85-87)	87 (86-89)
Men	Iceland	Melanoma[b]	68 (43-84)	73 (56-84)	82 (71-89)	78 (66-87)	85 (73-91)	86 (76-91)
Men	Norway	Melanoma	77 (75-80)	78 (76-79)	78 (76-79)	78 (77-80)	83 (82-84)	87 (86-89)
Men	Sweden	Melanoma	85 (83-86)	85 (84-86)	86 (85-86)	87 (87-88)	89 (89-90)	91 (90-92)
Men	Denmark	Kidney	38 (34-42)	37 (35-39)	40 (38-42)	49 (48-51)	60 (59-62)	67 (65-69)
Men	Finland	Kidney	50 (47-54)	54 (52-56)	57 (55-59)	59 (57-61)	62 (61-64)	65 (62-67)
Men	Iceland	Kidney	43 (32-58)	52 (46-59)	58 (51-65)	62 (56-68)	64 (58-70)	65 (58-73)
Men	Norway	Kidney	47 (43-51)	47 (46-49)	51 (49-53)	58 (56-60)	67 (65-69)	72 (70-74)
Men	Sweden	Kidney	47 (45-50)	49 (48-51)	54 (52-55)	61 (60-63)	69 (67-70)	74 (72-76)
Men	Denmark	Prostate	37 (35-39)	44 (42-45)	57 (56-58)	77 (76-77)	88 (88-89)	87 (86-87)
Men	Finland	Prostate	53 (50-56)	75 (74-76)	87 (86-88)	93 (92-93)	94 (94-95)	94 (93-95)
Men	Iceland	Prostate	68 (60-77)	74 (71-78)	81 (78-84)	87 (85-89)	88 (86-90)	89 (86-91)
Men	Norway	Prostate	56 (53-58)	69 (68-70)	79 (79-80)	87 (86-87)	92 (91-92)	93 (92-94)
Men	Sweden	Prostate	61 (59-62)	73 (72-74)	83 (82-83)	90 (90-90)	92 (92-92)	91 (91-92)

[a] Follow-up window for Denmark, Norway and Sweden: 2013-2017; Finland: 2013-2016; Iceland: 2012-2017.
[b] Age-standardized Pohar Perme estimates over 5-year intervals of calendar year. The column year is the start of each interval.

Supplementary table 6. Trends in 5-year relative survival conditional on surviving 1 year 1990-2010 and period estimates for the latest available 5-year period with 95% confidence intervals, the NORDCAN survival studies

Sex	Country	Site	1990	1995	2000	2005	2010	Period[a]
Women	Denmark	Colon	66 (64-68)	70 (69-71)	72 (71-74)	74 (73-75)	77 (76-78)	80 (79-81)
Women	Finland	Colon	74 (71-77)	76 (75-77)	78 (77-79)	79 (78-80)	80 (78-81)	80 (78-82)
Women	Iceland	Colon	74 (65-83)	72 (67-78)	73 (68-79)	77 (73-81)	77 (73-82)	75 (70-81)
Women	Norway	Colon	72 (70-74)	73 (72-74)	74 (73-75)	76 (75-77)	80 (79-81)	82 (80-83)
Women	Sweden	Colon	71 (70-73)	72 (71-73)	74 (73-75)	77 (77-78)	79 (78-80)	78 (77-79)
Women	Denmark	Rectum	58 (55-61)	63 (61-64)	67 (66-69)	71 (70-73)	77 (75-78)	80 (79-82)
Women	Finland	Rectum	65 (61-69)	69 (67-70)	73 (71-74)	76 (75-78)	79 (78-81)	80 (78-82)
Women	Iceland	Rectum	62 (49-78)	67 (59-76)	71 (63-80)	75 (68-82)	83 (78-89)	86 (79-94)
Women	Norway	Rectum	67 (64-70)	71 (70-73)	75 (73-76)	77 (76-78)	79 (77-80)	79 (77-81)
Women	Sweden	Rectum	68 (66-70)	71 (70-72)	73 (72-74)	75 (74-76)	76 (75-77)	76 (75-78)
Women	Denmark	Lung	26 (23-28)	27 (26-28)	29 (28-30)	32 (31-34)	39 (38-40)	44 (42-45)
Women	Finland	Lung	34 (31-38)	35 (33-37)	36 (34-38)	36 (35-38)	38 (37-40)	41 (38-43)
Women	Iceland	Lung	31 (24-41)	35 (31-40)	39 (34-44)	40 (36-45)	46 (42-50)	50 (44-56)
Women	Norway	Lung	33 (30-36)	35 (33-37)	37 (35-38)	38 (37-40)	44 (42-45)	49 (48-51)
Women	Sweden	Lung	36 (34-39)	37 (35-38)	37 (36-39)	39 (38-40)	42 (41-43)	44 (42-45)
Women	Denmark	Melanoma	90 (88-92)	91 (90-92)	93 (92-93)	94 (93-95)	95 (95-96)	96 (95-97)
Women	Finland	Melanoma	88 (86-91)	90 (88-91)	91 (90-92)	92 (91-93)	93 (93-94)	95 (93-96)
Women	Iceland	Melanoma[b]	91 (73-97)	97 (78-100)	88 (69-95)	91 (78-96)	96 (85-99)	98 (87-100)
Women	Norway	Melanoma	91 (90-93)	92 (91-93)	92 (91-93)	92 (91-93)	93 (92-94)	94 (93-95)
Women	Sweden	Melanoma	93 (92-94)	93 (92-94)	93 (93-94)	94 (93-94)	95 (94-95)	95 (94-96)
Women	Denmark	Kidney	67 (62-72)	67 (64-69)	69 (66-71)	74 (72-76)	79 (77-81)	82 (79-84)
Women	Finland	Kidney	77 (73-80)	79 (77-81)	80 (79-82)	81 (80-83)	82 (81-84)	83 (80-85)
Women	Iceland	Kidney	75 (62-91)	77 (70-84)	80 (74-87)	84 (79-90)	86 (81-92)	84 (77-91)
Women	Norway	Kidney	73 (69-77)	75 (72-77)	78 (76-80)	82 (80-84)	86 (84-88)	87 (85-89)
Women	Sweden	Kidney	72 (69-75)	73 (72-75)	76 (74-78)	80 (78-81)	83 (81-84)	85 (83-87)
Women	Denmark	Breast	77 (76-79)	81 (81-82)	85 (84-85)	88 (87-88)	90 (89-90)	90 (90-91)
Women	Finland	Breast	83 (82-85)	87 (86-87)	89 (89-90)	91 (91-92)	93 (92-93)	93 (92-94)
Women	Iceland	Breast	80 (74-86)	85 (82-87)	88 (86-90)	89 (87-91)	89 (87-91)	90 (87-92)
Women	Norway	Breast	80 (79-82)	85 (84-85)	87 (87-88)	89 (88-90)	91 (90-92)	92 (91-92)
Women	Sweden	Breast	86 (85-87)	87 (86-87)	88 (88-89)	90 (90-91)	92 (91-92)	92 (91-92)
Women	Denmark	Uterus	86 (84-89)	87 (86-88)	88 (87-89)	88 (87-90)	88 (87-89)	88 (86-89)
Women	Finland	Uterus	87 (84-89)	88 (87-90)	90 (89-91)	91 (90-92)	90 (89-91)	90 (89-92)
Women	Iceland	Uterus[b]	73 (56-84)	79 (67-88)	90 (76-96)	86 (75-93)	88 (69-96)	92 (78-97)
Women	Norway	Uterus	85 (82-88)	86 (85-87)	88 (86-89)	89 (88-90)	90 (88-91)	89 (88-91)
Women	Sweden	Uterus	84 (83-86)	88 (87-88)	90 (89-90)	90 (89-91)	89 (88-90)	89 (88-90)
Women	Denmark	Ovary	45 (42-48)	46 (44-47)	48 (46-50)	52 (50-53)	53 (52-55)	53 (51-55)
Women	Finland	Ovary	49 (45-52)	52 (51-54)	57 (55-59)	60 (58-61)	58 (56-59)	56 (54-58)
Women	Iceland	Ovary[b]	56 (41-69)	48 (34-61)	63 (49-74)	54 (40-66)	54 (39-67)	60 (47-70)
Women	Norway	Ovary	51 (47-54)	52 (50-54)	54 (53-56)	57 (55-58)	58 (56-60)	59 (57-62)
Women	Sweden	Ovary	55 (52-57)	54 (53-56)	55 (54-57)	56 (54-57)	57 (55-58)	59 (57-60)
Men	Denmark	Colon	64 (62-67)	68 (67-69)	71 (69-72)	73 (72-74)	75 (74-77)	79 (77-80)
Men	Finland	Colon	72 (69-75)	74 (72-75)	76 (74-77)	77 (76-78)	79 (78-80)	80 (78-82)
Men	Iceland	Colon	75 (66-85)	73 (68-78)	73 (68-78)	77 (73-81)	78 (74-82)	79 (74-84)
Men	Norway	Colon	68 (66-71)	71 (70-73)	74 (72-75)	75 (74-76)	77 (76-78)	78 (76-79)

Men	Sweden	Colon	72 (70-74)	70 (69-71)	72 (71-73)	75 (74-76)	76 (75-77)	76 (75-77)
Men	Denmark	Rectum	56 (53-59)	61 (60-63)	66 (64-67)	69 (68-71)	74 (73-75)	78 (76-80)
Men	Finland	Rectum	63 (59-67)	67 (65-69)	71 (69-73)	74 (73-76)	76 (74-77)	76 (74-78)
Men	Iceland	Rectum	66 (51-84)	71 (63-80)	76 (69-83)	77 (71-83)	80 (74-87)	82 (74-90)
Men	Norway	Rectum	63 (60-66)	67 (66-69)	71 (70-73)	74 (73-75)	76 (75-78)	78 (76-80)
Men	Sweden	Rectum	64 (62-67)	67 (66-68)	70 (68-71)	72 (71-73)	74 (73-75)	75 (74-76)
Men	Denmark	Lung	26 (24-28)	26 (25-27)	27 (26-28)	29 (28-30)	34 (33-35)	37 (36-39)
Men	Finland	Lung	26 (24-28)	26 (25-27)	26 (25-28)	27 (26-28)	31 (29-32)	33 (31-36)
Men	Iceland	Lung	32 (24-42)	35 (30-40)	37 (32-43)	37 (33-42)	41 (36-46)	44 (37-51)
Men	Norway	Lung	28 (26-31)	30 (28-31)	31 (30-32)	32 (31-34)	38 (37-39)	43 (41-45)
Men	Sweden	Lung	30 (28-32)	31 (30-32)	32 (31-33)	34 (32-35)	36 (35-37)	39 (38-41)
Men	Denmark	Melanoma	81 (78-84)	83 (82-84)	85 (84-87)	89 (88-90)	92 (91-93)	93 (92-94)
Men	Finland	Melanoma	82 (79-85)	85 (83-86)	87 (85-88)	88 (87-89)	90 (89-91)	91 (89-92)
Men	Iceland	Melanoma[b]	75 (47-90)	79 (62-89)	87 (76-94)	83 (70-90)	88 (77-94)	91 (82-96)
Men	Norway	Melanoma	84 (81-86)	83 (82-85)	83 (82-84)	84 (82-85)	87 (86-88)	91 (89-92)
Men	Sweden	Melanoma	88 (86-90)	88 (87-88)	88 (87-89)	89 (89-90)	91 (90-92)	92 (91-93)
Men	Denmark	Kidney	65 (60-69)	64 (62-66)	66 (63-68)	72 (70-74)	78 (76-79)	80 (77-82)
Men	Finland	Kidney	73 (69-77)	75 (73-77)	77 (75-79)	77 (76-79)	79 (77-81)	80 (77-83)
Men	Iceland	Kidney	66 (54-81)	71 (65-77)	75 (69-81)	79 (73-84)	80 (75-85)	82 (75-89)
Men	Norway	Kidney	71 (67-75)	71 (69-74)	73 (71-75)	77 (75-79)	82 (80-84)	85 (83-87)
Men	Sweden	Kidney	69 (66-72)	71 (69-73)	74 (72-75)	77 (76-79)	80 (79-82)	83 (81-84)
Men	Denmark	Prostate	45 (42-47)	52 (51-53)	64 (63-65)	81 (81-82)	90 (90-91)	89 (88-90)
Men	Finland	Prostate	60 (57-63)	80 (79-81)	90 (89-91)	95 (94-95)	96 (95-96)	96 (95-96)
Men	Iceland	Prostate	75 (67-82)	79 (76-83)	85 (82-88)	90 (88-92)	91 (89-93)	91 (89-94)
Men	Norway	Prostate	62 (60-65)	75 (74-76)	84 (83-85)	90 (89-90)	94 (94-94)	95 (95-96)
Men	Sweden	Prostate	67 (66-69)	77 (77-78)	86 (85-86)	92 (92-92)	93 (93-94)	93 (92-93)

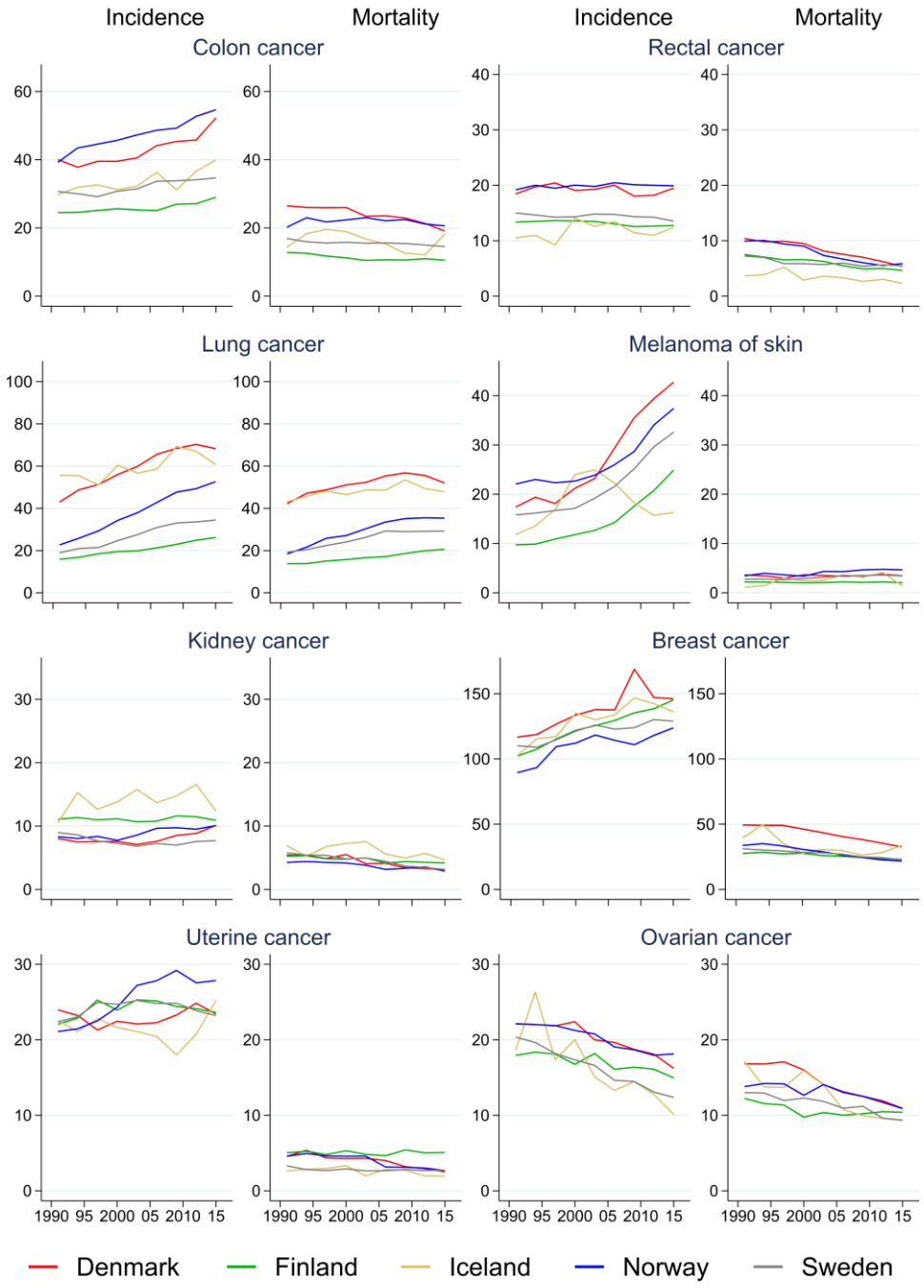
[a] Follow-up window for Denmark, Norway and Sweden: 2013-2017; Finland: 2013-2016; Iceland: 2012-2017.
[b] Age-standardized Pohar Perme estimates over 5-year intervals of calendar year. The column year is the start of each interval.

Supplementary table 7. Overview of national efforts to improve cancer care in the Nordic countries

	Denmark	Finland	Iceland	Norway	Sweden
National cancer plans	Introduced in 2000, updates 2005, 2010, 2016	Proposal for intensifying and improving cancer treatments published 2010	First cancer plan developed 2013-2016 and accepted by Ministry of Health 2019	Implemented 1999-2003, followed by national cancer strategy 2006	Cancer strategy launched 2011 and cancer plans since 2013
National care guidelines	Cancer specific patient pathways established 2007-2009 and later copied in Norway and Sweden	National guidelines for time-to-treatment published 2016	Treatment guidelines adapted from Nordic, European or American versions	Standardized patient assessment and treatment processes introduced 2014	Cancer specific national guidelines developed and updated by the regional cancer centers since 2012
Screening for colorectal cancer	Implemented over a 4-year period of biannual screening starting in 2014 for ages 50-74	Ages 60-69 randomized to screening in selected voluntary municipalities 2004-2016, and for ages 60-74 from 2019	Not started, plans to start biannual screening for ages 60-69	Several randomized studies, pilot project in two counties from 2012	Regional in Stockholm-Gotland from 2009 for ages 60-69
Screening for breast cancer	Implemented in some regions in the 1990's and for the remaining 80% of women ages 50-69 in 2007-2009	Implemented gradually 1987-1992, now biannual for ages 50-69	Started in 1987 for ages 40-69	Stepwise implementation 1995-2005 for all women aged 50-69	Started in late 1980's, now biannual for ages 40-74

More information available here:
Denmark: https://www.sst.dk/da/sygdom-og-behandling/kraeft/nationale-planer [Danish]
Finland: http://urn.fi/URN:ISBN:978-952-00-2971-5 [Finnish]; http://urn.fi/URN:ISBN:978-952-302-782-4 [Finnish]; http://urn.fi/URN:ISBN:978-952-302-813-5 [Finnish]
Iceland: https://ec.europa.eu/health/sites/health/files/state/docs/2019_chp_is_english.pdf
Norway: https://www.regjeringen.no/globalassets/upload/hod/sykehus/kreftstrategi-2006-2009.pdf [Norwegian]
Sweden: https://cancercentrum.se/samverkan/om-oss/nationella-cancerstrategin [Swedish]

Supplementary figure 1a. Incidence and mortality rates per 100 000 women, 1990-2016, the NORDCAN survival studies



Supplementary figure 1b. Incidence and mortality rates per 100 000 men, 1990-2016, the NORDCAN survival studies