

Cancer in Norway 2016

Cancer incidence, mortality,
survival and prevalence in Norway

Special issue:

The Norwegian Breast Cancer Screening Program 1996–2016

Celebrating 20 years of organised
mammographic screening



Cancer in Norway 2016

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The Norwegian Breast Cancer Screening Program, 1996–2016 Celebrating 20 years of organised mammographic screening

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Special issue

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Foreword

Because we have an aging population, the number of cancer cases increases every year. A total of 32 827 new cancer cases were diagnosed and reported in 2016. The changes are small compared with the previous year. In addition, we know that for most cancers there are some fluctuations in the rates from one year to another. Thus, to understand changes in the trends we need to compare the rates, not only from one year to another, but from the latest five-year period (2012–2016) to the previous one (2007–2011). This comparison shows a particularly large increase for melanoma of the skin, with more than a 20% increase since the previous five-year period among both men and women. Thyroid cancer is another cancer where we see a remarkable increase in incidence over time. Compared to the previous five-year period, there is a 30% rise in women, and more than 40% in men. This increase may be mostly due to increased use of ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) for other indications, and better cytological and/or histological diagnostics. We hope there is no opportunistic screening ongoing.

A few weeks ago, the Norwegian government announced that they will allocate funding over the National Budget to initiate a national screening program for colorectal cancer. We think this was a wise decision. Norwegian women have among the highest incidence rates of colorectal cancer worldwide, and we still see that the incidence rate for women is increasing more than for men. In 2016, the number of new colon cancer cases surpassed 3000. Adding the number of rectal cancer cases, more than 4300 persons were diagnosed with colorectal cancer last year.

This is the second year we complete the Cancer in Norway report already in October the following year. A challenge with this early reporting is that the numbers of some cancer types may be underestimated. The reason is that we have not yet received all the death certificates for 2016. Thus the rate of some fatal cancers, commonly first notified from death certificates, such as lung and pancreatic cancers, may be too low. This will likely remain a challenge as long as the Cause of Death Registry has not become fully electronic. Despite the fact that some lung cancers may be missing, we still feel confident that there is a continued decline in the overall age-standardised lung cancer rate for men. By contrast, the incidence rate for lung cancer has increased by 9% in women.

We are sometimes asked to comment on overdiagnosis in our report. We prefer to abstain from this, as the term is misleading and could imply that the cancer diagnoses were false. Pathologists often point out that a better term is overtreatment. Specifically, the issue is possible overtreatment of slow-growing cancers. But although there are cancers that grow slowly or remain dormant for shorter or longer time periods, presently it is not possible to predict which cancers will remain dormant, and which will change to an aggressive behaviour. Pathologists and molecular biologists would very much like to be able to predict such growth trajectories in order to improve diagnostic stratification. But we are not quite there yet. In the meantime, cancer patients will continue to receive the recommended treatment. For a large group of patients, this will be more treatment than necessary. For others, this treatment will not be sufficient to cure the disease, and these patients may die from their disease. Of the two options, over- or undertreatment, the choice seems obvious. However, a goal must be better diagnostic stratification, more targeted and just-sufficient treatment.

This year's special issue is part of the celebration of the 20th anniversary of the Norwegian Breast Cancer Screening Program. A large thank you to Solveig Hofvind and her staff. The program has come a long way over the past two decades.

Thank you to everyone who has contributed to this report, first of all thank you to everyone at the hospitals across the country, who have reported cancers to the Cancer Registry. Second, thank you to our staff for their coding of cancers and assistance with development of cancer statistics. Finally thanks to the editorial team for writing and editing this report.

Oslo, October 2017

Giske Ursin, MD, PhD, Director

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Chapter 1 Definitions

Incidence The number of new cases of a disease in a defined population within a specific period of time.

Incidence rate The number of new cases that arise in a population (incidence) divided by the number of people who are at risk of getting cancer in the same period. The rate is expressed per 100 000 person-years. Person-years is a metric that combines persons and time (in years) as the denominator in rates.

Crude rate Unadjusted rates, often estimated for the entire population, with no standardisation by age.

Age-specific rate A rate calculated by age strata, often with five-year intervals.

Age-standardisation A procedure for adjusting rates, e.g. incidence rates, designed to minimize the effects of differences in age composition when comparing rates for different populations. Referred to as age-standardised (or age-adjusted) rates. For this report, we use the Norwegian mid-year population in 2014 (referred to in the text as Norwegian standard).

Prevalence Prevalence is the number or proportion of a population that has the disease at a given point in

time. In this report we use lifetime cancer prevalence that can be defined as the number of living individuals having ever been diagnosed with cancer.

Relative survival The observed survival after a given period of time in a patient group, divided by the expected survival of a comparable group in the general population with respect to key factors affecting survival such as age, sex and calendar year of observation. Relative survival is thus determined by the mortality experienced by the patients regardless of whether an excess mortality may be directly or indirectly attributable to the disease under investigation. A key advantage is that it does not require cause-of-death information.

Conditional relative survival The probability of surviving an additional number of years given that the person has already survived X years. As the time from diagnosis lengthens, this statistic becomes more informative to survivors than the conventional relative survival estimate. A five-year conditional relative survival that reaches close to 100% some number of years after diagnosis indicates that from thereon, there is little or no excess mortality in the patient group.

Most definitions are based on Last & al, 2001^[1].

Chapter 2 Summary

The aim of the annual publication of Cancer in Norway is to provide detailed cancer statistics. This publication should help health professionals, policy-makers and researchers to identify and make decisions about areas that need more attention and investigation. This publication may also be valuable for the media, educators and members of the public with an interest in cancer. Cancer trends should be interpreted by examining rates over the past several years. This is because there is some random variation in the incidence rates from one year to another.

Further, the numbers for 2016 might be slightly under-reported due to delayed notification of cancer cases. The present report is published before the complete numbers for 2016 was received from the Cause of Death Registry. Thus, the possible under-reporting might be slightly higher for cancers with the highest percentage of cases registered based on a death certificate only (DCO).

The report is available online at:
<https://www.kreftregisteret.no/>

Incidence

A total of 32 827 new cancer cases were reported in 2016: 54.1% were among men and 45.9% were among women. Cancer in prostate, lung, colon and bladder (including the urinary tract) were the most common cancer sites in men, whereas breast, colon, lung cancer and malignant melanoma were the most common cancer sites in women. The relative impact of cancers, however, varies considerably by age.

The incidence rate for all sites combined has increased by 1.1% in men and 4.4% in women when comparing the last five-year periode (2012–2016) with the previous one.

For the most common cancers in men, the largest incidence increase in rates was observed for malignant melanoma, kidney, non-melanoma skin cancer and urinary tract. On the positive side, the rate for lung cancer has been reduced by 6%.

For the most common cancers in women, the strongest increase in incidence rate occurred for malignant melanoma, non-melanoma skin cancer, urinary tract and lung cancer. A reduction in rates was seen for cancer in ovary and corpus uteri.

Of note is that the incidence rate for thyroid cancer in men and women has increased markedly in the last decade, and is probably due to increased use of ultrasound, CT or MRI and better cytological and histological diagnostics.

The probability of being diagnosed with a cancer before the age of 75 is 36% in men, and 30% in women.

Prevalence

At the end of 2016 a total of 262 884 Norwegians were alive after having had at least one cancer diagnosis at an earlier point in time.

Mortality

There were 10 944 deaths from cancer in Norway in 2015¹. Cancer of the lung, colon, rectum, prostate and female breast cancer account for 50% of the cancer mortality.

Survival

There has been a slight increase in the five-year relative survival for most cancers when comparing the five-year periode (2012–2016) with the previous one:

Prostate cancer: Increased from 91.7% to 93.6%.

Breast cancer: Increased from 88.6% to 89.7%.

Lung cancer (M): Increased from 13.0% to 16.0%.

Lung cancer (W): Increased from 18.3% to 22.0%.

Colon cancer (M): Increased from 60.0% to 62.0%.

Colon cancer (W): Increased from 63.6% to 67.3%.

Rectum cancer (M): Increased from 65.7% to 68.5%.

Rectum cancer (W): Increased from 66.4% to 67.2%.

¹The mortality data from the Cause of Death Registry for 2016 was not complete when this report was published, and we therefore reports figures for 2015.

Table 2.1: Summary of cancer statistics for selected cancers

ICD-10	Site	Sex	Incidence number, 2016 ¹	Incidence rate, 2012–16 ²	Change in rate (%) from 2007–11 to 2012–16 ³	Mortality rate, 2015 ⁴	Survival (%), 2007–11 ⁵	Survival (%), 2012–16 ⁶
C00–96	All sites	M	17 763	728.7	1.2	261.9	69.0	72.2
		F	15 064	540.6	4.5	173.6	69.0	71.6
C18	Colon	M	1 415	59.0	2.7	24.1	60.0	62.0
		F	1 588	53.3	7.3	20.4	63.6	67.3
C19–20	Rectum, rectosigmoid	M	823	33.3	1.2	11.2	65.7	68.5
		F	517	20.0	-0.9	5.5	66.4	67.2
C33–34	Lung, trachea	M	1 615	68.6	-6.1	50.1	13.0	16.0
		F	1 465	52.1	9.4	35.0	18.3	22.0
C43	Melanoma of the skin	M	1 066	40.4	23.9	8.5	78.6	83.7
		F	1 048	36.4	23.2	4.6	88.4	90.1
C44	Skin, non-melanoma	M	1 085	46.1	11.2	...	...	...
		F	997	29.4	15.7	...	...	...
C50	Breast	F	3 371	123.8	7.0	20.5	88.6	89.7
C53	Cervix uteri	F	342	13.2	8.9	2.9	79.0	80.5
C54	Corpus uteri	F	774	27.6	-5.9	2.3	83.3	84.0
C56, C57.0–4	Ovary etc.	F	488	17.9	-7.4	...	...	...
C61	Prostate	M	5 118	207.2	-3.2	51.1	91.7	93.6
C62	Testis	M	285	11.8	-1.5	0.2	98.1	98.6
C65–68	Urinary tract	M	1 271	51.4	8.4	11.0	73.4	76.7
		F	488	16.1	15.0	3.5	65.7	69.3
C70–72	Central nervous system	M	380	19.0	-13.8	8.2	60.4	61.3
		F	460	20.3	-20.2	5.9	77.0	76.4
C73	Thyroid gland	M	137	4.4	42.8	0.8	85.9	89.6
		F	307	10.1	29.7	1.0	92.6	94.2
C82–86, C96	Non-Hodgkin lymphoma	M	587	23.3	3.9	8.4	67.5	72.6
		F	429	16.3	2.2	4.7	73.2	77.1
C91–95	Leukaemia	M	648	26.1	2.7	11.6	60.0	61.8
		F	513	17.9	4.3	5.9	64.7	67.2

¹ Number of new cases, 2016.² Age-standardised incidence rates per 100 000 person-years, 2012–16.³ Percent change in age-standardised incidence rate from the previous five-year period to the current five-year period, 2007–11 to 2012–16.⁴ Age-standardised mortality rates per 100 000 person-years, 2015. The mortality rates are presented for 2015, as complete numbers for 2016 is not yet received from the Cause of Death Registry.⁵ Five-year relative survival (%), 2007–11.⁶ Five-year relative survival (%), 2012–16.

... Not estimated in this report.

Chapter 3 Data and data sources

3.1 The population of Norway

By January 1st 2017 the total number of inhabitants in Norway was 5 258 317 (Source: Statistics Norway www.ssb.no/befolkning). Table 3.1 shows the age structure by sex for the Norwegian mid-year population in 2016. When the first census in Norway took place in 1769, the number of inhabitants was 739 180. The population has increased remarkably since then, and the growth is expected to continue the next few decades. The total number of inhabitants in Norway has increased by 46% from 1960 to 2016, largely because of rising life expectancy and, more recently, due to increases in net immigration. By 2031, the size of the population is expected to reach 6 million, and by 2060 it will reach 7 million¹ (Source: Statistics Norway www.ssb.no/folkfram). The elderly will represent an increasingly large proportion of the population of Norway over the next decades. Long-term projections estimate that 19% of the population will be 70 years or older in 2060^[2].

The immigrant population

The immigrant population is heterogeneous in relation to length of stay, country of birth and reason for immigration. The immigrant population (first-generation) constitutes of persons from 221 countries and comprises 13.8% of the total population, and an additional 3% of the Norwegian population are second-generation immigrants (born in Norway with two foreign born parents). Today, immigrants from Poland are the largest immigrant group with about 97 000 persons. Immigrants from Lithuania (37 600) and Sweden (36 300) are the second and third largest immigrant groups, when classifying immigrants by country of birth. In total, about 50% of the first-generation immigrants are from EU/EEA, US, Canada, Australia and New Zealand, 30% from Asia (incl. Turkey), and 12% from Africa (Source: Statistics Norway www.ssb.no/befolkning).

Table 3.1: Norwegian mid-year population 2016 by five-year age group and sex

Age group	Males	Females	Total
0–4	156 289	148 156	304 445
5–9	165 245	156 751	321 996
10–14	158 023	151 370	309 393
15–19	168 161	157 762	325 923
20–24	177 189	165 879	343 068
25–29	185 706	179 517	365 223
30–34	181 423	171 090	352 513
35–39	177 984	166 350	344 334
40–44	188 708	177 806	366 514
45–49	193 992	183 504	377 496
50–54	178 785	168 948	347 733
55–59	162 161	156 247	318 408
60–64	147 766	146 385	294 151
65–69	138 038	138 303	276 341
70–74	107 679	113 818	221 497
75–79	67 280	79 342	146 622
80–84	43 989	60 445	104 434
85+	38 708	77 362	116 070

¹Considered the scenario of medium national growth

3.2 The Cancer Registry of Norway

The Cancer Registry of Norway (CRN) has, since 1952, systematically collected notifications on cancer occurrence for the Norwegian population. The registration has from 1953 been considered to be close to complete, and a comprehensive study on data quality estimates the completeness to be 98.8% for the registration period 2001–05^[3]. The reporting of neoplasms has been mandatory since the implementation of a directive from the Ministry of Health and Social Affairs in January 1952. The CRN Regulations came into force in 2002 (Regulations for the collection and processing of data in the CRN).

Main objectives

The main objectives of the Cancer Registry of Norway can be summarized as follows:

- Collect data on cancer occurrence and describe the distribution of cancer and changes over time.
- Provide a basis for research on the aetiology, diagnostic procedures, natural course of the disease, and effects of treatment in order to determine appropriate preventive measures and to improve the quality of medical care.
- Provide advice and information to public authorities and the general public about preventive measures.
- Perform epidemiological research of high international standard.

Data items registered

The following must be reported to the CRN:

- All malignant neoplasms and precancerous disorders.

- All benign tumours of the central nervous system and meninges.

The incidence registry

The incidence registry contains the basic data items collected from clinicians and pathologists, as well as, data from the Norwegian Patient Registry (NPR) and mortality sources. As of October 16th 2017, the incidence registry contained information registered since 1953 on 1 862 411 cancer cases (including premalignant and some benign conditions) in 1 483 365 persons. The incidence registry is updated continuously with information on both new cases and cases diagnosed previous years. A total of 4 750 154 notifications have been registered since 1969 (earlier notifications were not registered).

The clinical registries

Clinical registries, i.e. comprehensive registration schemes dedicated to specific cancers, have been established to provide more detailed information about diagnostic procedures, pathology-examinations, treatment and follow-up. The aims are to provide data for monitoring patient outcome and survival and to be an empirical base for scientific studies concerning prognostic factors and treatment outcomes, as well as for evaluation of the quality of cancer care.

Several clinical registries are now established, and the ongoing and expanding activities of these clinical registries are a major focus for CRN. Each clinical registry has a reference group — a panel of multi-disciplinary experts from clinical and research milieus in Norway. These experts advise on the contents and activities of each clinical registry and its strategic direction. Registries are integrated in the CRN coding and registration activities. Table 3.2 shows the status of the clinical registries as of October 2017.

Table 3.2: Status of the clinical registries, October 2017

Clinical registry for	Clinical reference/ project group	Established with extended data*	Clinical parameters for electronical report specified	Electronical report form in use	National status
Colorectal cancer	Yes	Yes	Yes	Yes	2009
Prostate cancer	Yes	Yes	Yes	Yes	2009
Breast cancer	Yes	Yes	Yes	Yes	2013
Childhood cancer	Yes	Yes	Yes	Yes	2013
Gynecological cancer**	Yes	Yes	Yes	Yes	2013
Lung cancer	Yes	Yes	Yes	Yes	2013
Lymphomas and lymphoid leukaemias	Yes	Yes	Yes	Yes	2013
Malignant melanoma	Yes	Yes	Yes	Yes	2013
Oesophagus and stomach cancer	Yes	Yes	Yes	Yes	***
Sarcoma	Yes	No	Yes	No	***
Central nervous system	Yes	No	Yes	No	***
Urinary tract	Yes	No	Yes	No	***
Hematological cancer	Yes	No	Yes	No	***
Testicular cancer	Yes	No	Yes	No	***

* Either by having a separate clinical report form and/or by having a database with extended information beyond the incidence registry.

** Established for ovarian cancer, will be extended to include all gynecological cancers.

*** It has been applied for funding, but the establishment of new clinical registries in the South-Eastern health region is currently stopped in order to evaluate the ongoing registries and to discuss a better model of funding.

3.3 Sources of information

The sources of information and the notification process are illustrated in Figure 3.1. Information from clinical notifications, pathology reports and death certificates are the main sources that enables the CRN to code and store data on cancer patients in Norway. Information from the Norwegian Patient Registry is an important additional source for identifying cancer cases. The information is identified and linked by the personal identification number system that was established in Norway in 1964.

Clinical and pathological notifications

The CRN Regulations, as issued by the Ministry of Health and Social Affairs, require all health institutions in Norway involved in cancer diagnostics, treatment and follow-up to report to the CRN. Reporting should be done as soon as possible after end of diagnostics or treatment. The clinical registries use specific forms with extended information relevant for each cancer site. In addition, there are two generic forms for reporting solid or non-solid tumours not yet included in a clinical registry. These forms provide information on primary site, stage of disease, the basis for the diagnosis and primary treatment given to the patient. Clinical notifications are sent using the CRN electronical reporting service (KREMT) at the Norwegian Health Network.

More information about KREMT can be found at:

<https://www.kreftregisteret.no/Registrene/Innrapportering/KREMT---Kreftregisterets-elektroniske-meldetjeneste/>

Pathology reports from hospitals and independent laboratories provide histological, cytological or autopsy information. The amount of electronical pathology reports have increased over the past two years, but more than half of the pathology departments still send paper copies. A major focus for the future is to receive electronical and structured pathology reports to the CRN.

Death certificates

The CRN receives monthly updates on patients' vital status from the National Population Registry. In addition, the Cause of Death Registry, run by the Norwegian Institute of Public Health, send death certificates and information on cause of death throughout the year. The automated procedure that matches registered cancer cases to death certificates is important for maintaining quality control, facilitating a high level of completeness and ensuring validity of the CRN data items. Death certificates also represent a complementary source of information on new cancer cases which are not previously reported, or where the diagnosis differs. Cancer cases first identified from death certificates are traced back to the health institution responsible for the treatment of

the patient to verify the diagnosis and, if possible, get clinical information about the case.

The Norwegian Patient Registry

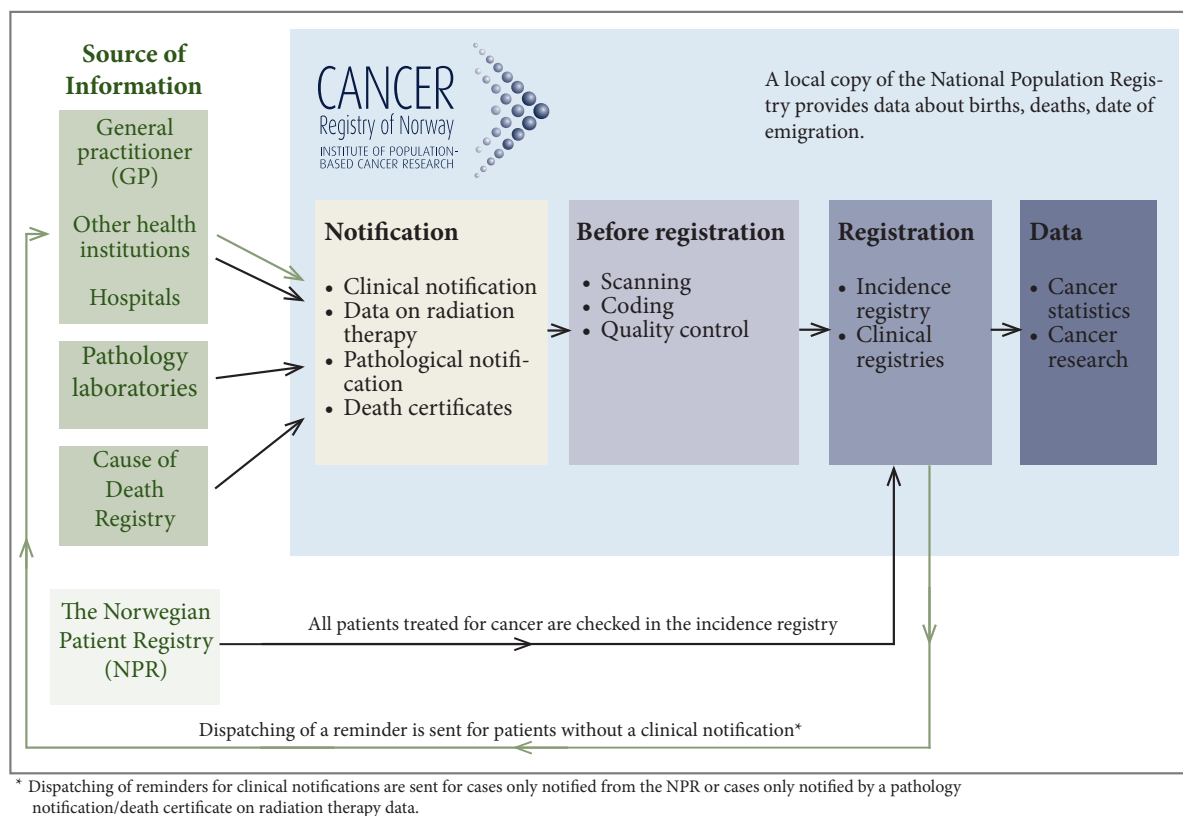
Since 2002, the CRN has received data from the Patient Administrative Data System (PAS) used in all Norwegian hospitals. Information was first sent directly from the hospitals, but from 2010 it has been provided by the Norwegian Patient Registry (NPR). The data contain information about patients who have been treated for premalignant and malignant conditions, and reminders are sent to clinicians for all cancer cases not previously

registered in the CRN. The NPR is a key source in finding information on unreported cases (Figure 3.1).

Dispatching of reminders to clinicians

It is mandatory to report clinical information on all new cases of cancer, except those diagnosed at autopsy. Thus, at least one clinical notification should be registered for each cancer case. In those cases where the clinical notification is missing for a cancer case notified from one of the other sources, a reminder is sent via the KREMT-portal to the hospital/ward/physician responsible for the treatment. The procedure for cancer registration and the dispatching of reminders are illustrated in Figure 3.1.

Figure 3.1: Sources of information and the process of cancer registration at the Cancer Registry of Norway



3.4 Incidence and mortality data

The incidence data presented in the first part of this report are based on an extraction from the incidence registry on October 16th 2017. The tables and figures in general represent either the latest year of complete incidence (2016) or the latest five-year period (2012–2016). Population data, stratified by year, sex and age, are provided by Statistics Norway.

Registered codes from ICD-7, ICD-O-2 and ICD-O-3 are converted to ICD-10 using a combination of topo-

graphy and morphology. The main cancer types are tabulated according to their ICD-10 three-digit categories. Table 3.3 gives a detailed description of specific morphologies that are included or excluded in all cancer statistics presented in the present report. The “All sites” figure comprises all malignant neoplasms (ICD-10 C00–96) and the D-diagnoses listed in Table 3.3. Corresponding mortality data coded in ICD-10 were obtained from the Cause of Death Registry and are presented in the same ICD-10 categories as for the rest of this report. Of notice is that in the subsequent tables and figures the D-codes are not shown in labels due to lack of space.

Table 3.3: Description of ICD-10 codes

ICD-10	Site	Comments
C00–96	All sites	Includes the following D-diagnoses: D32–33, D35.2–35.4, D42–43, D44.3–44.5 and D45–47. Excludes all basal cell carcinomas
C38	Heart, mediastinum and pleura	Excludes mesotheliomas (which are included in C45)
C50	Breast	Excludes pagets disease
C56, C57.0–4	Ovary etc.	Excludes borderline tumours. Includes the following sites: Neoplasms in fallopian tube (C57.0), broad ligament (C57.1), round ligament (C57.2), parametrium (C57.3) and uterine adnexa, unspecified (C57.4)
C64	Kidney except renal pelvis	Excludes non-invasive tumours
C65	Renal pelvis	Includes non-invasive papillary tumours, dysplasia and carcinoma in situ
C66	Ureter	Includes non-invasive papillary tumours, dysplasia and carcinoma in situ
C67	Bladder	Includes non-invasive papillary tumours, dysplasia and carcinoma in situ
C68	Other and unspecified urinary organs	Includes non-invasive papillary tumours, dysplasia and carcinoma in situ
C70	Meninges	Includes benign tumours (D32–33, D42–43)
C71	Brain	Includes benign tumours (D32–33, D42–43)
C72	Spinal cord, cranial nerves and other parts of central nervous system	Includes benign tumours (D32–33, D42–43)
C75	Other endocrine glands and related structures	Includes benign tumours (D35.2–35.4, D44.3–44.5)
C90	Multiple myeloma	Includes plasmacytomas (C90.2–3)
C92	Myeloid leukaemia	Includes myelodysplastic syndrome (D46)
C95	Leukaemia of unspecified cell type	Includes polycythaemia vera (D45) and other unspecified tumours in lymphatic or hematopoietic tissue (D47)

Multiple primary neoplasms

In general, multiple primaries occur where two or more primary cancers develop within the same organ (or a pair of organs), as opposed to a recurrence or progression of an existing cancer. They may occur at the same time (synchronous), or in sequences (metachronous). Multifocal tumours are counted only once. This is also the case for the systemic cancers like lymphomas, leukaemias, kaposi's sarcomas and mesotheliomas.

The rules of multiple primary neoplasms states that only one tumour is recognized as arising in an organ or pair of organs or tissue. This means that for this report, only the first invasive tumour of a defined histological type is counted within one two-digit topography code (ICD-O-3) (for example breast C50). A new cancer of the same histological group many years later in the same organ will not be counted. If there are different histological diagnoses, for example an adenocarcinoma and a sarcoma in the same organ, these will be counted as two cancers. Some organs are considered as only one organ in this respect (for example trachea C33 and lung C34). The recommendations for counting multiple primary neoplasms were outlined by the IARC/WHO/ENCR/IACR Working group in 2004. The rules are followed with the following exceptions: for metachronous cases within the same histological group, i.e. cancer cases not considered to be histological different, we report the case with the

first date of diagnosis as is. For synchronous cases we report the case with the most severe metastasis status. If the metastasis status is equal, we report the case that was registered first. This differs with respect to the IARC rules where the numerically highest ICD-O morphology code is used even if it occurs at a later point of time or if it has a less severe metastasis status at the same point of time. Non-specific groups are considered as separate morphology groups. We thus might report a slightly higher number of cases than if the IARC rules had been followed strictly (as described in table 25, page 26, World health Organization International Classification of Diseases for Oncology, third edition, first revision, 2013)^[4]. Furthermore, we do consider the groups of topographies as one organ according to table 24, page 25^[4], but in case of synchronous cancers we do not create a new topography code as described in table 24^[4].

Metastases and changes in coding practice

The coding and registration of stage has varied over time. For some cases, the Cancer Registry of Norway only receive histological reports and no clinical notifications. A large proportion of these cases lack verified information on metastases at the time of diagnosis. For patients diagnosed between 1953 and 2008, the guidelines for coding was to consider these patients as having unknown metastatic status (unknown stage). A detailed investigation

of data for these patients, including survival analyses, showed that most of them probably had a localised disease. This led to a change in the guidelines for coding for all patients diagnosed after January 1st 2009. Cancer cases without clinical notification and with no pathological information about metastasis were from this date coded as a localised stage. However, this practice might have led to misclassification of stage for some patients who were not properly examined/diagnosed due to e.g. poor health or severe comorbidity. The guidelines for coding were therefore changed again in 2017, and all cases in the Cancer Registry for the entire period from 1953 to 2017 were updated with the correct stage according to the following rules: If a patient has major surgery and there is no clinical or pathological information that indicates metastasis, then the patient is considered to have localised disease. If only a cytology or biopsy exist for the case, and there is no information about extent of disease, the patient is registered with an unknown stage.

In the present report, we have classified stage as follows:

Localised stage: All cases with a verified localised stage.

Regional stage: All cases with a clinical or pathological verified regional stage.

Distant stage: All cases with a clinical or pathological verified distant stage.

Unknown: All cases reported with unknown stage, or cases with insufficient information to set the stage.

3.5 Data quality

A comprehensive assessment of the data quality in the CRN was conducted in 2007^[3]. Larsen & al. reported that the coding and classification systems in general follow international standards. Estimated overall completeness was 98.8% for the registration period 2001–2005, a lower completeness was observed for haematological malignancies and cancers of the central nervous system. Practical aspects and techniques for addressing the data

quality at a cancer registry, including the documentation of comparability, validity and timeliness were reviewed in 2009^[5]. Methods for the evaluation of registry completeness were also assessed the same year^[6].

Two indicators of accuracy are shown in Table 3.4, namely the percentage of cases morphologically verified (MV%), and the percentage of death certificate only registrations (DCO%).

3.6 Completeness and timeliness

Table 3.5 shows the number of cancer cases diagnosed in 2015 as extracted on September 30st 2016 (for CiN 2015), and on October 16th 2017. The number of cancer cases diagnosed in 2015 reported and appearing in this issue (CiN 2016) are 581 (1.8%) more than those reported in the previous Cancer in Norway (CiN 2015).

Of note is:

- Cancers that to a lesser extent are verified by a pathology report might be under-reported in the present report. The main reason for this is most likely the transition from paper to electronic forms and thus new routines for reporting from the health institutions. This has led to a lower degree of spontaneous reporting, especially for sites not yet covered by clinical registries. To ensure reporting, the Cancer Registry routinely issues reminders for missing clinical information. However, due to upgrades of the electronic reporting system, reminders were not available for the health institutions in the period December 2016–June 2017. The result is a lower degree of reporting of clinical notifications than for previous years. We are also aware that we are missing most pathology data from Haugesund Hospital for the period July–December 2016 (estimated to be 0.4% of all cases).
- The present report is published before the mortality data for 2016 was complete.

Table 3.4: Percentage distribution of morphologically verified (MV) and death certificate only (DCO) cases by primary site, 2012–2016

ICD-10	Site	Cases	MV (%)	DCO (%)
C00–96	All sites	159 748	93.0	1.3
C00–14	Mouth, pharynx	2 951	99.2	0.3
C00	Lip	577	100.0	0.0
C01–02	Tongue	673	99.4	0.1
C03–06	Mouth, other	501	99.2	0.2
C07–08	Salivary glands	311	98.4	0.6
C09–14	Pharynx	889	98.8	0.7
C15–26	Digestive organs	32 790	90.6	1.8
C15	Oesophagus	1 381	94.6	0.9
C16	Stomach	2 332	95.9	1.5
C17	Small intestine	830	95.4	1.6
C18	Colon	14 337	94.9	1.3
C19–20	Rectum, rectosigmoid	6 722	97.6	0.3
C21	Anus	419	96.7	0.7
C22	Liver	1 255	68.7	3.6
C23–24	Gallbladder, bile ducts	885	78.0	4.2
C25	Pancreas	3 918	68.3	3.0
C26	Other digestive organs	711	81.4	13.4
C30–34, C38	Respiratory organs	16 036	87.8	2.2
C30–31	Nose, sinuses	231	99.1	0.9
C32	Larynx, epiglottis	587	98.1	0.3
C33–34	Lung, trachea	15 139	87.3	2.3
C38	Heart, mediastinum and pleura	79	72.2	10.1
C40–41	Bone	263	97.0	1.5
C43	Melanoma of the skin	9 704	99.9	0.1
C44	Skin, non-melanoma	9 319	99.7	0.1
C45	Mesothelioma	393	93.6	0.5
C47	Autonomic nervous system	46	95.7	2.2
C48–49	Soft tissues	757	98.3	0.4
C50	Breast	16 411	99.2	0.4
C51–58	Female genital organs	8 422	97.6	0.9
C51–52, C57.7–9	Other female genital	584	95.4	2.6
C53	Cervix uteri	1 681	99.3	0.4
C54	Corpus uteri	3 708	99.1	0.4
C55	Uterus, other	50	70.0	26.0
C56, C57.0–4	Ovary etc.	2 387	95.3	1.0
C58	Placenta	12	83.3	0.0
C60–63	Male genital organs	26 792	96.5	1.0
C61	Prostate	24 947	96.3	1.0
C62	Testis	1 552	99.7	0.1
C60, C63	Other male genital	293	99.3	0.3
C64–68	Urinary organs	12 280	96.4	1.0
C64	Kidney (excl. renal pelvis)	4 130	93.2	1.7
C65–68	Urinary tract	8 150	97.9	0.6
C69	Eye	386	55.2	0.0
C70–72	Central nervous system	5 035	66.4	2.2
C73	Thyroid gland	1 851	99.0	0.5
C37, C74–75	Other endocrine glands	1 069	48.3	1.2
C39, C76, C80	Other or unspecified	1 536	58.7	23.0
C81–96	Lymphoid/haematopoietic tissue	13 707	91.3	1.2
C81	Hodgkin lymphoma	756	99.5	0.3
C82–86, C96	Non-Hodgkin lymphoma	5 029	98.1	0.7
C88	Immunoproliferative disease	327	94.2	1.5
C90	Multiple myeloma	2 053	88.9	1.3
C91–95	Leukaemia	5 542	84.7	1.7

Table 3.5: Registered cancer cases in Norway 2015, as obtained from the incidence registry September 30th 2016 and October 16th 2017

ICD-10	Site	Cases diagnosed 2015 as of			
		30.09.2016	16.10.2017	Difference	%
C00-96	All sites	32 592	33 173	581	1.8
C00-14	Mouth, pharynx	628	626	-2	-0.3
C00	Lip	122	122	0	0.0
C01-02	Tongue	137	136	-1	-0.7
C03-06	Mouth, other	99	98	-1	-1.0
C07-08	Salivary glands	76	76	0	0.0
C09-14	Pharynx	194	194	0	0.0
C15-26	Digestive organs	6 638	6 838	200	3.0
C15	Oesophagus	288	294	6	2.1
C16	Stomach	447	460	13	2.9
C17	Small intestine	169	175	6	3.6
C18	Colon	2 935	2 985	50	1.7
C19-20	Rectum, rectosigmoid	1 333	1 358	25	1.9
C21	Anus	73	79	6	8.2
C22	Liver	268	287	19	7.1
C23-24	Gallbladder, bile ducts	155	163	8	5.2
C25	Pancreas	825	882	57	6.9
C26	Other digestive organs	145	155	10	6.9
C30-34, C38	Respiratory organs	3 191	3 282	91	2.9
C30-31	Nose, sinuses	39	37	-2	-5.1
C32	Larynx, epiglottis	107	107	0	0.0
C33-34	Lung, trachea	3 035	3 125	90	3.0
C38	Heart, mediastinum and pleura	10	13	3	30.0
C40-41	Bone	54	57	3	5.6
C43	Melanoma of the skin	2 001	2 023	22	1.1
C44	Skin, non-melanoma	1 884	1 904	20	1.1
C45	Mesothelioma	78	79	1	1.3
C47	Autonomic nervous system	11	11	0	0.0
C48-49	Soft tissues	135	138	3	2.2
C50	Breast	3 439	3 446	7	0.2
C51-58	Female genital organs	1 786	1 815	29	1.6
C51-52, C57.7-9	Other female genital	124	123	-1	-0.8
C53	Cervix uteri	370	384	14	3.8
C54	Corpus uteri	779	784	5	0.6
C55	Uterus, other	8	9	1	12.5
C56, C57.0-4	Ovary etc.	504	514	10	2.0
C58	Placenta	1	1	0	0.0
C60-63	Male genital organs	5 410	5 465	55	1.0
C61	Prostate	5 061	5 116	55	1.1
C62	Testis	291	290	-1	-0.3
C60, C63	Other male genital	58	59	1	1.7
C64-68	Urinary organs	2 605	2 628	23	0.9
C64	Kidney (excl. renal pelvis)	874	887	13	1.5
C65-68	Urinary tract	1 731	1 741	10	0.6
C69	Eye	82	83	1	1.2
C70-72	Central nervous system	937	986	49	5.2
C73	Thyroid gland	363	371	8	2.2
C37, C74-75	Other endocrine glands	180	183	3	1.7
C39, C76, C80	Other or unspecified	325	315	-10	-3.1
C81-96	Lymphoid/haematopoietic tissue	2 845	2 923	78	2.7
C81	Hodgkin lymphoma	163	164	1	0.6
C82-86, C96	Non-Hodgkin lymphoma	1 053	1 075	22	2.1
C88	Immunoproliferative disease	53	60	7	13.2
C90	Multiple myeloma	437	449	12	2.7
C91-95	Leukaemia	1 139	1 175	36	3.2

Chapter 4 Statistical methods

In this report, we use four measures to describe the burden and risk of disease: *incidence*, *mortality*, *survival* and *prevalence*.

4.1 Incidence and mortality

Incidence and mortality refer to the number of new cases and deaths, respectively. Both measures can be expressed as the absolute number, or as the rate, taking into account the size of the population at risk. Rates are essential for the comparisons of groups, and within a group over time. The denominator is the underlying person-time at risk in which the new cases or deaths in the numerator arise. Cancer incidence and mortality are presented in this report both as numbers and rates. Several different types of rates are also used in this report. We use the mid-year population (calculated as the mean of the population as obtained by January 1st and December 31st) as the denominator in the calculation of rates. For periods with several years, we use the sum of mid-year populations.

Age-specific rates

There are compelling reasons for adjusting for the distribution of age when comparing cancer risk in populations. Age is a strong determinant of cancer risk. The crude rate, is a rate based on the frequency of cancer in the entire population irrespective of age. Although this measure is useful as an indicator of the total cancer burden, its utility in comparing cancer risk between different populations is severely limited when the age distribution differs between the groups, or where demographic changes in the size and age structure of a population have occurred over time.

To obtain a more accurate picture of the true risk of cancer, rates can be calculated for specific age strata, usually grouped in five-year intervals. The age-specific rate for age group i , denoted as r_i , is obtained by dividing the number of events, d_i , by the corresponding person-years, Y_i . As rates are most often given per 100 000 person-years we multiply by 100 000:

$$r_i = \frac{d_i}{Y_i} \cdot 100000$$

Usually, rates are provided separately for males and females, because of the different patterns by sex. Age- and sex-specific incidence and mortality rates are the basis of epidemiological analysis of cancer frequency data.

Age-standardised rates

To facilitate comparisons, a summary rate is derived that takes into account age-specific rates in each comparison group. The summary measure that appears in this report is the age-standardised rate (ASR), a statistic that is independent of the effects of age, thus allowing comparisons of cancer risk between different groups and over time. The calculation of the ASR is an example of direct standardisation, whereby the observed age-specific rates are applied to a standard population. The population size or proportion in each age group of the standard population are known as the weights to be used in the standardisation process. Many possible sets of weights, w_i , can be used.

For weight w_i in the i th age group of the standard, r_i is the age-specific rate in the i th age group. The ASR is calculated as:

$$\text{ASR} = \frac{\sum_i r_i w_i}{\sum_i w_i}$$

The World Standard Population^[7-9] has been used in several previous report of Cancer in Norway. Since Cancer in Norway 2014 we have used the Norwegian mid-year population in 2014 as the reference population. This standard is referred to as the *Norwegian standard*.

The two standards are shown in Figure 4.1, and it clearly illustrates the difference between them: The Norwegian standard has higher weights for the oldest age groups.

The main advantage of using the Norwegian standard as the reference population is that we are getting age-standardised rates that resemble the crude rates for the Norwegian population. The main disadvantage is that the rates are not comparable with national rates from other countries. Table 5.1 shows the ASR in 2016 with different standards.

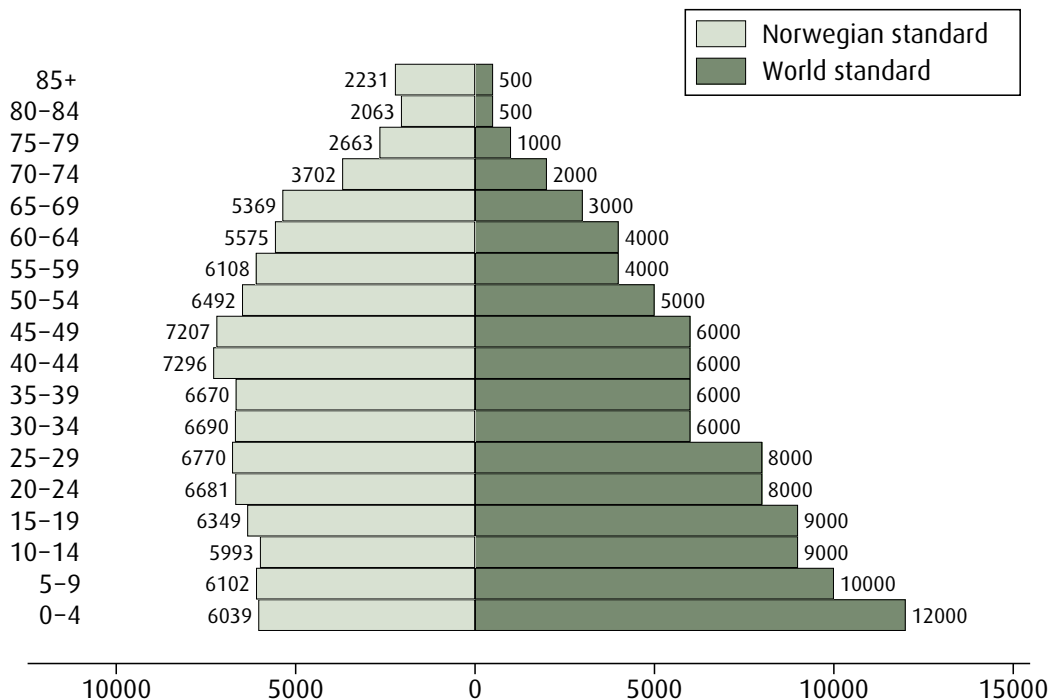
Of notice is that, in general, the ASRs with Norwegian standard gives twice as high rates as the ASRs with World standard. This is because the World standard has lower

weights for the oldest age groups. Cancers that have the highest incidence rates in the youngest age groups (e.g. testicular cancer) are less affected by the choice of reference population.

Age-standardised incidence rates (World standard) are available at:

<https://www.kreftregisteret.no/Registrene/Kreftstatistikk>

Figure 4.1: Comparison of population weights



Cumulative risk

The cumulative risk is the probability that an individual will develop the cancer under study during a certain age span, in the absence of other competing causes of death^[10]. The age span over which the risk is accumulated must be specified, and in this report, the range 0–74 years is used and provides an approximation of the risk of developing cancer. If before the age of 75 the cumulative risk is less than 10%, as is the case for most cancer forms, it is reasonably approximated by the cumulative rate (CR). This is the summation of the age-specific rates over each year of age from birth to a defined upper age limit. As age-specific incidence rates are computed according to five-year age groups, the cumulative rate is five times the sum of the age-specific rates calculated over the five-year age groups, assuming the age-specific rates are the same for all ages within the five-year age stratum:

$$CR = 5 \sum_i r_i$$

The cumulative rate has several advantages compared to age-standardised rates. Firstly, as a form of direct standardisation, the problem of choosing an arbitrary

reference population is eliminated. Secondly, as an approximation to the cumulative risk, it has a greater intuitive appeal, and is more directly interpretable as a measurement of lifetime risk, assuming no other causes of death are in operation. The precise mathematical relationship between the two is:

$$\text{Cumulative risk} = 1 - e^{-CR}$$

4.2 Prevalence

Prevalence is the number or proportion of a population that has the disease at a given point in time. It is a complex measure of cancer incidence, mortality, and other factors affecting individuals after diagnosis and treatment.

Prevalence is a useful measure of the number of persons requiring care for chronic illnesses such as hypertension and diabetes. For cancer, on the other hand, many patients diagnosed in the past may now be considered cured, that is to say they no longer have a greater risk of death. However, there may be special needs and disabilities subsequent to cancer disease and treatment, thus it

is likely that the number of prevalent cancer cases also represents a useful measure.

Cancer prevalence can be defined as the number of persons alive having ever been diagnosed with cancer. Such a measure can easily be derived from the CRN data, given the registration of cases and complete follow up over many years. We provide additional estimates that may be useful for quantifying care burden. Therefore, this report shows the numbers of persons alive on December 31st 2016 who were previously diagnosed with cancer during the last year, one to four years, five to nine years, and 10 or more years.

We also show the number of patients who have been diagnosed with metastatic disease or local recurrence with metastasis and who were alive at various specific time points. This is another estimate of how the cancer burden has increased over time.

4.3 Survival

The survival time of a cancer patient is defined as the time that elapse between a cancer diagnosis and subsequent death or end of follow-up.

Follow-up data

To estimate long-term survival patterns and trends, vital statistics of patients diagnosed with cancer during 1965–2016 were obtained from the National Population Registry and Statistics Norway through December 31st 2016.

The 23 most common cancers, grouped according to their respective ICD-10 categories, were selected for analysis. About 3% of the cases were excluded as they were either registered as DCO cases (Death Certificate Only), emigrated before diagnosis, or had zero survival time. It has been shown that exclusion of patients with a prior cancer diagnosis, which often is associated with a poorer prognosis, may give rise to artificially elevated estimates of survival^[11]. Therefore patients with previous cancer diagnoses were included in each site-specific analysis. However, to provide an estimate of “all sites” survival, analysis was restricted to first primary cancers. While the inclusion of multiple primaries has been recommended for comparative purposes, the corresponding reduction in the overall survival estimates has been shown to be negligible; the effect of their inclusion has been shown to reduce five-year survival in Norway (for diagnoses 1995–2009) by less than a percentage point^[12].

Results should be interpreted with caution. Survival of prostate cancer and breast cancer in women has been affected by the impact of PSA testing and mammographic screening, respectively.

Relative survival (Net survival)

The most basic measure of survival is five-year survival, which represents the percentage of patients still alive 5 years after the date of diagnosis.

Not all deaths among cancer patients are due to the cancer under study. Deaths resulting from other causes will lower the survival and may possibly invalidate comparisons between populations. Relative survival is calculated to circumvent this problem by providing an estimate of net survival, and is defined as the observed survival proportion in a patient group divided by the expected survival of a comparable group in the general population with respect to age, sex and calendar year of investigation. At each time $t(\text{year})$ since diagnosis, the relative survival from the cancer, $R(t)$, is defined as follows:

$$R(t) = \frac{S_O(t)}{S_E(t)}$$

where $S_O(t)$ is the observed survival of cancer patients while the calculation of expected survival $S_E(t)$ is based on matching the major demographic characteristics of the patients to the general population. This requires the Norwegian population life tables from Statistics Norway by 1-year age group, sex, and 1-year calendar period.

Expected survival is calculated using the Ederer II method^[13], and the relative survival estimates are age-standardised applying the age distribution of the patients diagnosed during the most recent 5-year period. For patient cohorts with complete 5-year follow-up the cohort method is used.

With traditional cohort-based analyses, the most up-to-date estimates of long-term survival would have pertained to patients diagnosed in the distant past, with corresponding profiles of prognosis. Period-based analyses consider the survival experience in recent years, and the survival that would have been observed in a hypothetical cohort of patients who experienced the same interval-specific survival as the patients who were actually at risk during a specific calendar period^[14].

In this report, we have used a five-year period window (2012–2016) to estimate relative survival up to 15 years. Patients diagnosed in 2011–2016 contribute with (part of) their survival experience the first year of follow up, patients diagnosed in 2010–2015 contribute to the

second year of follow-up, patients diagnosed in 2009–2014 contribute to the third year of follow-up etc. Thus, the period approach consists of the pieces of survival experience observed in the period 2012–2016 for all patients who have been diagnosed up to 15 years ago.

The period-approach was also used to estimate five-year relative survival for the most recent period (2012–2016), where full five-year follow-up is not observed. When analyzing time trends in five-year, relative survival rolling five-year cohorts was used to obtain smoother curves. This means that estimates for e.g. 2012 is based on patients diagnosed in 2008–2012. Estimates were obtained using the cohort method when follow-up was complete. Estimates for the last year were obtained using the most recent five-year period window, while estimates for the years where only part of the cohort had complete follow-up (2013–2016) were obtained using a combination of the cohort and period approach, ensuring that only a minimum of survival experience from patients diagnosed in the past was used.

Estimates were not presented if there was < 50 patients diagnosed or < 5 patients still alive at start of any subsequent year of follow-up.

Detailed description of the methods are found in supplement:

<https://www.kreftregisteret.no/globalassets/cancer-in-norway/2016/cin2016supmeth.pdf>

Conditional relative survival

Cancer survivors want information on their current prognosis, once they have survived a certain period of time. Conditional survival is a key indicator in this respect, estimating survival proportions given that patients have already survived a certain duration of time^[15;16].

The time where five-year relative survival reaches 100% is the point from where there is no excess mortality among the cancer patients, and prognosis is equivalent to that experienced in the general population. We present estimates of sex-specific five-year relative survival conditional on being alive 1 to 10 years after diagnosis.

Estimates were not plotted when there were less than twenty patients alive ($n < 20$).

Chapter 5 Incidence

5.1 New cancer cases

In 2016, there were 32 827 new cases of cancer (in 32 068 individuals) recorded in Norway, of which 17 763 cases occurred among men and 15 064 cases were diagnosed in women (Table 5.1). Cancers of the prostate, female breast, lung and colon were the most common cancers and accounted for 45% of the new cancer cases in 2016.

In men, prostate cancer continued to be the leading site for cancer incidence, with 5118 cases; followed by lung, 1615 cases; and colon cancer, 1415 cases. Breast cancer remained the most frequent cancer site in women, with 3371 new cases; followed by colon and lung cancer, with 1588 and 1465 incident cases, respectively.

When this report was made (October 2017) we had not received complete mortality data for 2016 from the Cause of Death Registry. For some cancers, especially those with poor survival, the incidence numbers for 2016 might thus be under-reported.

When comparing the rates in the most recent five-year period (2012–2016) with the previous one (2007–2011) (Tables 5.15 and 5.16) we observe that:

- There has been an overall increase in rates for all cancers combined by about 1% for men and 4% for women.
- The rate of prostate cancer appears to decline slightly, while the rate for breast cancer has increased by 7%.
- The rates of melanoma of the skin have increased by more than 20% in both men and women.
- The rates of colon cancer have increased by 3% in men, and 7% in women, while the rates for rectum cancer have stabilised in both men and women.
- The rate of lung cancer for women is 9% higher in the last five-year period compared to the previous one, and is a matter of great concern. The rate of lung cancer in men has declined by 6%.
- Among more uncommon cancer sites, there has been a notable increase in the rates for liver and thyroid cancer in both genders.

Table 5.1: Number and age-standardised rates of new cases by primary site and sex, 2016

ICD-10	Site	Cases			Age-standardised rates			
		Males	Females	Total	Norwegian std.		World std.	
					Males	Females	Males	Females
C00-96	All sites	17 763	15 064	32 827	714.4	538.4	366.8	309.9
C00-14	Mouth, pharynx	400	237	637	15.8	8.5	8.7	4.8
C00	Lip	60	51	111	2.5	1.8	1.1	0.8
C01-02	Tongue	94	66	160	3.6	2.4	2.2	1.4
C03-06	Mouth, other	60	47	107	2.4	1.6	1.3	0.9
C07-08	Salivary glands	43	29	72	1.8	1.0	0.9	0.6
C09-14	Pharynx	143	44	187	5.4	1.6	3.3	1.1
C15-26	Digestive organs	3 575	3 028	6 603	144.4	105.1	71.5	52.6
C15	Oesophagus	213	69	282	8.5	2.4	4.4	1.1
C16	Stomach	298	144	442	12.1	5.0	6.0	2.4
C17	Small intestine	113	67	180	4.5	2.4	2.4	1.3
C18	Colon	1 415	1 588	3 003	58.0	54.6	27.5	26.4
C19-20	Rectum, rectosigmoid	823	517	1 340	32.6	18.3	17.2	9.8
C21	Anus	30	72	102	1.2	2.6	0.6	1.6
C22	Liver	163	96	259	6.5	3.4	3.4	1.8
C23-24	Gallbladder, bile ducts	78	70	148	3.1	2.4	1.5	1.2
C25	Pancreas	377	336	713	15.3	11.5	7.3	5.6
C26	Other digestive organs	65	69	134	2.6	2.5	1.3	1.3
C30-34, C38	Respiratory organs	1 735	1 513	3 248	70.1	53.3	33.3	27.6
C30-31	Nose, sinuses	24	17	41	1.0	0.6	0.5	0.3
C32	Larynx, epiglottis	81	23	104	3.2	0.8	1.6	0.5
C33-34	Lung, trachea	1 615	1 465	3 080	65.3	51.6	30.9	26.6
C38	Heart, mediastinum and pleura	15	8	23	0.7	0.3	0.3	0.2
C40-41	Bone	31	27	58	1.2	1.0	1.1	0.8
C43	Melanoma of the skin	1 066	1 048	2 114	42.2	38.3	23.4	24.5
C44	Skin, non-melanoma	1 085	997	2 082	48.8	32.7	17.9	12.8
C45	Mesothelioma	61	14	75	2.5	0.5	1.1	0.2
C47	Autonomic nervous system	2	1	3	0.1	0.0	0.1	0.0
C48-49	Soft tissues	55	83	138	2.2	3.0	1.3	2.1
C50	Breast	31	3 371	3 402	1.3	125.1	0.7	80.3
C51-58	Female genital organs		1 746	1 746		63.4		38.8
C51-52, C57.7-9	Other female genital		124	124		4.4		2.4
C53	Cervix uteri		342	342		13.2		10.3
C54	Corpus uteri		774	774		27.6		15.1
C55	Uterus, other		15	15		0.5		0.2
C56, C57.0-4	Ovary etc.		488	488		17.7		10.7
C58	Placenta		3	3		0.1		0.1
C60-63	Male genital organs	5 488		5 488	215.6		115.3	
C61	Prostate	5 118		5 118	201.5		103.6	
C62	Testis	285		285	10.7		9.9	
C60, C63	Other male genital	85		85	3.5		1.8	
C64-68	Urinary organs	1 860	771	2 631	75.7	27.0	36.5	14.2
C64	Kidney (excl. renal pelvis)	589	283	872	22.9	10.1	13.3	5.9
C65-68	Urinary tract	1 271	488	1 759	52.8	16.9	23.2	8.3
C69	Eye	40	30	70	1.6	1.1	0.9	0.7
C70-72	Central nervous system	380	460	840	14.8	17.0	10.1	11.8
C73	Thyroid gland	137	307	444	5.3	11.6	3.4	8.6
C37, C74-75	Other endocrine glands	73	58	131	2.8	2.2	2.1	1.7
C39, C76, C80	Other or unspecified	141	161	302	6.1	5.4	2.6	2.3
C81-96	Lymphoid/haematopoietic tissue	1 603	1 212	2 815	63.9	43.1	36.7	26.0
C81	Hodgkin lymphoma	91	76	167	3.4	2.9	2.8	2.6
C82-86, C96	Non-Hodgkin lymphoma	587	429	1 016	23.3	15.1	13.2	8.4
C88	Immunoproliferative disease	31	11	42	1.3	0.4	0.6	0.2
C90	Multiple myeloma	246	183	429	9.9	6.4	5.0	3.4
C91-95	Leukaemia	648	513	1 161	26.1	18.3	15.1	11.4

5.2 Incidence by age

The vast majority of cancers in Norway, over 90% in men and 85% in women, are diagnosed among people aged 50 years or more (Figure 5.1). In men, nearly half are diagnosed at age 70 years or more, while 43% of all new cases occur between the ages 50 and 69. In women, 45% are diagnosed at age 70 or more, and 40% are diagnosed between the age of 50 and 69 years. Among the 25 to 49-year-old, a larger proportion of the cancers are diagnosed in women than men. In children and young adults under 25, slightly over 1% of all cancers occurs, with equal frequencies in males and females.

Table 5.2 shows the median age at diagnosis at different time periods. For all sites combined, the median age at diagnosis is 69 years, and this has been quite stable over the last decades. There is however some variation between the sites. Testis cancer has the lowest median age at diagnosis (36 years). Non-melanoma skin cancer, on the other hand, has the highest median age (79 years). Among the most common cancers, we observe

that prostate and breast have 3–5 years lower median age at diagnosis in the latest period 2012–2016 compared to the early 1980s. For lung cancers and melanoma of the skin, however, the median age at diagnosis has increased. Changes in median age at diagnosis may be influenced by changes in the age distribution of the population, and by the age-specific incidence rates at different periods. It might thus be difficult to interpret patterns and trends without information on these topics.

Figure 5.2 shows the most common cancer types by gender and age at diagnosis. The most commonly occurring cancers in boys and girls (0–14 years old) were tumours in the central nervous system and leukaemia. For young women (15–24 years), tumours in the central nervous system and Hodgkin lymphoma were the most common types, while testicular cancer was by far the most common one diagnosed in young men (15–24). Prostate cancer was the most frequent cancer in men above 50, while breast cancer was the lead in women aged 25 through 69. Colon cancer was the most common cancer in women above 70.

Figure 5.1: Percentage distribution of cancer incidence by age, 2012–2016

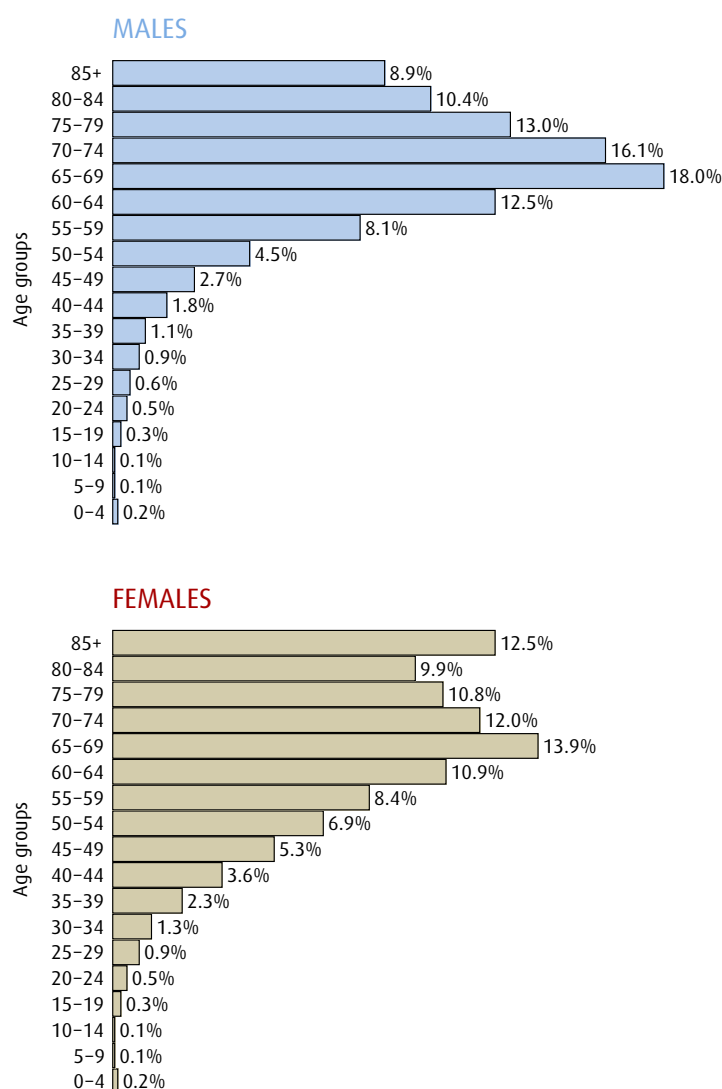


Table 5.2: Median age at diagnosis at different time periods by primary site

ICD-10	Site	Median age in			
		1982-86	1992-96	2002-06	2012-16
C00-96	All sites	69.0	70.0	69.0	69.0
C00-14	Mouth, pharynx	67.0	67.0	65.0	66.0
C00	Lip	69.0	70.0	71.0	74.0
C01-02	Tongue	67.0	66.0	63.0	64.0
C03-06	Mouth, other	68.0	67.0	65.0	68.0
C07-08	Salivary glands	66.0	68.0	66.0	67.0
C09-14	Pharynx	64.0	64.0	61.0	62.0
C15-26	Digestive organs	72.0	73.0	73.0	72.0
C15	Oesophagus	70.0	71.0	70.0	69.0
C16	Stomach	73.0	74.0	75.0	72.0
C17	Small intestine	69.0	71.0	68.0	68.0
C18	Colon	72.0	73.0	74.0	73.0
C19-20	Rectum, rectosigmoid	71.0	72.0	72.0	69.0
C21	Anus	67.0	68.0	67.0	66.0
C22	Liver	70.0	72.0	72.0	69.0
C23-24	Gallbladder, bile ducts	73.0	73.5	75.0	72.0
C25	Pancreas	72.0	74.0	74.0	72.0
C26	Other digestive organs	79.0	79.0	79.0	74.0
C30-34, C38	Respiratory organs	67.0	69.0	70.0	71.0
C30-31	Nose, sinuses	68.5	69.0	67.0	67.0
C32	Larynx, epiglottis	66.0	67.0	67.0	68.0
C33-34	Lung, trachea	68.0	69.0	70.0	71.0
C38	Heart, mediastinum and pleura	67.0	72.0	75.0	72.0
C40-41	Bone	40.0	40.0	42.0	50.0
C43	Melanoma of the skin	56.0	58.0	61.0	65.0
C44	Skin, non-melanoma	75.0	76.0	78.0	79.0
C45	Mesothelioma	67.0	70.5	72.0	73.0
C47	Autonomic nervous system	42.5	39.0	37.0	41.0
C48-49	Soft tissues	64.0	65.0	63.0	64.0
C50	Breast	65.0	64.0	60.0	62.0
C51-58	Female genital organs	62.0	63.0	64.0	65.0
C51-52, C57.7-9	Other female genital	73.0	73.0	74.0	72.0
C53	Cervix uteri	53.0	49.0	48.0	45.0
C54	Corpus uteri	64.0	66.0	67.0	68.0
C55	Uterus, other	80.0	78.5	78.0	81.5
C56, C57.0-4	Ovary etc.	64.0	65.0	64.0	65.0
C58	Placenta	27.0	28.0	31.0	31.0
C60-63	Male genital organs	73.0	73.0	71.0	68.0
C61	Prostate	74.0	74.0	72.0	69.0
C62	Testis	31.0	32.0	34.0	36.0
C60, C63	Other male genital	68.0	71.0	69.0	69.0
C64-68	Urinary organs	70.0	72.0	73.0	71.0
C64	Kidney (excl. renal pelvis)	68.0	70.0	69.0	66.0
C65-68	Urinary tract	71.0	73.0	74.0	73.0
C69	Eye	61.0	63.0	64.0	65.0
C70-72	Central nervous system	58.0	58.0	58.0	60.0
C73	Thyroid gland	57.0	53.0	54.0	54.0
C37, C74-75	Other endocrine glands	44.0	48.0	52.0	55.0
C39, C76, C80	Other or unspecified	73.0	74.0	78.0	78.0
C81-96	Lymphoid/haematopoietic tissue	68.0	69.0	69.0	68.0
C81	Hodgkin lymphoma	45.0	32.5	36.0	41.0
C82-86, C96	Non-Hodgkin lymphoma	66.0	67.0	67.0	68.0
C88	Immunoproliferative disease	71.5	71.0	74.0	72.0
C90	Multiple myeloma	72.0	74.0	73.0	71.0
C91-95	Leukaemia	69.0	70.0	71.0	69.0

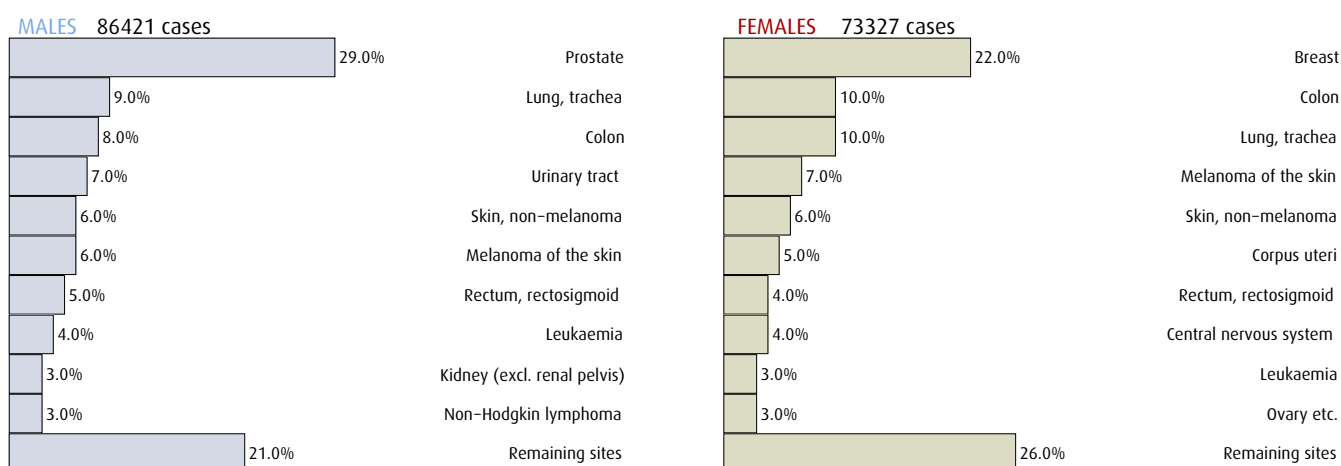
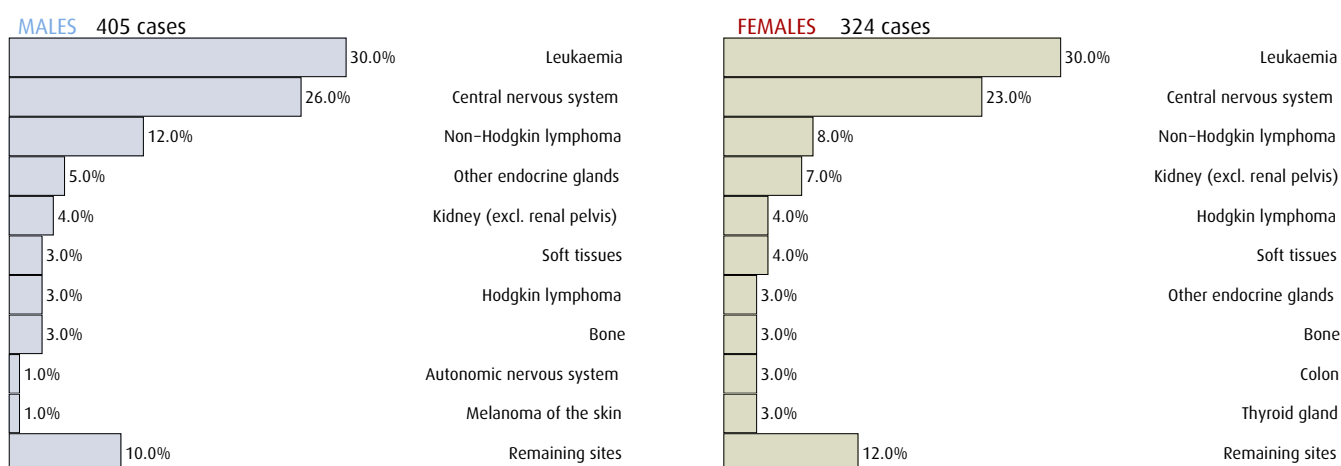
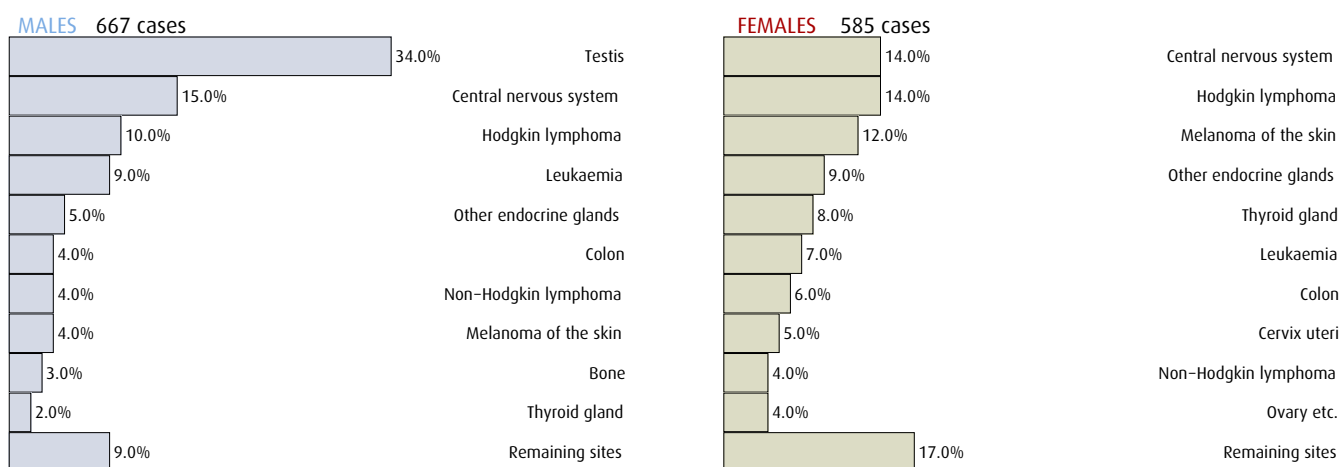
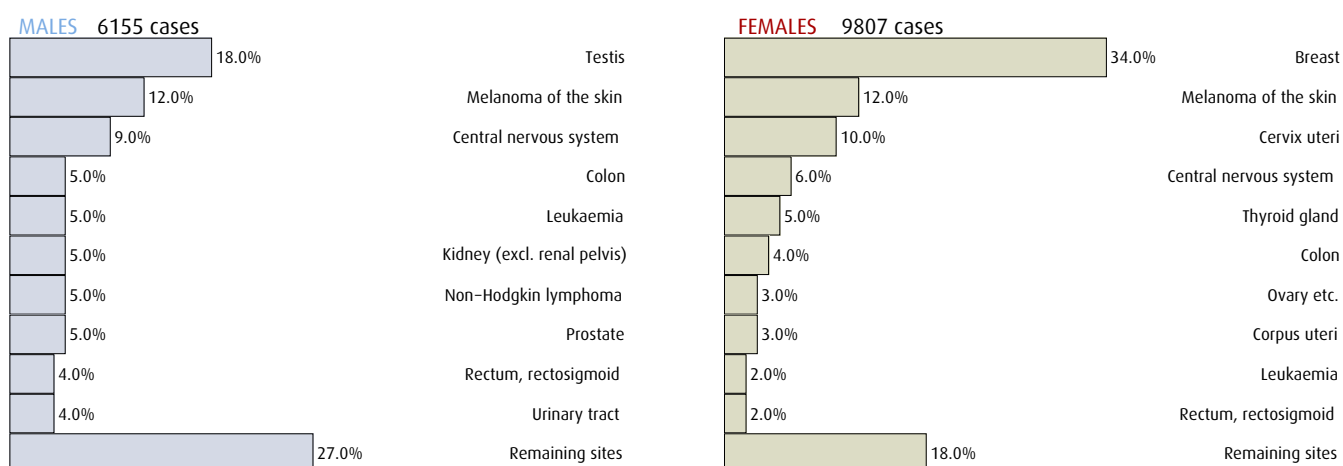
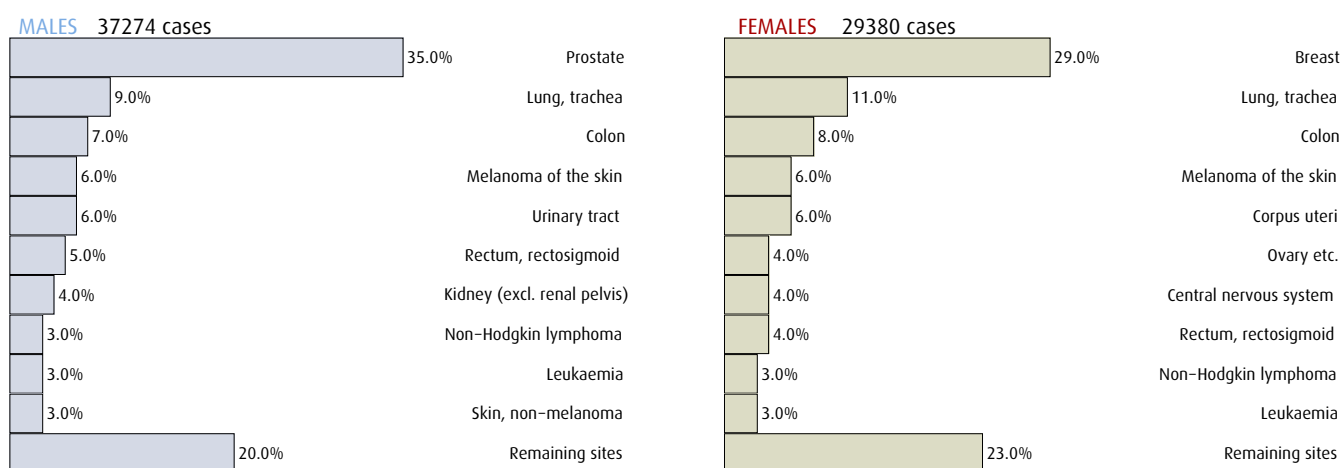
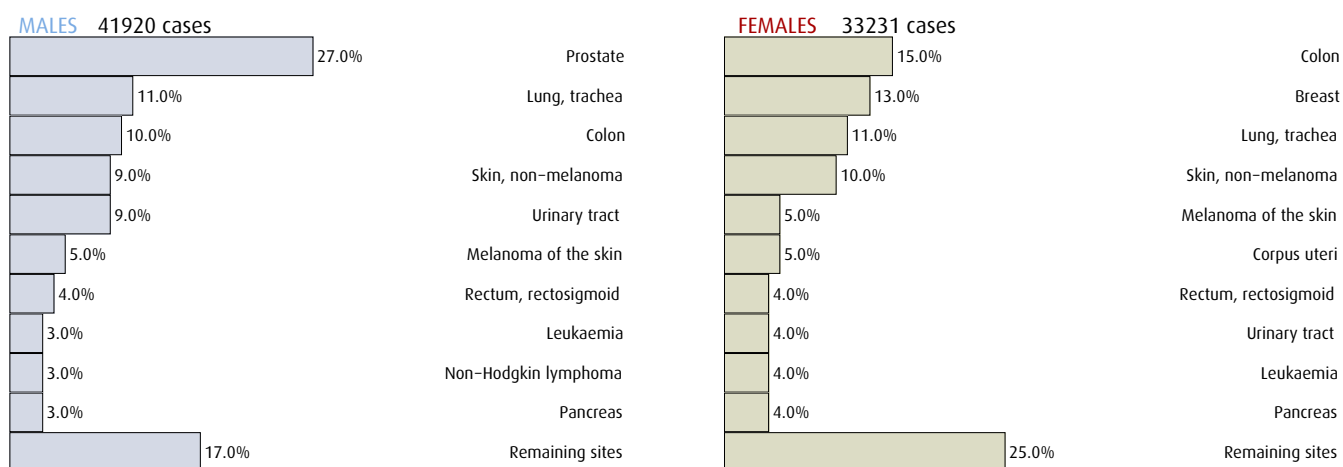
Figure 5.2: The most frequent types of cancer by age and sex, 2012–2016**Figure 5.2-A: All ages****Figure 5.2-B: 0–14 years****Figure 5.2-C: 15–24 years**

Figure 5.2: The most frequent types of cancer by age and sex, 2012–2016**Figure 5.2-D: 25–49 years****Figure 5.2-E: 50–69 years****Figure 5.2-F: 70+ years**

5.3 Male to female ratios

The age-standardised rates and male to female ratio (M:F) for selected cancer types in 1982–1986 and 2012–2016 are displayed in Table 5.3. Men tend to have higher incidence rates for most cancer types in both time periods, except for melanoma of the skin, cancer of the gallbladder, anus, thyroidea, central nervous system and soft tissue. The highest M:F ratios were observed for mesothelioma, several cancers of the head and neck, and for cancers in the urinary tract.

Some cancers, including cancer of the urinary tract, kidney, liver, stomach, rectum and leukaemia, are consistently more common among men. The decline in the M:F ratios for several neoplasms over the last 25 years is largely a result of a more rapid increase in the incidence rates among women. For lung cancer, the increase in women has been accompanied by a levelling off and a slight decline in the rate among men, and the M:F ratio is now at 1.3 against 4.0 in the early 1980s.

Table 5.3: Sex ratio (male:female) of age-adjusted rates (Norwegian standard) in 1982–1986 and 2012–2016 for selected cancers, sorted in descending order in last period

ICD-10	Site	1982–86			2012–16		
		M	F	M:F ratio	M	F	M:F ratio
C00–96	All sites	513.1	380.7	1.3	728.7	540.6	1.3
C45	Mesothelioma	1.5	0.2	6.6	2.8	0.5	6.0
C32	Larynx, epiglottis	6.0	0.5	11.8	4.0	0.8	5.3
C15	Oesophagus	5.0	1.6	3.1	8.7	2.5	3.5
C09–14	Pharynx	3.2	1.0	3.3	5.3	1.7	3.2
C65–68	Urinary tract	42.3	11.9	3.5	51.4	16.1	3.2
C38	Heart, mediastinum and pleura	0.7	0.2	4.0	0.5	0.2	2.3
C64	Kidney (excl. renal pelvis)	14.4	7.2	2.0	22.8	9.8	2.3
C16	Stomach	35.6	17.8	2.0	12.8	6.0	2.1
C22	Liver	4.0	2.1	2.0	6.7	3.2	2.1
C88	Immunoproliferative disease	0.6	0.3	2.1	1.7	0.9	1.9
C17	Small intestine	1.8	1.2	1.5	4.2	2.4	1.7
C19–20	Rectum, rectosigmoid	30.7	18.8	1.6	33.3	20.0	1.7
C00	Lip	6.2	1.0	6.0	2.9	1.7	1.7
C01–02	Tongue	2.0	1.2	1.8	3.3	1.9	1.7
C30–31	Nose, sinuses	1.3	0.7	1.8	1.1	0.7	1.6
C07–08	Salivary glands	0.8	0.6	1.3	1.5	1.0	1.6
C03–06	Mouth, other	2.7	1.1	2.4	2.4	1.5	1.6
C44	Skin, non-melanoma	20.0	10.7	1.9	46.1	29.4	1.6
C91–95	Leukaemia	14.4	8.7	1.7	26.1	17.9	1.5
C82–86, C96	Non-Hodgkin lymphoma	12.6	9.4	1.3	23.3	16.3	1.4
C90	Multiple myeloma	9.3	6.1	1.5	9.6	6.7	1.4
C81	Hodgkin lymphoma	2.8	1.7	1.6	3.4	2.5	1.4
C33–34	Lung, trachea	61.5	15.4	4.0	68.6	52.1	1.3
C40–41	Bone	1.2	0.7	1.8	1.1	0.9	1.3
C39, C76, C80	Other or unspecified	14.2	10.3	1.4	6.5	5.5	1.2
C25	Pancreas	18.1	12.4	1.5	16.7	14.0	1.2
C69	Eye	1.4	1.1	1.3	1.6	1.5	1.1
C47	Autonomic nervous system	0.4	0.3	1.4	0.2	0.2	1.1
C43	Melanoma of the skin	14.8	18.2	0.8	40.4	36.4	1.1
C37, C74–75	Other endocrine glands	2.2	2.3	1.0	4.3	4.1	1.1
C18	Colon	40.9	36.1	1.1	59.0	53.3	1.1
C23–24	Gallbladder, bile ducts	2.8	3.8	0.7	3.5	3.4	1.0
C48–49	Soft tissues	2.5	2.2	1.1	2.8	3.1	0.9
C70–72	Central nervous system	11.7	11.1	1.1	19.0	20.3	0.9
C26	Other digestive organs	4.8	4.9	1.0	2.7	2.8	0.9
C73	Thyroid gland	2.5	7.0	0.4	4.4	10.1	0.4
C21	Anus	0.8	1.2	0.6	1.0	2.3	0.4

5.4 Incidence trends

Figure 5.3: Time trends in age-standardised incidence rates (Norway) for selected cancers, 1957–2016

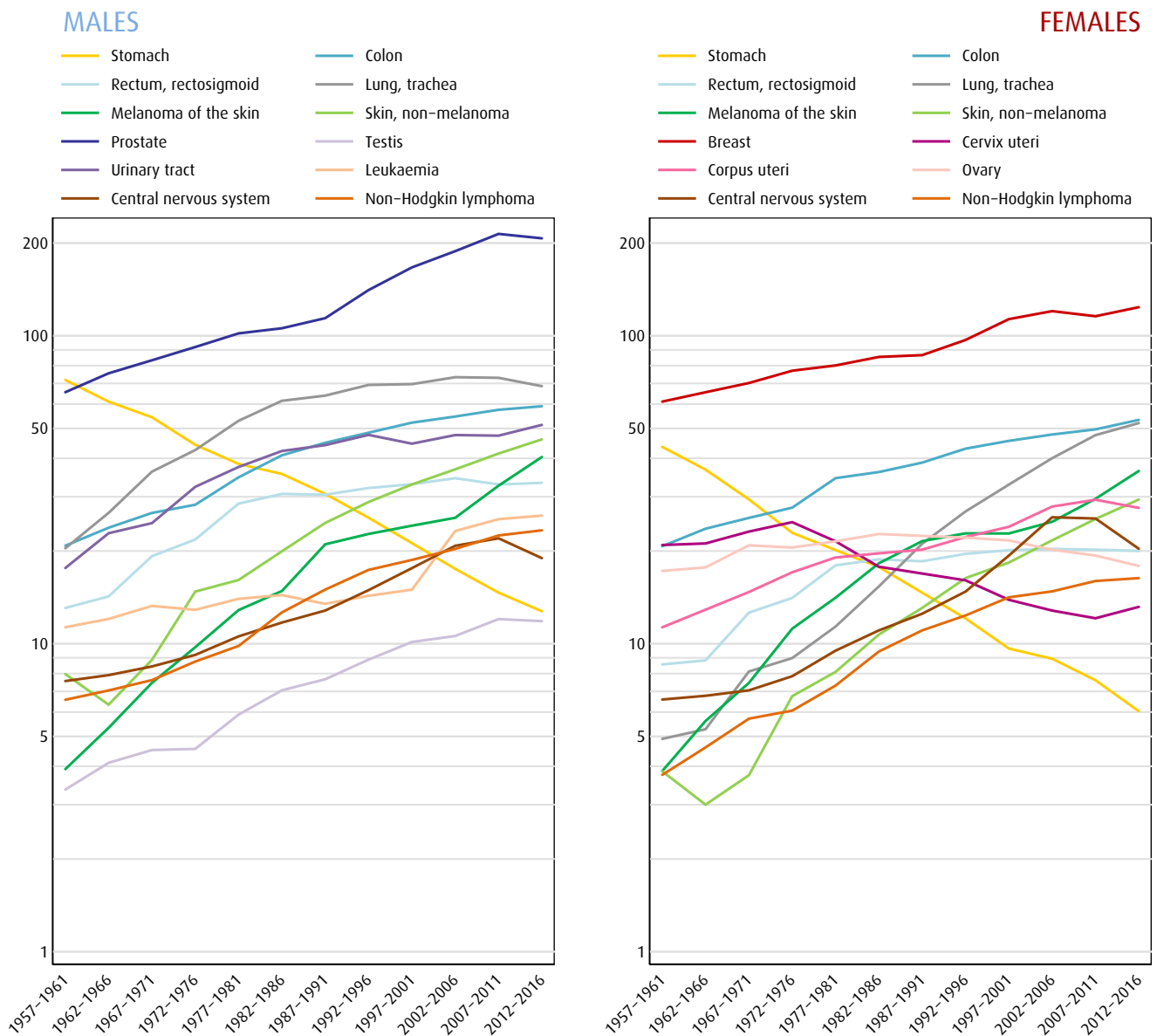


Figure 5.3 depicts time trends in incidence over six decades for a number of selected cancers. Of note are:

The incidence trends have increased in Norway for most cancer types since the first observation period. The upward trends have been most pronounced for lung cancer and skin cancer (both melanoma and non-melanoma), and slightly less for non-Hodgkin lymphoma, tumours of the central nervous system, colon cancer, rectum cancer, prostate cancer, and testicular cancer.

Stomach cancer is one of the few that demonstrates a sharp and consistent decline. In the first observation period, stomach cancer was clearly the most common cancer in men and women combined, in line with observations of cancer mortality reported by Norwegian

general practitioners one hundred years ago^[17]. The monotonous drop in incidence over six decades reflects improvement in hygiene and environmental exposures. Changes in the prevalence of *Helicobacter pylori* infection and in dietary habits (refrigerators) are likely contributors to this trend. The decline also demonstrates a vast potential for prevention, although the causes of stomach cancer were unknown, and the waning the rates has been a chance phenomenon rather than an intended one.

The age-standardised incidence rate of prostate cancer has tripled since registration started in the early 1950s. A dramatic upsurge came from around 1990 with changes in diagnostic practice with wild screening and testing by

general practitioners. The introduction and subsequent widespread use of the Prostate Specific Antigen (PSA) test, followed by biopsies, are considered the main explanation for the increased rate.

The incidence of breast cancer has doubled since the beginning of registration. The trend was monotonously upward until 2005, with a somewhat steeper rise in the late 1990s after implementation of the Norwegian Breast Cancer Screening Program. During the last decade, the rate seems to have levelled off, although there is certain variation from year to year, as seen in Table 5.8. Some of the increase might be ascribed to better diagnostic tool used in the program, in local breast cancer studies, or that women continue to have mammography after the age of 70. It might also reflect random variations.

In women, the incidence of lung cancer has increased almost tenfold since the beginning of the 1950s. In men, the incidence of lung cancer has been levelling off in the last two decades, and an overall decline is now indisputable. This pattern is however not yet observed for women, where the overall trend is still increasing and the incidence recently reached the level of another increasing cancer type, that of the colon.

Melanoma of the skin is another cancer of great concern. From being an uncommon cancer in 1953, it now ranks among the leading ones among men and women alike. After levelling off during the 1990s, the rate has risen fairly consistently the last decade (Table 5.7 and 5.8), most probably caused by new suntanning among those who enter the highest age bands.

The downward trend in cervical cancer is a result of identification and treatment of premalignant conditions as part of an organised screening program. In 2009, vaccination against human papilloma virus (HPV) was introduced as part of the Norwegian Childhood Immunisation Programme for girls born in 1997 and after. A catch up program was implemented in November 2016.

Still, we do not expect this primary prevention to affect the incidence rate for another 15 to 20 years.

For some common cancers, the explanation for the increase in incidence rate is unknown or incompletely understood. Colon cancer has been associated with an affluent western lifestyle, such as diet, smoking, obesity and lack of exercise. For testicular cancer and non-Hodgkin lymphoma, genetic factors play a role, while other determinants are largely unknown.

Even if rates were to remain stable over the next 15 years, the number of new cases would increase as a result of the joint effects of population growth and aging. The NORDCAN project (<http://www-dep.iarc.fr/nordcan.htm>) provides access to online predictions of incidence and mortality in the Nordic countries.

More detailed trends in incidence, mortality and survival for 23 cancers are provided in Chapter 9.

5.5 Cumulative risk

Figure 5.4 and Table 5.4 show the cumulative risk of cancer in men and women. One in three Norwegians will develop a cancer before the age of 75. The risk of prostate cancer is the highest one in men, as one in seven will have a diagnosis by the age of 75. The cumulative risk of breast cancer is the highest one in women, with 8.6%, indicating that one in 12 Norwegian women will diagnosed the disease before turning 75. As among men, lung and colon cancers rank second and third.

5.6 Incidence tables

Tables 5.5–5.24 provide further information on cancer incidence in Norway. The number of incident cases and rates are tabulated according to year of diagnosis, age group, county of residence, and stage.

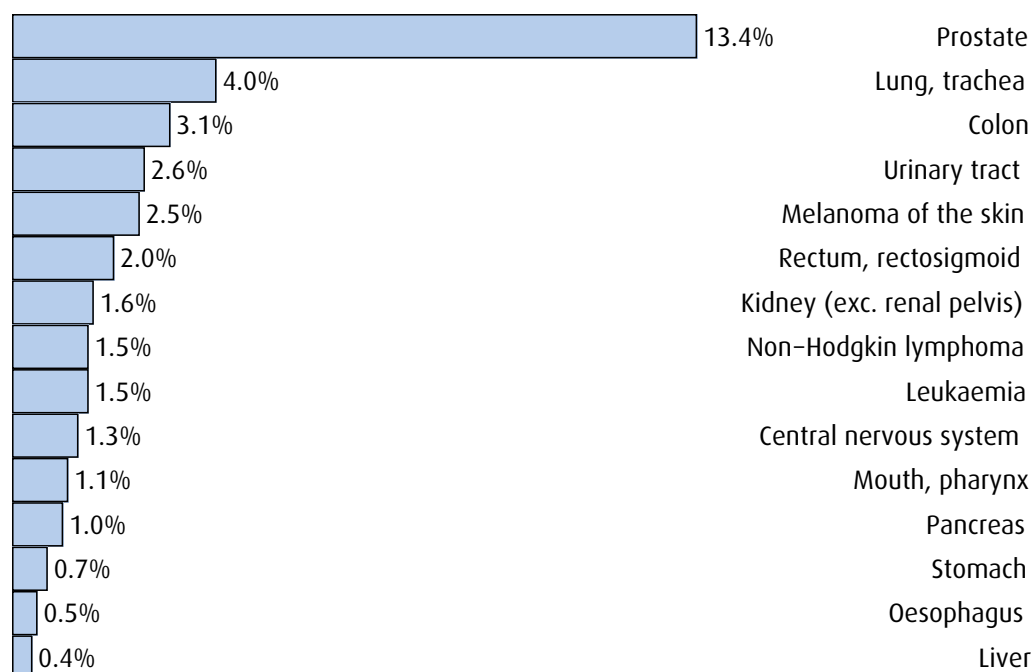
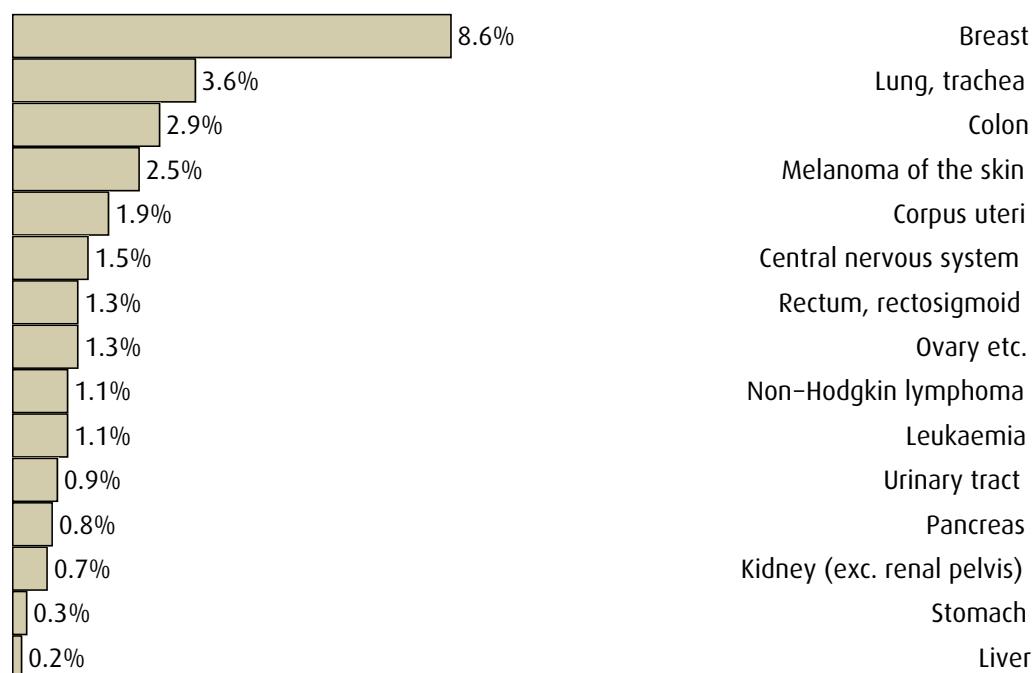
Figure 5.4: Cumulative risk of developing cancer (%) by the age of 75 for selected cancers, 2012–2016**MALES****FEMALES**

Table 5.4: Cumulative risk of developing cancer (%) by age of 75 by primary site and sex, 2012–2016

ICD-10	Site	Males	Females
C00–96	All sites	36.0	29.6
C00–14	Mouth, pharynx	1.1	0.5
C00	Lip	0.1	0.1
C01–02	Tongue	0.2	0.1
C03–06	Mouth, other	0.2	0.1
C07–08	Salivary glands	0.1	0.1
C09–14	Pharynx	0.4	0.1
C15–26	Digestive organs	8.2	6.1
C15	Oesophagus	0.5	0.1
C16	Stomach	0.7	0.3
C17	Small intestine	0.3	0.2
C18	Colon	3.1	2.9
C19–20	Rectum, rectosigmoid	2.0	1.3
C21	Anus	0.1	0.2
C22	Liver	0.4	0.2
C23–24	Gallbladder, bile ducts	0.2	0.2
C25	Pancreas	1.0	0.8
C26	Other digestive organs	0.1	0.1
C30–34, C38	Respiratory organs	4.4	3.7
C30–31	Nose, sinuses	0.1	0.0
C32	Larynx, epiglottis	0.3	0.1
C33–34	Lung, trachea	4.0	3.6
C38	Heart, mediastinum and pleura	0.0	0.0
C40–41	Bone	0.1	0.1
C43	Melanoma of the skin	2.5	2.5
C44	Skin, non-melanoma	1.6	1.1
C45	Mesothelioma	0.2	0.0
C47	Autonomic nervous system	0.0	0.0
C48–49	Soft tissues	0.2	0.2
C50	Breast	0.1	8.6
C51–58	Female genital organs		4.3
C51–52, C57.7–9	Other female genital		0.2
C53	Cervix uteri		1.0
C54	Corpus uteri		1.9
C55	Uterus, other		0.0
C56, C57.0–4	Ovary etc.		1.3
C58	Placenta		0.0
C60–63	Male genital organs	14.3	
C61	Prostate	13.4	
C62	Testis	0.9	
C60, C63	Other male genital	0.1	
C64–68	Urinary organs	4.2	1.6
C64	Kidney (excl. renal pelvis)	1.6	0.7
C65–68	Urinary tract	2.6	0.9
C69	Eye	0.1	0.1
C70–72	Central nervous system	1.3	1.5
C73	Thyroid gland	0.3	0.8
C37, C74–75	Other endocrine glands	0.3	0.3
C39, C76, C80	Other or unspecified	0.3	0.2
C81–96	Lymphoid/haematopoietic tissue	3.8	2.8
C81	Hodgkin lymphoma	0.3	0.2
C82–86, C96	Non-Hodgkin lymphoma	1.5	1.1
C88	Immunoproliferative disease	0.1	0.1
C90	Multiple myeloma	0.5	0.4
C91–95	Leukaemia	1.5	1.1

Table 5.5: Number of new cases by primary site and year, 2007–2016, **males**

ICD-10	Site	Year									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
C00–96	All sites	14 550	14 774	15 134	15 270	16 385	16 738	16 757	17 331	17 832	17 763
C00–14	Mouth, pharynx	277	269	343	313	327	361	334	405	402	400
C00	Lip	66	53	82	77	80	70	62	77	69	60
C01–02	Tongue	57	63	74	60	70	70	82	84	86	94
C03–06	Mouth, other	40	43	65	52	38	57	57	62	59	60
C07–08	Salivary glands	18	18	23	28	18	30	28	44	36	43
C09–14	Pharynx	96	92	99	96	121	134	105	138	152	143
C15–26	Digestive organs	2 854	2 937	2 953	3 228	3 138	3 328	3 435	3 484	3 611	3 575
C15	Oesophagus	131	161	149	187	181	175	200	224	219	213
C16	Stomach	336	299	264	299	325	285	302	307	291	298
C17	Small intestine	67	65	82	71	88	104	88	96	101	113
C18	Colon	1 106	1 173	1 123	1 298	1 230	1 300	1 336	1 365	1 420	1 415
C19–20	Rectum, rectosigmoid	635	676	730	744	698	753	802	812	786	823
C21	Anus	18	20	20	33	20	24	15	27	22	30
C22	Liver	98	98	98	127	130	137	176	146	185	163
C23–24	Gallbladder, bile ducts	59	66	74	87	59	87	97	74	80	78
C25	Pancreas	366	341	360	319	336	402	363	376	438	377
C26	Other digestive organs	38	38	53	63	71	61	56	57	69	65
C30–34, C38	Respiratory organs	1 626	1 625	1 660	1 682	1 768	1 785	1 716	1 773	1 728	1 735
C30–31	Nose, sinuses	27	25	23	19	22	32	34	30	15	24
C32	Larynx, epiglottis	78	113	90	106	100	98	104	115	87	81
C33–34	Lung, trachea	1 501	1 481	1 539	1 547	1 636	1 644	1 570	1 618	1 619	1 615
C38	Heart, mediastinum and pleura	20	6	8	10	10	11	8	10	7	15
C40–41	Bone	21	23	37	27	29	33	18	29	34	31
C43	Melanoma of the skin	581	671	703	747	872	894	848	1 032	1 029	1 066
C44	Skin, non-melanoma	727	775	852	823	862	891	914	1 012	1 058	1 085
C45	Mesothelioma	63	64	69	79	64	65	78	58	66	61
C47	Autonomic nervous system	7	8	7	6	5	5	6	7	4	2
C48–49	Soft tissues	67	49	71	52	67	82	79	63	65	55
C50	Breast	19	21	15	13	27	28	35	24	24	31
C60–63	Male genital organs	4 784	4 786	4 746	4 569	5 309	5 275	5 247	5 317	5 465	5 488
C61	Prostate	4 443	4 436	4 384	4 256	4 984	4 911	4 866	4 936	5 116	5 118
C62	Testis	297	300	314	267	286	321	333	323	290	285
C60, C63	Other male genital	44	50	48	46	39	43	48	58	59	85
C64–68	Urinary organs	1 375	1 386	1 409	1 445	1 529	1 605	1 632	1 774	1 844	1 860
C64	Kidney (excl. renal pelvis)	397	414	426	487	519	532	537	580	576	589
C65–68	Urinary tract	978	972	983	958	1 010	1 073	1 095	1 194	1 268	1 271
C69	Eye	29	40	26	38	26	29	34	49	42	40
C70–72	Central nervous system	529	480	482	489	512	527	499	494	462	380
C73	Thyroid gland	67	60	73	80	76	92	106	113	104	137
C37, C74–75	Other endocrine glands	141	135	148	109	126	144	116	125	86	73
C39, C76, C80	Other or unspecified	176	170	170	146	165	123	147	156	152	141
C81–96	Lymphoid/haematopoietic tissue	1 207	1 275	1 370	1 424	1 483	1 471	1 513	1 416	1 655	1 603
C81	Hodgkin lymphoma	71	80	83	82	69	88	73	80	110	91
C82–86, C96	Non-Hodgkin lymphoma	429	468	487	553	506	526	551	534	609	587
C88	Immunoproliferative disease	36	34	28	34	34	52	36	39	43	31
C90	Multiple myeloma	186	207	219	206	241	206	227	194	249	246
C91–95	Leukaemia	485	486	553	549	633	599	626	569	644	648

Table 5.6: Number of new cases by primary site and year, 2007–2016, **females**

ICD-10	Site	Year									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
C00–96	All sites	12 523	12 711	13 049	13 348	13 878	13 768	14 199	14 955	15 341	15 064
C00–14	Mouth, pharynx	159	188	167	208	199	184	191	213	224	237
C00	Lip	46	49	35	54	46	41	49	45	53	51
C01–02	Tongue	24	33	34	33	38	47	45	49	50	66
C03–06	Mouth, other	36	40	44	43	41	31	42	47	39	47
C07–08	Salivary glands	23	25	17	32	29	17	18	26	40	29
C09–14	Pharynx	30	41	37	46	45	48	37	46	42	44
C15–26	Digestive organs	2 690	2 746	2 851	2 743	2 878	2 947	3 030	3 125	3 227	3 028
C15	Oesophagus	56	59	54	65	60	72	63	71	75	69
C16	Stomach	216	213	223	175	199	182	165	189	169	144
C17	Small intestine	55	52	76	62	65	61	49	77	74	67
C18	Colon	1 264	1 281	1 357	1 270	1 394	1 422	1 457	1 469	1 565	1 588
C19–20	Rectum, rectosigmoid	504	518	519	529	530	501	582	574	572	517
C21	Anus	42	42	49	53	38	48	59	65	57	72
C22	Liver	54	65	65	77	81	82	81	87	102	96
C23–24	Gallbladder, bile ducts	83	82	84	92	87	104	103	109	83	70
C25	Pancreas	361	371	363	349	365	394	392	396	444	336
C26	Other digestive organs	55	63	61	71	59	81	79	88	86	69
C30–34, C38	Respiratory organs	1 162	1 200	1 200	1 320	1 280	1 362	1 379	1 491	1 554	1 513
C30–31	Nose, sinuses	33	16	12	20	20	18	20	19	22	17
C32	Larynx, epiglottis	17	23	20	19	16	19	21	19	20	23
C33–34	Lung, trachea	1 104	1 157	1 160	1 273	1 236	1 321	1 333	1 448	1 506	1 465
C38	Heart, mediastinum and pleura	8	4	8	8	8	4	5	5	6	8
C40–41	Bone	22	23	28	25	23	14	25	29	23	27
C43	Melanoma of the skin	643	623	729	795	878	889	898	1 006	994	1 048
C44	Skin, non-melanoma	670	677	744	708	782	777	810	929	846	997
C45	Mesothelioma	14	10	12	14	13	16	11	11	13	14
C47	Autonomic nervous system	4	7	5	5	1	0	6	8	7	1
C48–49	Soft tissues	95	81	101	90	83	81	90	86	73	83
C50	Breast	2 729	2 745	2 736	2 849	3 086	2 945	3 199	3 332	3 422	3 371
C51–58	Female genital organs	1 530	1 593	1 588	1 669	1 669	1 546	1 601	1 714	1 814	1 746
C51–52, C57.7–9	Other female genital	100	90	111	115	104	108	103	126	123	124
C53	Cervix uteri	278	293	297	311	294	314	288	353	384	342
C54	Corpus uteri	673	718	715	758	748	650	766	734	784	774
C55	Uterus, other	3	8	11	6	5	5	8	13	9	15
C56, C57.0–4	Ovary etc.	475	484	452	476	513	465	434	486	513	488
C58	Placenta	1	0	2	3	5	4	2	2	1	3
C64–68	Urinary organs	577	602	607	640	652	667	682	661	784	771
C64	Kidney (excl. renal pelvis)	253	257	238	242	260	256	230	236	311	283
C65–68	Urinary tract	324	345	369	398	392	411	452	425	473	488
C69	Eye	29	31	38	31	34	31	45	45	41	30
C70–72	Central nervous system	659	614	658	606	600	589	544	556	524	460
C73	Thyroid gland	160	175	184	205	220	228	248	249	267	307
C37, C74–75	Other endocrine glands	127	163	133	123	141	117	141	112	97	58
C39, C76, C80	Other or unspecified	233	191	200	183	168	156	168	169	163	161
C81–96	Lymphoid/haematopoietic tissue	1 020	1 042	1 068	1 134	1 171	1 219	1 131	1 219	1 268	1 212
C81	Hodgkin lymphoma	50	45	50	57	73	64	57	63	54	76
C82–86, C96	Non-Hodgkin lymphoma	384	372	397	407	449	458	415	454	466	429
C88	Immunoproliferative disease	19	17	28	27	26	33	33	32	17	11
C90	Multiple myeloma	170	164	163	181	141	181	177	190	200	183
C91–95	Leukaemia	397	444	430	462	482	483	449	480	531	513

Table 5.7: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years by primary site and year, 2007–2016, **males**

ICD-10	Site	Year									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
C00–96	All sites	716.6	712.6	718.3	708.3	741.9	740.0	722.7	731.8	735.7	714.4
C00–14	Mouth, pharynx	13.2	12.4	15.7	14.1	14.5	15.4	14.0	16.5	16.0	15.8
C00	Lip	3.4	2.6	4.0	3.7	3.7	3.2	2.7	3.3	2.9	2.5
C01–02	Tongue	2.7	2.9	3.3	2.6	3.0	3.0	3.4	3.3	3.3	3.6
C03–06	Mouth, other	1.9	2.0	3.1	2.4	1.8	2.4	2.4	2.5	2.3	2.4
C07–08	Salivary glands	0.8	0.8	1.1	1.3	0.8	1.3	1.2	1.9	1.5	1.8
C09–14	Pharynx	4.4	4.1	4.3	4.1	5.0	5.5	4.2	5.5	5.9	5.4
C15–26	Digestive organs	142.5	143.4	142.5	151.5	144.0	149.0	149.7	148.8	150.6	144.4
C15	Oesophagus	6.4	7.8	7.0	8.7	8.1	7.6	8.7	9.4	8.9	8.5
C16	Stomach	16.8	14.7	13.0	14.0	15.0	12.8	13.2	13.2	12.5	12.1
C17	Small intestine	3.2	3.1	3.7	3.2	3.9	4.5	3.8	4.0	4.1	4.5
C18	Colon	55.8	57.5	55.0	61.7	57.4	58.7	59.2	59.5	59.9	58.0
C19–20	Rectum, rectosigmoid	31.3	32.8	34.6	34.2	31.6	33.6	34.2	34.0	32.4	32.6
C21	Anus	0.9	1.0	0.9	1.5	0.8	1.1	0.7	1.1	0.9	1.2
C22	Liver	4.7	4.6	4.7	6.0	5.8	5.9	7.5	6.0	7.6	6.5
C23–24	Gallbladder, bile ducts	3.0	3.3	3.7	4.0	2.6	4.0	4.2	3.1	3.3	3.1
C25	Pancreas	18.4	16.7	17.4	15.2	15.4	18.0	15.9	16.0	18.1	15.3
C26	Other digestive organs	2.1	1.9	2.6	3.0	3.4	2.8	2.4	2.5	2.9	2.6
C30–34, C38	Respiratory organs	79.4	78.5	78.9	78.3	80.5	79.8	74.5	75.7	71.5	70.1
C30–31	Nose, sinuses	1.3	1.3	1.1	0.8	1.0	1.4	1.4	1.3	0.6	1.0
C32	Larynx, epiglottis	3.7	5.3	4.2	4.9	4.4	4.3	4.4	4.8	3.5	3.2
C33–34	Lung, trachea	73.4	71.7	73.3	72.1	74.7	73.6	68.3	69.2	67.1	65.3
C38	Heart, mediastinum and pleura	1.0	0.3	0.4	0.4	0.5	0.5	0.3	0.4	0.3	0.7
C40–41	Bone	0.9	1.0	1.6	1.1	1.2	1.3	0.7	1.1	1.4	1.2
C43	Melanoma of the skin	27.5	31.1	32.1	33.3	38.3	38.8	35.9	42.9	41.7	42.2
C44	Skin, non-melanoma	38.4	40.8	43.8	41.5	42.7	43.0	43.5	47.0	48.0	48.8
C45	Mesothelioma	3.1	3.2	3.2	3.9	3.0	3.0	3.5	2.5	2.8	2.5
C47	Autonomic nervous system	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.2	0.1
C48–49	Soft tissues	3.1	2.2	3.4	2.3	2.8	3.5	3.3	2.6	2.7	2.2
C50	Breast	0.9	1.0	0.7	0.6	1.2	1.3	1.5	1.0	1.1	1.3
C60–63	Male genital organs	237.6	231.2	224.4	210.6	238.1	229.6	222.7	220.4	220.3	215.6
C61	Prostate	222.9	216.4	209.3	197.7	225.0	215.2	207.7	205.6	207.0	201.5
C62	Testis	12.6	12.5	12.8	10.8	11.4	12.5	12.9	12.3	10.9	10.7
C60, C63	Other male genital	2.1	2.3	2.3	2.1	1.7	1.8	2.1	2.5	2.4	3.5
C64–68	Urinary organs	67.5	67.1	67.3	67.8	69.7	71.5	70.9	75.6	77.1	75.7
C64	Kidney (excl. renal pelvis)	18.9	19.2	19.6	21.7	22.7	22.6	22.3	23.5	23.0	22.9
C65–68	Urinary tract	48.6	47.9	47.7	46.0	46.9	49.0	48.6	52.0	54.0	52.8
C69	Eye	1.3	1.9	1.2	1.7	1.2	1.2	1.4	2.0	1.7	1.6
C70–72	Central nervous system	24.3	21.4	21.3	21.4	21.7	22.0	20.2	19.9	18.3	14.8
C73	Thyroid gland	3.0	2.6	3.2	3.4	3.2	3.8	4.3	4.5	4.0	5.3
C37, C74–75	Other endocrine glands	6.3	6.0	6.4	4.6	5.3	5.9	4.7	5.0	3.3	2.8
C39, C76, C80	Other or unspecified	9.2	8.8	8.6	7.1	7.9	5.8	6.9	7.0	6.8	6.1
C81–96	Lymphoid/haematopoietic tissue	58.1	59.9	63.7	64.9	66.5	64.9	64.7	59.1	68.2	63.9
C81	Hodgkin lymphoma	3.0	3.5	3.5	3.5	2.8	3.6	2.9	3.1	4.2	3.4
C82–86, C96	Non-Hodgkin lymphoma	20.4	21.7	22.6	25.0	22.5	23.0	23.3	22.3	24.9	23.3
C88	Immunoproliferative disease	1.8	1.7	1.3	1.6	1.6	2.3	1.5	1.6	1.8	1.3
C90	Multiple myeloma	9.2	9.9	10.4	9.6	10.9	9.4	10.1	8.1	10.5	9.9
C91–95	Leukaemia	23.7	23.0	25.8	25.3	28.8	26.6	27.0	24.0	26.8	26.1

Table 5.8: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years by primary site and year, 2007–2016, **females**

ICD-10	Site	Year									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
C00–96	All sites	506.6	508.1	514.7	521.6	533.7	523.0	531.2	551.5	557.2	538.4
C00–14	Mouth, pharynx	6.5	7.4	6.6	8.2	7.7	6.9	7.1	7.9	8.1	8.5
C00	Lip	1.8	1.9	1.3	2.0	1.7	1.4	1.8	1.6	1.8	1.8
C01–02	Tongue	1.0	1.3	1.4	1.3	1.4	1.8	1.7	1.8	1.8	2.4
C03–06	Mouth, other	1.5	1.5	1.7	1.7	1.6	1.1	1.6	1.7	1.4	1.6
C07–08	Salivary glands	1.0	1.0	0.7	1.3	1.2	0.6	0.7	1.0	1.5	1.0
C09–14	Pharynx	1.3	1.7	1.5	1.9	1.8	1.9	1.5	1.8	1.6	1.6
C15–26	Digestive organs	104.3	105.1	108.4	103.2	107.4	108.8	110.1	112.0	113.6	105.1
C15	Oesophagus	2.1	2.3	2.1	2.4	2.3	2.7	2.3	2.6	2.6	2.4
C16	Stomach	8.3	7.9	8.3	6.4	7.2	6.7	6.0	6.8	5.9	5.0
C17	Small intestine	2.2	2.2	3.0	2.4	2.5	2.3	1.8	2.8	2.7	2.4
C18	Colon	48.7	49.1	51.1	47.6	51.9	52.4	52.4	52.4	54.7	54.6
C19–20	Rectum, rectosigmoid	20.5	20.1	20.2	20.2	20.2	18.7	21.6	21.0	20.6	18.3
C21	Anus	1.7	1.7	2.1	2.1	1.5	1.8	2.2	2.4	2.1	2.6
C22	Liver	2.1	2.4	2.5	2.9	2.9	3.0	3.0	3.1	3.6	3.4
C23–24	Gallbladder, bile ducts	3.2	3.2	3.2	3.6	3.2	3.9	3.8	3.9	2.9	2.4
C25	Pancreas	13.6	14.0	13.8	13.0	13.5	14.4	14.2	14.2	15.5	11.5
C26	Other digestive organs	2.0	2.2	2.3	2.6	2.2	2.9	2.8	3.0	3.0	2.5
C30–34, C38	Respiratory organs	48.0	49.1	47.7	52.4	49.8	52.1	51.9	55.0	56.1	53.3
C30–31	Nose, sinuses	1.3	0.6	0.5	0.8	0.8	0.7	0.7	0.7	0.8	0.6
C32	Larynx, epiglottis	0.7	0.9	0.8	0.8	0.6	0.7	0.8	0.7	0.7	0.8
C33–34	Lung, trachea	45.7	47.4	46.1	50.5	48.1	50.5	50.1	53.4	54.3	51.6
C38	Heart, mediastinum and pleura	0.3	0.2	0.3	0.3	0.3	0.1	0.2	0.2	0.2	0.3
C40–41	Bone	0.9	1.0	1.1	1.0	0.9	0.5	0.9	1.1	0.9	1.0
C43	Melanoma of the skin	26.3	25.4	29.5	31.8	34.3	34.6	34.3	37.8	36.9	38.3
C44	Skin, non-melanoma	24.3	24.6	26.2	24.9	27.0	27.0	27.5	31.4	28.3	32.7
C45	Mesothelioma	0.5	0.4	0.5	0.5	0.5	0.6	0.4	0.4	0.5	0.5
C47	Autonomic nervous system	0.2	0.3	0.2	0.2	0.0	0.0	0.2	0.3	0.3	0.0
C48–49	Soft tissues	4.0	3.3	4.0	3.6	3.2	3.2	3.4	3.3	2.7	3.0
C50	Breast	114.2	113.8	112.2	115.1	122.9	115.1	123.4	126.8	128.2	125.1
C51–58	Female genital organs	63.6	65.1	64.2	66.7	65.4	59.8	61.2	64.4	67.4	63.4
C51–52, C57.7–9	Other female genital	3.8	3.3	4.3	4.2	3.9	4.0	3.7	4.4	4.4	4.4
C53	Cervix uteri	11.7	11.9	12.2	12.7	11.9	12.5	11.4	13.9	14.9	13.2
C54	Corpus uteri	28.2	29.9	29.1	30.3	29.2	25.0	29.2	27.3	28.9	27.6
C55	Uterus, other	0.1	0.3	0.4	0.3	0.2	0.2	0.3	0.4	0.3	0.5
C56, C57.0–4	Ovary etc.	19.7	19.7	18.1	19.1	20.0	17.9	16.6	18.2	19.0	17.7
C58	Placenta	0.0	0.0	0.1	0.1	0.2	0.2	0.1	0.1	0.0	0.1
C64–68	Urinary organs	22.9	23.6	23.7	24.5	24.5	24.7	25.0	24.1	28.0	27.0
C64	Kidney (excl. renal pelvis)	10.1	10.2	9.6	9.5	10.0	9.8	8.6	8.8	11.4	10.1
C65–68	Urinary tract	12.8	13.4	14.1	15.1	14.5	14.9	16.4	15.3	16.7	16.9
C69	Eye	1.2	1.3	1.5	1.3	1.3	1.2	1.7	1.7	1.6	1.1
C70–72	Central nervous system	27.5	25.4	26.7	24.3	23.7	23.1	20.9	21.1	19.6	17.0
C73	Thyroid gland	6.7	7.3	7.6	8.4	8.9	9.2	9.8	9.7	10.2	11.6
C37, C74–75	Other endocrine glands	5.4	6.9	5.6	5.1	5.7	4.6	5.6	4.3	3.7	2.2
C39, C76, C80	Other or unspecified	8.4	7.0	7.1	6.5	5.6	5.4	5.7	5.7	5.5	5.4
C81–96	Lymphoid/haematopoietic tissue	41.4	41.1	41.8	44.0	44.8	46.2	41.9	44.5	45.7	43.1
C81	Hodgkin lymphoma	2.1	1.9	2.1	2.4	3.0	2.6	2.3	2.4	2.1	2.9
C82–86, C96	Non-Hodgkin lymphoma	15.7	15.1	15.8	15.9	17.4	17.5	15.5	16.7	16.8	15.1
C88	Immunoproliferative disease	0.7	0.7	1.0	1.1	1.0	1.2	1.2	1.2	0.6	0.4
C90	Multiple myeloma	6.8	6.3	6.4	6.9	5.3	6.7	6.4	6.8	7.1	6.4
C91–95	Leukaemia	16.0	17.1	16.6	17.8	18.2	18.1	16.5	17.4	19.1	18.3

Table 5.9: Average annual number of new cases by primary site and five-year age group, 2012–2016, **males**

ICD-10	Site	0–4	5–9	10–14	15–19	20–24	25–29	30–34
C00–96	All sites	35	22	24	46	87	110	152
C00–14	Mouth, pharynx	0	0	0	0	1	0	3
C00	Lip	0	0	0	0	0	0	0
C01–02	Tongue	0	0	0	0	0	0	1
C03–06	Mouth, other	0	0	0	0	0	0	1
C07–08	Salivary glands	0	0	0	0	0	0	1
C09–14	Pharynx	0	0	0	0	0	0	0
C15–26	Digestive organs	1	0	1	2	6	7	17
C15	Oesophagus	0	0	0	0	0	0	1
C16	Stomach	0	0	0	0	0	1	1
C17	Small intestine	0	0	0	0	0	0	1
C18	Colon	0	0	0	1	5	3	5
C19–20	Rectum, rectosigmoid	0	0	0	0	0	2	6
C21	Anus	0	0	0	0	0	0	0
C22	Liver	1	0	0	0	0	0	1
C23–24	Gallbladder, bile ducts	0	0	0	0	0	0	0
C25	Pancreas	0	0	0	0	0	1	0
C26	Other digestive organs	0	0	0	0	0	0	1
C30–34, C38	Respiratory organs	0	0	0	1	0	0	2
C30–31	Nose, sinuses	0	0	0	0	0	0	0
C32	Larynx, epiglottis	0	0	0	0	0	0	0
C33–34	Lung, trachea	0	0	0	0	0	0	1
C38	Heart, mediastinum and pleura	0	0	0	0	0	0	0
C40–41	Bone	0	0	2	2	2	1	2
C43	Melanoma of the skin	0	0	1	1	4	9	14
C44	Skin, non-melanoma	0	0	0	1	1	2	3
C45	Mesothelioma	0	0	0	0	0	0	0
C47	Autonomic nervous system	1	0	0	0	0	0	0
C48–49	Soft tissues	1	1	1	1	1	1	2
C50	Breast	0	0	0	0	0	0	0
C60–63	Male genital organs	1	0	1	10	36	43	53
C61	Prostate	0	0	0	0	0	0	0
C62	Testis	1	0	1	9	36	43	53
C60, C63	Other male genital	0	0	0	0	0	0	0
C64–68	Urinary organs	3	1	0	1	1	4	6
C64	Kidney (excl. renal pelvis)	3	1	0	0	0	3	4
C65–68	Urinary tract	0	0	0	1	1	1	1
C69	Eye	0	1	0	0	0	0	0
C70–72	Central nervous system	8	7	7	10	10	15	17
C73	Thyroid gland	0	0	0	1	1	4	6
C37, C74–75	Other endocrine glands	3	1	1	3	5	2	5
C39, C76, C80	Other or unspecified	0	0	0	0	0	0	0
C81–96	Lymphoid/haematopoietic tissue	17	11	9	13	18	21	24
C81	Hodgkin lymphoma	0	1	1	5	8	11	5
C82–86, C96	Non-Hodgkin lymphoma	3	4	3	2	3	3	8
C88	Immunoproliferative disease	0	0	0	0	0	0	0
C90	Multiple myeloma	0	0	0	0	0	0	1
C91–95	Leukaemia	14	6	5	6	6	7	9

35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
194	304	472	777	1396	2 167	3 116	2 788	2 255	1 803	1 539
3	9	18	36	49	57	71	49	36	27	21
0	1	2	2	5	6	9	11	11	11	9
1	2	6	10	11	13	17	9	7	4	3
1	1	1	4	6	10	14	9	4	4	3
1	2	1	3	3	3	5	4	4	4	4
1	2	8	16	24	25	25	16	10	4	2
28	52	89	157	283	423	585	558	500	433	345
1	3	7	11	19	28	42	31	26	21	17
3	4	8	14	27	31	46	47	43	37	35
2	3	4	5	10	14	18	15	11	10	7
10	19	28	47	89	146	216	229	211	200	158
8	13	24	43	73	111	141	121	111	82	60
0	0	1	2	2	3	6	2	3	1	3
2	2	6	11	20	24	21	20	21	19	11
1	1	1	4	9	10	16	15	10	8	8
2	5	8	18	29	49	69	69	55	48	38
0	1	2	3	4	7	10	9	9	8	7
4	12	25	57	118	216	344	334	268	212	153
1	1	1	2	3	3	6	3	2	2	3
0	1	3	3	7	17	20	17	14	9	6
3	9	21	52	107	196	317	312	252	199	143
0	1	0	0	1	0	1	2	1	1	2
1	1	2	2	3	2	4	2	1	0	1
21	50	53	73	91	109	148	137	102	86	73
6	8	12	16	27	59	109	135	170	191	249
0	0	0	2	3	6	11	15	12	9	7
0	0	0	0	0	0	1	0	0	0	0
2	2	5	6	6	8	8	9	5	5	5
0	1	0	2	2	3	6	5	3	3	4
55	49	89	190	483	816	1 213	948	648	406	319
1	8	53	167	466	805	1 202	937	639	398	312
53	39	33	17	12	5	4	2	1	1	1
1	1	3	6	5	6	7	8	8	7	6
13	31	53	87	137	202	279	292	253	206	175
9	18	29	50	66	80	96	86	62	34	23
4	12	24	37	71	122	183	207	192	171	152
1	2	2	3	4	6	5	5	3	3	2
20	26	34	39	44	54	55	46	35	29	18
8	8	10	10	11	12	14	9	8	5	4
5	7	7	10	13	11	13	9	7	5	3
0	2	3	6	6	11	21	20	18	21	32
27	44	67	81	116	170	229	212	184	160	129
7	7	9	6	6	7	6	4	3	1	2
10	18	23	35	44	66	95	81	69	54	40
0	1	1	1	4	4	7	7	6	7	2
2	4	9	10	17	28	33	35	31	31	25
9	14	24	30	45	65	88	85	75	68	60

Table 5.10: Average annual number of new cases by primary site and five-year age group, 2012–2016, **females**

ICD-10	Site	0–4	5–9	10–14	15–19	20–24	25–29	30–34
C00–96	All sites	30	15	20	43	74	132	196
C00–14	Mouth, pharynx	0	0	1	1	1	2	2
C00	Lip	0	0	0	0	0	0	0
C01–02	Tongue	0	0	0	0	0	1	0
C03–06	Mouth, other	0	0	0	0	0	0	0
C07–08	Salivary glands	0	0	0	0	0	0	2
C09–14	Pharynx	0	0	0	0	0	0	0
C15–26	Digestive organs	1	0	2	3	5	10	15
C15	Oesophagus	0	0	0	0	0	0	0
C16	Stomach	0	0	0	0	0	0	0
C17	Small intestine	0	0	0	0	0	0	1
C18	Colon	0	0	2	3	4	7	8
C19–20	Rectum, rectosigmoid	0	0	0	0	0	1	4
C21	Anus	0	0	0	0	0	0	0
C22	Liver	1	0	0	0	1	0	0
C23–24	Gallbladder, bile ducts	0	0	0	0	0	0	0
C25	Pancreas	0	0	0	0	0	0	1
C26	Other digestive organs	0	0	0	0	0	1	0
C30–34, C38	Respiratory organs	0	0	0	0	1	2	3
C30–31	Nose, sinuses	0	0	0	0	0	0	0
C32	Larynx, epiglottis	0	0	0	0	0	0	0
C33–34	Lung, trachea	0	0	0	0	1	1	2
C38	Heart, mediastinum and pleura	0	0	0	0	0	0	0
C40–41	Bone	0	1	1	1	2	1	2
C43	Melanoma of the skin	0	0	1	4	11	20	24
C44	Skin, non-melanoma	0	1	0	1	1	2	2
C45	Mesothelioma	0	0	0	0	0	0	0
C47	Autonomic nervous system	1	0	0	0	0	0	0
C48–49	Soft tissues	1	0	1	1	1	2	2
C50	Breast	0	0	0	0	2	17	40
C51–58	Female genital organs	0	0	1	3	9	30	46
C51–52, C57.7–9	Other female genital	0	0	0	0	0	0	1
C53	Cervix uteri	0	0	0	0	6	23	36
C54	Corpus uteri	0	0	0	0	0	1	3
C55	Uterus, other	0	0	0	0	0	0	0
C56, C57.0–4	Ovary etc.	0	0	0	2	2	4	5
C58	Placenta	0	0	0	0	0	1	0
C64–68	Urinary organs	5	0	0	0	2	2	3
C64	Kidney (excl. renal pelvis)	4	0	0	0	0	1	2
C65–68	Urinary tract	0	0	0	0	1	1	1
C69	Eye	1	0	0	0	0	0	1
C70–72	Central nervous system	5	5	5	7	10	12	16
C73	Thyroid gland	0	0	1	3	7	12	15
C37, C74–75	Other endocrine glands	1	0	1	3	7	6	7
C39, C76, C80	Other or unspecified	0	0	0	0	0	0	1
C81–96	Lymphoid/haematopoietic tissue	14	5	8	15	14	16	17
C81	Hodgkin lymphoma	0	0	2	8	8	6	4
C82–86, C96	Non-Hodgkin lymphoma	2	1	2	2	3	4	6
C88	Immunoproliferative disease	0	0	0	0	0	0	0
C90	Multiple myeloma	0	0	0	0	0	0	0
C91–95	Leukaemia	11	4	4	5	4	6	7

35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
333	525	777	1 007	1 236	1 592	2 041	1 764	1 584	1 459	1 840
4	6	10	14	21	28	27	20	22	21	30
1	1	1	1	3	6	6	5	5	8	11
1	1	4	4	5	7	8	5	5	5	5
0	1	1	2	4	4	5	5	5	4	9
2	1	2	3	1	2	2	2	3	2	3
1	2	3	4	8	8	6	4	4	1	2
29	43	81	135	188	277	421	442	441	443	535
0	1	2	2	4	6	12	11	11	8	13
4	3	6	10	9	14	22	21	21	25	35
1	2	3	3	5	7	10	9	7	9	8
11	16	33	58	80	120	188	223	234	240	273
8	11	21	32	45	62	81	75	70	65	75
1	3	5	5	7	6	10	7	5	6	4
1	1	2	4	6	8	12	15	12	12	15
1	1	1	4	6	9	15	13	13	14	16
2	4	6	13	23	37	61	58	57	53	77
0	1	2	3	4	8	10	8	12	11	20
4	10	30	59	114	180	283	275	209	166	124
0	0	1	1	2	2	1	3	2	3	3
1	1	1	2	3	2	4	2	3	1	1
3	9	28	55	109	176	278	270	203	161	117
0	0	0	0	0	1	1	0	0	0	2
1	2	2	0	1	2	3	2	1	2	1
45	69	84	77	87	99	111	102	74	68	91
2	8	11	16	30	43	74	95	125	144	317
0	0	0	1	0	2	2	1	3	2	1
0	1	0	0	0	1	0	0	0	0	0
2	4	5	5	8	11	11	11	7	7	5
99	192	313	393	386	451	480	253	221	177	230
65	82	102	129	167	195	237	196	158	125	139
2	4	6	6	10	11	14	10	12	13	27
48	49	45	23	22	20	20	14	10	8	11
6	14	26	55	79	103	127	112	91	67	56
0	0	1	1	0	0	1	1	1	2	3
9	15	25	45	56	61	74	58	45	34	41
0	0	0	0	0	0	0	0	0	0	0
7	14	20	31	53	73	106	108	97	90	103
5	10	11	18	18	30	42	43	31	25	23
2	4	9	14	35	43	64	65	66	65	80
1	2	2	3	4	3	10	4	3	3	1
20	33	39	47	52	61	66	53	36	35	34
24	24	29	26	20	23	24	22	13	7	8
7	8	10	8	9	8	9	7	6	3	3
1	1	2	5	8	9	12	14	25	25	59
21	26	37	57	89	126	164	159	143	141	158
6	3	4	1	2	4	4	3	2	4	1
6	8	12	26	37	51	65	67	54	50	50
0	0	1	0	1	4	4	3	4	4	2
1	3	4	8	16	21	26	22	29	26	30
8	11	16	22	32	47	65	63	53	58	75

Table 5.11: Age-specific incidence rates per 100 000 person-years by primary site and five-year age group, 2012–2016, **males**

ICD-10	Site	0–4	5–9	10–14	15–19	20–24	25–29	30–34
C00–96	All sites	22.1	14.0	15.0	27.6	49.7	62.2	86.0
C00–14	Mouth, pharynx	0.1	0.2	0.3	0.0	0.7	0.2	1.5
C00	Lip	0.0	0.0	0.0	0.0	0.1	0.0	0.1
C01–02	Tongue	0.0	0.0	0.0	0.0	0.1	0.1	0.5
C03–06	Mouth, other	0.0	0.0	0.1	0.0	0.2	0.0	0.3
C07–08	Salivary glands	0.0	0.0	0.1	0.0	0.1	0.1	0.5
C09–14	Pharynx	0.1	0.2	0.0	0.0	0.1	0.0	0.1
C15–26	Digestive organs	0.4	0.1	0.4	1.2	3.3	4.2	9.4
C15	Oesophagus	0.0	0.0	0.0	0.0	0.0	0.1	0.6
C16	Stomach	0.0	0.0	0.0	0.1	0.1	0.5	0.6
C17	Small intestine	0.0	0.0	0.0	0.1	0.0	0.1	0.5
C18	Colon	0.0	0.0	0.1	0.6	2.9	1.9	3.0
C19–20	Rectum, rectosigmoid	0.0	0.0	0.0	0.0	0.2	1.1	3.5
C21	Anus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C22	Liver	0.4	0.1	0.1	0.1	0.1	0.1	0.7
C23–24	Gallbladder, bile ducts	0.0	0.0	0.0	0.0	0.0	0.0	0.1
C25	Pancreas	0.0	0.0	0.1	0.2	0.0	0.3	0.1
C26	Other digestive organs	0.0	0.0	0.0	0.0	0.0	0.0	0.5
C30–34, C38	Respiratory organs	0.3	0.0	0.0	0.6	0.2	0.2	1.0
C30–31	Nose, sinuses	0.0	0.0	0.0	0.1	0.1	0.0	0.1
C32	Larynx, epiglottis	0.0	0.0	0.0	0.0	0.0	0.0	0.1
C33–34	Lung, trachea	0.3	0.0	0.0	0.2	0.0	0.2	0.7
C38	Heart, mediastinum and pleura	0.0	0.0	0.0	0.2	0.1	0.0	0.1
C40–41	Bone	0.1	0.1	1.3	1.2	1.1	0.8	0.9
C43	Melanoma of the skin	0.1	0.1	0.5	0.5	2.5	5.2	7.8
C44	Skin, non-melanoma	0.1	0.2	0.1	0.8	0.6	1.1	1.8
C45	Mesothelioma	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C47	Autonomic nervous system	0.5	0.2	0.0	0.2	0.1	0.2	0.2
C48–49	Soft tissues	0.8	0.4	0.6	0.4	0.8	0.6	0.9
C50	Breast	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C60–63	Male genital organs	0.5	0.1	0.5	5.8	20.6	24.1	30.1
C61	Prostate	0.0	0.0	0.0	0.2	0.0	0.0	0.0
C62	Testis	0.4	0.0	0.4	5.6	20.6	24.1	30.0
C60, C63	Other male genital	0.1	0.1	0.1	0.0	0.0	0.0	0.1
C64–68	Urinary organs	1.9	0.4	0.1	0.6	0.6	2.2	3.2
C64	Kidney (excl. renal pelvis)	1.6	0.4	0.0	0.1	0.0	1.5	2.4
C65–68	Urinary tract	0.3	0.0	0.1	0.5	0.6	0.7	0.8
C69	Eye	0.1	0.4	0.3	0.1	0.0	0.1	0.2
C70–72	Central nervous system	4.8	4.1	4.4	5.7	5.6	8.3	9.5
C73	Thyroid gland	0.0	0.0	0.1	0.8	0.8	2.0	3.2
C37, C74–75	Other endocrine glands	1.6	0.5	0.6	1.5	2.6	0.9	2.7
C39, C76, C80	Other or unspecified	0.3	0.0	0.0	0.2	0.1	0.1	0.1
C81–96	Lymphoid/haematopoietic tissue	10.5	7.0	5.7	7.9	10.0	11.9	13.4
C81	Hodgkin lymphoma	0.0	0.7	0.9	2.9	4.6	6.0	3.1
C82–86, C96	Non-Hodgkin lymphoma	1.6	2.7	1.8	1.2	1.9	1.8	4.5
C88	Immunoproliferative disease	0.0	0.0	0.0	0.0	0.0	0.0	0.1
C90	Multiple myeloma	0.0	0.0	0.0	0.0	0.0	0.0	0.3
C91–95	Leukaemia	8.8	3.5	3.0	3.8	3.5	4.1	5.3

35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
109.0	158.5	248.5	451.4	877.8	1 492.4	2 306.2	3 000.0	3 616.9	4 095.6	4 126.3
1.8	4.5	9.5	20.7	30.9	39.1	52.6	53.2	57.4	60.9	55.8
0.1	0.4	1.2	1.4	2.9	4.3	6.8	11.6	18.0	25.0	23.1
0.6	1.0	3.0	6.0	7.2	8.7	12.3	9.5	10.9	8.6	8.0
0.3	0.6	0.7	2.1	4.0	6.9	10.7	9.7	7.1	9.1	7.5
0.3	1.1	0.6	1.6	1.9	2.2	4.0	4.7	6.1	9.5	10.7
0.4	1.3	4.0	9.5	15.0	17.1	18.8	17.6	15.4	8.6	6.4
15.5	27.1	47.1	91.4	177.9	291.5	432.9	600.3	802.3	984.7	925.1
0.4	1.8	3.5	6.4	11.8	19.0	31.1	33.4	41.7	47.7	45.0
1.5	2.2	4.3	8.1	16.7	21.4	33.8	51.0	69.0	83.2	94.4
0.9	1.8	2.1	2.7	6.5	9.9	13.5	15.7	17.0	23.2	19.3
5.5	10.0	15.0	27.1	56.1	100.4	160.0	246.0	338.4	454.0	423.1
4.6	7.0	12.5	25.0	45.7	76.5	104.5	130.7	177.4	185.9	159.8
0.0	0.2	0.7	0.9	1.5	2.3	4.3	2.2	5.1	1.4	7.5
1.0	1.0	3.2	6.4	12.7	16.8	15.8	21.5	33.7	44.1	30.6
0.4	0.4	0.5	2.2	5.5	6.9	11.7	16.6	16.7	17.7	22.5
0.9	2.4	4.2	10.6	18.5	33.5	50.9	74.0	88.5	109.5	103.0
0.2	0.3	1.1	2.0	2.8	4.8	7.3	9.3	14.8	18.2	19.8
2.0	6.3	13.4	33.3	74.2	148.9	254.3	359.4	429.5	482.1	411.3
0.3	0.5	0.6	1.4	1.9	2.2	4.1	3.0	2.9	5.0	7.0
0.1	0.6	1.5	1.6	4.4	11.4	15.0	18.7	22.1	20.9	15.0
1.6	4.7	11.2	30.1	67.3	135.1	234.5	335.8	403.6	453.0	383.5
0.0	0.4	0.1	0.1	0.6	0.1	0.7	1.9	1.0	3.2	5.9
0.8	0.5	0.9	1.0	1.6	1.2	3.0	2.6	2.2	0.9	2.7
12.0	25.8	28.1	42.7	57.4	75.3	109.7	147.9	163.6	194.5	195.2
3.1	4.1	6.5	9.5	17.1	40.9	80.7	145.7	273.3	434.9	666.6
0.0	0.0	0.2	0.9	1.8	4.3	8.3	15.9	19.9	21.4	18.2
0.0	0.1	0.0	0.2	0.0	0.3	0.6	0.4	0.0	0.0	0.0
1.1	1.1	2.8	3.3	3.8	5.8	5.6	9.9	8.3	10.5	13.9
0.1	0.7	0.1	1.0	1.3	1.9	4.1	5.0	5.1	6.4	10.2
30.7	25.5	46.8	110.3	303.8	562.2	898.1	1 019.8	1 038.7	923.4	854.9
0.3	4.4	28.0	97.2	293.2	554.4	889.7	1 008.8	1 024.9	904.7	836.1
29.7	20.4	17.3	9.9	7.5	3.3	3.1	2.4	1.6	2.3	3.8
0.7	0.7	1.5	3.3	3.0	4.4	5.3	8.6	12.2	16.4	15.0
7.4	16.0	27.8	50.3	86.2	139.3	206.4	314.7	406.4	467.6	468.7
5.2	9.6	15.1	28.8	41.6	55.2	71.1	92.1	99.1	78.2	60.6
2.2	6.5	12.8	21.5	44.5	84.0	135.3	222.6	307.3	389.4	408.1
0.7	1.1	1.3	1.9	2.5	3.9	4.0	5.2	4.8	5.9	6.4
11.1	13.8	17.9	22.6	27.8	36.9	40.7	49.9	56.5	66.8	47.2
4.4	4.0	5.1	5.8	6.8	8.0	10.5	10.1	12.8	12.3	10.2
2.6	3.6	3.9	5.6	8.1	7.9	9.9	9.9	11.5	11.8	8.0
0.2	1.3	1.7	3.5	4.0	7.9	15.4	21.7	28.6	48.6	86.9
15.3	22.9	35.3	47.3	72.7	117.2	169.5	228.4	295.8	363.1	344.8
3.7	3.4	5.0	3.3	3.9	4.8	4.3	4.3	5.5	1.8	4.3
5.7	9.5	12.2	20.3	27.4	45.6	70.3	87.6	110.4	121.8	106.7
0.0	0.4	0.6	0.3	2.4	2.6	5.3	7.7	9.6	15.9	6.4
0.9	2.1	4.7	5.7	10.9	19.1	24.3	37.5	50.0	69.5	66.5
4.9	7.5	12.8	17.7	28.1	45.0	65.3	91.3	120.3	154.0	160.9

Table 5.12: Age-specific incidence rates per 100 000 person-years by primary site and five-year age group, 2012–2016, **females**

ICD-10	Site	0–4	5–9	10–14	15–19	20–24	25–29	30–34
C00–96	All sites	19.9	9.6	13.4	27.3	44.5	77.2	117.7
C00–14	Mouth, pharynx	0.3	0.0	0.4	0.5	0.6	0.9	1.3
C00	Lip	0.1	0.0	0.0	0.0	0.0	0.0	0.0
C01–02	Tongue	0.0	0.0	0.0	0.1	0.2	0.5	0.2
C03–06	Mouth, other	0.0	0.0	0.1	0.1	0.1	0.1	0.1
C07–08	Salivary glands	0.0	0.0	0.3	0.1	0.1	0.2	1.0
C09–14	Pharynx	0.1	0.0	0.0	0.1	0.1	0.1	0.0
C15–26	Digestive organs	0.4	0.3	1.1	2.2	3.3	5.8	9.0
C15	Oesophagus	0.0	0.0	0.0	0.0	0.1	0.0	0.1
C16	Stomach	0.0	0.0	0.0	0.0	0.1	0.1	0.1
C17	Small intestine	0.0	0.0	0.0	0.0	0.1	0.1	0.5
C18	Colon	0.0	0.1	1.1	1.9	2.3	4.1	4.8
C19–20	Rectum, rectosigmoid	0.0	0.0	0.0	0.0	0.0	0.8	2.2
C21	Anus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C22	Liver	0.4	0.1	0.0	0.1	0.4	0.0	0.2
C23–24	Gallbladder, bile ducts	0.0	0.0	0.0	0.0	0.0	0.0	0.2
C25	Pancreas	0.0	0.0	0.0	0.1	0.2	0.2	0.8
C26	Other digestive organs	0.0	0.0	0.0	0.0	0.0	0.4	0.0
C30–34, C38	Respiratory organs	0.1	0.1	0.0	0.3	0.4	0.9	1.7
C30–31	Nose, sinuses	0.0	0.0	0.0	0.1	0.0	0.2	0.2
C32	Larynx, epiglottis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C33–34	Lung, trachea	0.1	0.1	0.0	0.1	0.4	0.7	1.3
C38	Heart, mediastinum and pleura	0.0	0.0	0.0	0.0	0.0	0.0	0.1
C40–41	Bone	0.3	0.5	0.4	0.8	1.1	0.7	1.2
C43	Melanoma of the skin	0.1	0.1	0.8	2.4	6.5	11.5	14.4
C44	Skin, non-melanoma	0.1	0.4	0.0	0.9	0.8	1.1	1.3
C45	Mesothelioma	0.0	0.0	0.0	0.1	0.0	0.0	0.0
C47	Autonomic nervous system	0.7	0.0	0.0	0.0	0.0	0.1	0.2
C48–49	Soft tissues	0.9	0.3	0.5	0.5	0.8	1.2	1.0
C50	Breast	0.0	0.0	0.0	0.1	1.4	9.9	23.8
C51–58	Female genital organs	0.1	0.1	0.4	1.8	5.3	17.5	27.4
C51–52, C57.7–9	Other female genital	0.0	0.0	0.1	0.0	0.1	0.2	0.7
C53	Cervix uteri	0.0	0.0	0.0	0.1	3.6	13.6	21.9
C54	Corpus uteri	0.0	0.0	0.0	0.1	0.1	0.7	1.8
C55	Uterus, other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C56, C57.0–4	Ovary etc.	0.1	0.1	0.3	1.5	1.2	2.6	2.8
C58	Placenta	0.0	0.0	0.0	0.0	0.2	0.4	0.2
C64–68	Urinary organs	3.1	0.3	0.0	0.1	1.0	0.9	1.7
C64	Kidney (excl. renal pelvis)	2.9	0.3	0.0	0.1	0.2	0.5	1.1
C65–68	Urinary tract	0.1	0.0	0.0	0.0	0.7	0.5	0.6
C69	Eye	0.7	0.0	0.0	0.1	0.0	0.0	0.8
C70–72	Central nervous system	3.5	3.3	3.0	4.4	5.9	6.9	9.6
C73	Thyroid gland	0.0	0.3	0.9	1.6	4.3	6.9	9.3
C37, C74–75	Other endocrine glands	0.7	0.3	0.5	2.2	4.1	3.6	4.1
C39, C76, C80	Other or unspecified	0.0	0.1	0.0	0.1	0.2	0.1	0.4
C81–96	Lymphoid/haematopoietic tissue	9.0	3.5	5.3	9.2	8.7	9.2	10.5
C81	Hodgkin lymphoma	0.1	0.0	1.6	4.9	4.8	3.3	2.6
C82–86, C96	Non-Hodgkin lymphoma	1.6	0.7	1.1	1.1	1.6	2.1	3.6
C88	Immunoproliferative disease	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C90	Multiple myeloma	0.0	0.0	0.0	0.1	0.0	0.0	0.1
C91–95	Leukaemia	7.3	2.9	2.7	3.0	2.3	3.8	4.1

35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
199.4	289.8	435.3	618.0	801.3	1 114.8	1 499.0	1 761.5	2 101.9	2 349.4	2 376.4
2.3	3.3	5.6	8.5	13.6	19.9	19.5	20.4	28.9	34.1	39.0
0.4	0.3	0.6	0.7	2.1	4.2	4.3	5.2	6.6	12.9	14.2
0.4	0.4	2.2	2.3	3.4	5.0	5.6	5.0	6.9	8.1	6.7
0.2	0.8	0.3	1.2	2.3	3.1	3.7	5.0	6.4	7.1	11.1
1.0	0.4	0.9	1.8	0.6	1.7	1.6	1.6	4.2	3.9	4.4
0.4	1.3	1.6	2.3	5.2	5.9	4.4	3.6	4.8	2.3	2.6
17.4	23.5	45.3	83.0	122.1	194.2	309.6	441.0	585.0	713.5	691.0
0.0	0.4	0.9	1.5	2.6	4.1	8.7	11.0	15.1	12.9	16.5
2.2	1.7	3.1	6.4	5.6	10.1	15.9	21.0	27.6	40.3	45.5
0.6	0.9	1.9	2.1	3.1	5.0	7.5	9.2	9.0	14.2	10.3
6.6	8.8	18.5	35.7	51.9	84.3	138.4	222.9	310.0	386.5	352.4
4.6	6.3	11.5	19.5	29.4	43.7	59.4	74.9	92.4	104.7	96.4
0.7	1.8	2.7	3.1	4.7	3.9	7.3	7.4	6.6	10.3	5.7
0.5	0.7	1.2	2.5	3.6	5.7	8.8	14.8	15.9	19.6	18.9
0.7	0.3	0.8	2.6	3.8	6.0	11.3	13.2	17.5	21.9	20.9
1.3	2.0	3.3	7.7	15.2	25.8	44.7	58.3	75.4	85.0	99.2
0.2	0.7	1.3	2.0	2.3	5.6	7.6	8.4	15.4	18.0	25.3
2.3	5.7	16.8	36.0	74.2	126.0	208.2	275.0	276.8	267.0	159.6
0.2	0.2	0.4	0.6	1.0	1.4	0.6	2.8	2.7	5.5	3.9
0.4	0.3	0.6	1.1	1.9	1.1	2.9	2.0	4.2	1.9	1.8
1.7	5.2	15.8	34.0	70.9	122.9	203.9	270.0	269.4	259.3	151.4
0.0	0.0	0.0	0.2	0.3	0.6	0.7	0.2	0.5	0.3	2.6
0.5	1.0	1.1	0.1	0.4	1.4	1.9	1.8	1.6	2.6	1.3
26.9	38.3	47.3	47.4	56.3	69.2	81.5	101.5	98.5	109.5	117.5
1.4	4.3	6.1	9.8	19.2	29.8	54.4	95.3	165.4	232.2	409.2
0.1	0.0	0.1	0.5	0.3	1.3	1.8	1.4	3.5	2.6	1.8
0.1	0.6	0.0	0.0	0.0	0.4	0.3	0.4	0.0	0.0	0.3
1.0	2.0	2.6	3.2	4.9	7.7	8.1	10.6	9.6	11.0	6.5
59.4	106.1	175.4	241.2	250.3	315.9	352.5	252.3	293.6	285.1	297.1
39.2	45.5	57.3	79.3	108.1	136.8	174.1	195.7	210.2	201.0	179.0
1.1	2.1	3.4	3.6	6.2	7.7	10.4	10.4	16.2	20.6	35.1
28.7	27.2	25.0	14.0	14.4	14.1	15.0	14.4	13.0	13.5	13.7
3.6	7.6	14.8	33.8	51.3	71.8	93.6	111.7	121.0	108.5	72.6
0.0	0.1	0.3	0.4	0.1	0.3	0.7	1.2	0.8	2.9	4.4
5.6	8.3	13.8	27.5	36.0	42.8	54.4	58.1	59.2	55.4	53.2
0.2	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.2	7.7	11.3	19.1	34.1	51.0	77.9	107.5	129.3	144.9	133.0
2.8	5.5	6.4	10.8	11.5	20.9	30.7	42.9	41.4	39.6	30.2
1.4	2.2	4.9	8.3	22.6	30.1	47.2	64.5	87.9	105.3	102.8
0.7	1.0	0.9	1.8	2.3	2.4	7.3	4.4	3.7	4.2	1.8
12.2	18.1	22.0	28.7	33.5	42.4	48.2	52.9	48.3	56.7	43.4
14.3	13.5	16.3	16.2	13.2	16.0	17.6	22.0	16.7	11.6	10.8
4.4	4.5	5.6	4.9	6.1	5.7	6.5	6.6	8.2	5.5	4.4
0.7	0.4	0.9	3.1	5.1	6.4	9.1	14.4	33.4	40.3	76.5
12.4	14.1	20.8	35.2	57.7	88.3	120.6	158.4	189.2	227.7	204.1
3.5	1.8	2.0	0.9	1.6	2.7	3.1	2.6	3.2	6.1	1.5
3.7	4.6	6.9	15.7	23.9	35.4	47.7	67.3	71.1	79.9	64.3
0.0	0.0	0.6	0.2	0.8	2.7	3.2	3.4	5.6	7.1	3.1
0.6	1.4	2.1	5.2	10.5	14.8	19.1	21.8	38.8	41.2	38.7
4.6	6.3	9.2	13.3	21.0	32.8	47.5	63.3	70.6	93.4	96.4

Table 5.13: Average annual number of new cases by primary site and five-year period, 1957–2016, **males**

ICD-10	Site	1957–61	1962–66	1967–71	1972–76	1977–81
C00–96	All sites	4 092	4 716	5 596	6 512	7 628
C00–14	Mouth, pharynx	187	188	214	244	234
C00	Lip	97	94	112	118	111
C01–02	Tongue	20	22	21	28	27
C03–06	Mouth, other	23	22	31	30	38
C07–08	Salivary glands	12	13	14	14	14
C09–14	Pharynx	34	38	35	55	45
C15–26	Digestive organs	1 659	1 740	1 892	1 976	2 193
C15	Oesophagus	77	78	80	82	89
C16	Stomach	843	786	745	650	601
C17	Small intestine	10	13	18	18	19
C18	Colon	246	306	369	416	541
C19–20	Rectum, rectosigmoid	153	186	271	328	449
C21	Anus	5	7	5	7	9
C22	Liver	22	23	41	54	49
C23–24	Gallbladder, bile ducts	21	22	27	29	38
C25	Pancreas	148	185	226	251	271
C26	Other digestive organs	134	135	109	142	127
C30–34, C38	Respiratory organs	350	477	675	826	1 052
C30–31	Nose, sinuses	19	21	21	23	25
C32	Larynx, epiglottis	34	50	67	74	93
C33–34	Lung, trachea	284	396	574	710	915
C38	Heart, mediastinum and pleura	13	10	13	19	19
C40–41	Bone	12	17	18	22	21
C43	Melanoma of the skin	56	80	117	161	220
C44	Skin, non-melanoma	83	68	106	184	225
C45	Mesothelioma	1	2	4	9	21
C47	Autonomic nervous system	19	15	14	12	8
C48–49	Soft tissues	24	29	38	53	57
C50	Breast	7	8	9	10	11
C60–63	Male genital organs	764	961	1 157	1 387	1 666
C61	Prostate	689	871	1 057	1 281	1 524
C62	Testis	55	68	78	84	115
C60, C63	Other male genital	19	23	23	21	27
C64–68	Urinary organs	321	431	516	676	818
C64	Kidney (excl. renal pelvis)	106	128	158	177	210
C65–68	Urinary tract	215	302	358	499	607
C69	Eye	20	17	24	18	27
C70–72	Central nervous system	125	135	150	168	195
C73	Thyroid gland	20	26	35	36	44
C37, C74–75	Other endocrine glands	7	10	21	25	32
C39, C76, C80	Other or unspecified	63	88	127	160	185
C81–96	Lymphoid/haematopoietic tissue	375	424	480	546	621
C81	Hodgkin lymphoma	47	53	61	61	68
C82–86, C96	Non-Hodgkin lymphoma	94	107	117	142	166
C88	Immunoproliferative disease	0	0	2	7	8
C90	Multiple myeloma	73	83	95	126	151
C91–95	Leukaemia	162	180	205	210	229

1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16
8 619	9 301	10 469	11 430	12 974	15 223	17 284
253	251	257	260	258	306	380
101	91	72	61	51	72	68
36	36	43	49	49	65	83
45	47	56	45	48	48	59
15	18	18	23	20	21	36
56	60	68	82	89	101	134
2 373	2 385	2 463	2 567	2 725	3 022	3 487
84	103	107	121	138	162	206
579	518	449	381	327	305	297
30	26	32	48	53	75	100
674	760	850	948	1 038	1 186	1 367
513	527	563	601	661	697	795
12	11	19	17	19	22	24
68	60	59	70	81	110	161
47	49	53	61	63	69	83
297	294	281	276	310	344	391
68	36	51	43	35	53	62
1 223	1 285	1 394	1 440	1 560	1 672	1 747
21	24	21	23	22	23	27
107	105	105	107	105	97	97
1 084	1 147	1 253	1 295	1 421	1 541	1 613
12	8	15	16	13	11	10
24	20	21	21	25	27	29
263	380	427	470	520	715	974
301	393	481	568	671	808	992
27	37	44	56	65	68	66
8	8	6	6	5	7	5
45	43	48	50	56	61	69
12	13	13	15	15	19	28
1 890	2 116	2 676	3 220	3 817	4 839	5 358
1 711	1 921	2 439	2 952	3 527	4 501	4 989
151	170	204	238	248	293	310
29	25	33	30	42	45	59
959	1 011	1 104	1 103	1 260	1 429	1 743
249	254	268	293	356	449	563
710	757	836	810	904	980	1 180
25	23	29	27	34	32	39
220	242	289	358	440	498	472
46	50	42	49	60	71	110
43	42	55	68	94	132	109
229	279	299	272	220	165	144
678	723	822	880	1 148	1 352	1 532
52	51	52	58	71	77	88
218	272	324	355	408	489	561
10	8	18	22	33	33	40
152	154	166	166	182	212	224
245	238	262	279	454	541	617

Table 5.14: Average annual number of new cases by primary site and five-year period, 1957–2016, **females**

ICD-10	Site	1957–61	1962–66	1967–71	1972–76	1977–81
C00–96	All sites	4 233	4 670	5 457	6 210	7 098
C00–14	Mouth, pharynx	60	69	72	80	90
C00	Lip	8	8	11	11	16
C01–02	Tongue	11	14	17	17	17
C03–06	Mouth, other	11	13	16	16	23
C07–08	Salivary glands	8	14	13	12	15
C09–14	Pharynx	22	20	15	24	19
C15–26	Digestive organs	1 391	1 467	1 610	1 728	2 035
C15	Oesophagus	23	32	28	31	31
C16	Stomach	580	532	492	419	407
C17	Small intestine	8	11	15	18	21
C18	Colon	286	359	438	513	692
C19–20	Rectum, rectosigmoid	120	140	216	261	361
C21	Anus	6	10	13	13	20
C22	Liver	12	13	23	30	36
C23–24	Gallbladder, bile ducts	49	52	59	56	73
C25	Pancreas	105	124	167	189	224
C26	Other digestive organs	202	195	159	199	171
C30–34, C38	Respiratory organs	93	111	167	202	257
C30–31	Nose, sinuses	13	12	14	13	13
C32	Larynx, epiglottis	2	5	6	7	11
C33–34	Lung, trachea	73	87	143	173	227
C38	Heart, mediastinum and pleura	4	7	5	9	6
C40–41	Bone	10	9	14	13	14
C43	Melanoma of the skin	60	93	128	200	264
C44	Skin, non-melanoma	53	40	59	115	153
C45	Mesothelioma	0	1	2	2	2
C47	Autonomic nervous system	16	9	16	9	5
C48–49	Soft tissues	18	27	29	43	43
C50	Breast	941	1 072	1 230	1 408	1 535
C51–58	Female genital organs	893	963	1 125	1 238	1 279
C51–52, C57.7–9	Other female genital	64	61	60	75	81
C53	Cervix uteri	348	361	403	440	399
C54	Corpus uteri	181	221	268	326	370
C55	Uterus, other	24	17	15	7	8
C56, C57.0–4	Ovary etc.	273	300	375	386	417
C58	Placenta	3	3	4	2	3
C64–68	Urinary organs	200	226	273	327	377
C64	Kidney (excl. renal pelvis)	78	90	117	118	138
C65–68	Urinary tract	123	135	156	209	240
C69	Eye	15	16	18	20	21
C70–72	Central nervous system	111	119	131	151	186
C73	Thyroid gland	53	61	90	110	132
C37, C74–75	Other endocrine glands	6	7	13	16	33
C39, C76, C80	Other or unspecified	54	70	99	111	176
C81–96	Lymphoid/haematopoietic tissue	259	312	382	437	496
C81	Hodgkin lymphoma	33	37	47	43	40
C82–86, C96	Non-Hodgkin lymphoma	59	76	101	114	146
C88	Immunoproliferative disease	0	0	1	4	4
C90	Multiple myeloma	40	64	79	108	128
C91–95	Leukaemia	127	135	155	168	177

1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16
7 922	8 551	9 563	10 559	11 947	13 102	14 665
103	108	131	128	152	184	210
21	27	29	26	32	46	48
24	22	24	27	30	32	51
25	29	36	32	38	41	41
13	12	20	20	19	25	26
20	18	21	24	33	40	43
2 168	2 204	2 362	2 476	2 593	2 782	3 071
34	39	40	51	53	59	70
387	341	296	242	230	205	170
27	31	29	43	49	62	66
785	884	1 018	1 116	1 207	1 313	1 500
405	422	455	477	499	520	549
25	28	36	35	45	45	60
44	42	42	47	46	68	90
82	75	73	80	78	86	94
274	281	311	326	340	362	392
104	61	63	60	47	62	81
350	480	623	767	969	1 232	1 460
15	14	17	15	18	20	19
11	11	20	20	16	19	20
320	450	580	725	928	1 186	1 415
4	5	7	7	6	7	6
14	14	18	19	18	24	24
359	442	490	513	581	734	967
226	304	396	469	584	716	872
5	7	10	9	12	13	13
6	9	7	5	5	4	4
47	46	46	60	78	90	83
1 714	1 818	2 083	2 471	2 748	2 829	3 254
1 287	1 317	1 390	1 426	1 540	1 610	1 684
82	85	95	96	101	104	117
352	345	344	310	300	295	336
390	411	467	526	649	722	742
5	6	8	9	9	7	10
454	464	472	482	477	480	477
3	6	4	4	4	2	2
418	447	482	499	566	616	713
156	181	191	189	216	250	263
263	266	291	309	350	366	450
21	25	30	28	32	33	38
223	260	318	434	596	627	535
142	135	136	124	153	189	260
46	39	49	65	106	137	105
224	285	317	303	279	195	163
566	611	674	763	935	1 087	1 210
38	34	34	42	48	55	63
199	243	277	327	356	402	444
6	8	12	13	21	23	25
133	134	141	150	153	164	186
190	193	209	230	357	443	491

Table 5.15: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years by primary site and five-year period, 1957–2016, **males**

ICD-10	Site	1957–61	1962–66	1967–71	1972–76	1977–81
C00–96	All sites	336.5	357.8	393.7	429.2	476.2
C00–14	Mouth, pharynx	15.5	14.5	15.2	15.8	14.6
C00	Lip	8.4	7.6	8.3	7.7	7.2
C01–02	Tongue	1.6	1.6	1.5	1.9	1.6
C03–06	Mouth, other	1.9	1.9	2.1	2.0	2.4
C07–08	Salivary glands	0.8	0.8	1.0	0.9	0.9
C09–14	Pharynx	2.8	2.6	2.3	3.4	2.6
C15–26	Digestive organs	140.5	134.8	136.0	133.7	139.9
C15	Oesophagus	6.8	6.1	5.8	5.5	5.6
C16	Stomach	71.9	61.1	54.4	44.3	38.4
C17	Small intestine	0.8	0.9	1.2	1.1	1.2
C18	Colon	20.8	23.8	26.6	28.3	34.7
C19–20	Rectum, rectosigmoid	13.1	14.2	19.2	21.8	28.5
C21	Anus	0.4	0.5	0.4	0.5	0.5
C22	Liver	1.6	1.6	2.8	3.4	2.9
C23–24	Gallbladder, bile ducts	1.7	1.6	1.9	2.0	2.5
C25	Pancreas	11.6	13.6	15.6	16.4	16.8
C26	Other digestive organs	11.9	11.3	8.1	10.4	8.8
C30–34, C38	Respiratory organs	25.4	32.4	42.7	49.5	60.9
C30–31	Nose, sinuses	1.6	1.6	1.3	1.4	1.4
C32	Larynx, epiglottis	2.5	3.4	4.3	4.4	5.4
C33–34	Lung, trachea	20.4	26.6	36.2	42.6	53.0
C38	Heart, mediastinum and pleura	0.9	0.7	0.8	1.1	1.1
C40–41	Bone	0.7	1.0	0.9	1.2	1.1
C43	Melanoma of the skin	3.9	5.3	7.5	9.7	12.9
C44	Skin, non-melanoma	8.0	6.3	8.9	14.8	16.1
C45	Mesothelioma	0.0	0.2	0.3	0.5	1.2
C47	Autonomic nervous system	1.3	0.9	0.8	0.6	0.4
C48–49	Soft tissues	1.9	1.9	2.6	3.4	3.4
C50	Breast	0.6	0.7	0.6	0.6	0.7
C60–63	Male genital organs	70.6	81.6	89.6	98.0	109.5
C61	Prostate	65.6	75.5	83.3	91.9	101.8
C62	Testis	3.4	4.1	4.5	4.6	5.9
C60, C63	Other male genital	1.7	2.0	1.8	1.5	1.7
C64–68	Urinary organs	25.4	32.0	34.9	43.2	49.9
C64	Kidney (excl. renal pelvis)	7.8	9.2	10.2	10.8	12.4
C65–68	Urinary tract	17.6	22.8	24.6	32.3	37.5
C69	Eye	1.4	1.1	1.4	1.0	1.6
C70–72	Central nervous system	7.6	7.9	8.4	9.2	10.6
C73	Thyroid gland	1.5	1.8	2.2	2.2	2.6
C37, C74–75	Other endocrine glands	0.4	0.6	1.2	1.3	1.7
C39, C76, C80	Other or unspecified	4.9	6.4	9.3	10.7	11.7
C81–96	Lymphoid/haematopoietic tissue	26.8	28.4	31.4	33.8	37.4
C81	Hodgkin lymphoma	3.1	3.3	3.6	3.5	3.5
C82–86, C96	Non-Hodgkin lymphoma	6.6	7.1	7.6	8.8	9.8
C88	Immunoproliferative disease	0.0	0.0	0.2	0.4	0.5
C90	Multiple myeloma	5.8	6.0	6.7	8.2	9.5
C91–95	Leukaemia	11.3	12.0	13.3	12.9	14.0

1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16
513.1	536.5	588.0	623.3	673.8	719.8	728.7
15.0	14.6	14.3	14.0	13.0	14.0	15.6
6.2	5.4	4.0	3.4	2.8	3.5	2.9
2.0	2.0	2.3	2.6	2.4	2.9	3.3
2.7	2.8	3.1	2.4	2.4	2.2	2.4
0.8	1.0	1.0	1.3	1.0	1.0	1.5
3.2	3.4	3.9	4.2	4.4	4.4	5.3
144.4	139.9	140.5	141.7	143.2	144.8	148.5
5.0	5.9	6.1	6.6	7.3	7.6	8.7
35.6	30.7	25.7	21.2	17.5	14.7	12.8
1.8	1.5	1.7	2.6	2.6	3.4	4.2
40.9	44.9	48.4	52.2	54.7	57.5	59.0
30.7	30.5	32.0	33.0	34.5	32.9	33.3
0.8	0.6	1.1	0.9	0.9	1.0	1.0
4.0	3.5	3.1	3.8	4.2	5.2	6.7
2.8	2.8	3.1	3.5	3.3	3.3	3.5
18.1	17.1	16.0	15.3	16.3	16.6	16.7
4.8	2.3	3.2	2.6	1.9	2.6	2.7
69.5	71.7	77.1	77.3	80.5	79.1	74.2
1.3	1.3	1.2	1.1	1.1	1.1	1.1
6.0	6.0	5.9	5.7	5.4	4.5	4.0
61.5	63.9	69.3	69.7	73.4	73.0	68.6
0.7	0.5	0.8	0.8	0.6	0.5	0.5
1.2	1.0	1.0	1.0	1.2	1.2	1.1
14.8	21.0	22.7	24.2	25.6	32.6	40.4
20.0	24.7	28.8	32.9	36.8	41.5	46.1
1.5	2.1	2.5	3.0	3.4	3.3	2.8
0.4	0.4	0.3	0.3	0.2	0.3	0.2
2.5	2.3	2.6	2.6	2.7	2.8	2.8
0.8	0.8	0.7	0.9	0.8	0.9	1.2
114.6	123.3	151.5	178.5	201.1	228.3	221.6
105.8	114.1	140.8	166.7	188.3	214.2	207.2
7.1	7.7	8.9	10.1	10.6	12.0	11.8
1.7	1.5	1.8	1.6	2.2	2.1	2.5
56.6	58.7	62.4	60.3	65.5	67.9	74.2
14.4	14.5	14.7	15.6	17.9	20.5	22.8
42.3	44.1	47.7	44.6	47.6	47.4	51.4
1.4	1.2	1.6	1.4	1.7	1.4	1.6
11.7	12.8	14.9	17.6	20.8	22.0	19.0
2.5	2.7	2.2	2.4	2.8	3.1	4.4
2.2	2.2	2.8	3.3	4.4	5.7	4.3
14.2	16.7	17.5	15.2	12.0	8.3	6.5
39.6	40.5	44.6	46.8	57.9	62.7	64.2
2.8	2.5	2.4	2.7	3.2	3.3	3.4
12.6	15.0	17.4	18.7	20.3	22.5	23.3
0.6	0.5	1.0	1.2	1.7	1.6	1.7
9.3	9.1	9.5	9.2	9.5	10.0	9.6
14.4	13.5	14.3	15.0	23.2	25.4	26.1

Table 5.16: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years by primary site and five-year period, 1957–2016, **females**

ICD-10	Site	1957–61	1962–66	1967–71	1972–76	1977–81
C00–96	All sites	286.6	293.0	314.1	336.4	361.6
C00–14	Mouth, pharynx	4.4	4.5	4.3	4.4	4.6
C00	Lip	0.6	0.6	0.7	0.6	0.8
C01–02	Tongue	0.8	1.0	1.0	0.9	0.9
C03–06	Mouth, other	0.9	0.9	1.0	0.9	1.2
C07–08	Salivary glands	0.6	0.8	0.8	0.7	0.7
C09–14	Pharynx	1.5	1.2	0.9	1.3	0.9
C15–26	Digestive organs	102.8	98.6	95.4	93.9	101.3
C15	Oesophagus	1.7	2.3	1.7	1.6	1.6
C16	Stomach	43.6	36.8	29.4	22.9	20.2
C17	Small intestine	0.5	0.7	0.8	1.0	1.0
C18	Colon	20.7	23.6	25.6	27.7	34.5
C19–20	Rectum, rectosigmoid	8.6	8.8	12.6	14.1	18.0
C21	Anus	0.5	0.6	0.7	0.7	1.0
C22	Liver	0.9	0.8	1.3	1.5	1.8
C23–24	Gallbladder, bile ducts	3.4	3.4	3.4	3.0	3.5
C25	Pancreas	7.3	7.8	9.7	10.0	10.9
C26	Other digestive organs	15.8	13.8	10.0	11.5	8.9
C30–34, C38	Respiratory organs	6.4	6.9	9.6	10.5	12.8
C30–31	Nose, sinuses	1.0	0.8	0.9	0.7	0.6
C32	Larynx, epiglottis	0.1	0.3	0.3	0.4	0.6
C33–34	Lung, trachea	4.9	5.3	8.1	9.0	11.4
C38	Heart, mediastinum and pleura	0.3	0.4	0.3	0.5	0.3
C40–41	Bone	0.5	0.5	0.7	0.7	0.6
C43	Melanoma of the skin	3.9	5.6	7.5	11.2	14.1
C44	Skin, non-melanoma	3.9	3.0	3.7	6.8	8.1
C45	Mesothelioma	0.0	0.1	0.1	0.1	0.1
C47	Autonomic nervous system	1.0	0.5	0.8	0.5	0.3
C48–49	Soft tissues	1.1	1.7	1.6	2.4	2.2
C50	Breast	61.1	65.6	70.2	77.0	80.1
C51–58	Female genital organs	56.0	57.0	63.5	67.0	66.8
C51–52, C57.7–9	Other female genital	4.5	3.9	3.5	4.0	4.1
C53	Cervix uteri	20.9	21.2	23.1	24.8	21.5
C54	Corpus uteri	11.3	12.9	14.7	17.1	19.1
C55	Uterus, other	1.8	1.2	1.0	0.4	0.5
C56, C57.0–4	Ovary etc.	17.2	17.7	20.9	20.5	21.5
C58	Placenta	0.2	0.2	0.2	0.1	0.1
C64–68	Urinary organs	13.8	14.2	15.6	17.2	18.5
C64	Kidney (excl. renal pelvis)	5.1	5.4	6.5	6.1	6.7
C65–68	Urinary tract	8.8	8.8	9.1	11.1	11.8
C69	Eye	0.9	0.9	1.0	1.1	1.1
C70–72	Central nervous system	6.6	6.8	7.1	7.8	9.5
C73	Thyroid gland	3.5	3.9	5.2	6.0	6.9
C37, C74–75	Other endocrine glands	0.4	0.4	0.7	0.9	1.7
C39, C76, C80	Other or unspecified	3.7	4.3	5.9	6.0	8.7
C81–96	Lymphoid/haematopoietic tissue	16.5	18.6	21.3	23.0	24.3
C81	Hodgkin lymphoma	2.0	2.2	2.6	2.3	1.9
C82–86, C96	Non-Hodgkin lymphoma	3.8	4.6	5.7	6.1	7.3
C88	Immunoproliferative disease	0.0	0.0	0.0	0.2	0.2
C90	Multiple myeloma	2.7	3.9	4.5	5.6	6.2
C91–95	Leukaemia	8.0	7.9	8.5	8.9	8.6

1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16
380.7	393.4	426.2	457.8	497.8	517.2	540.6
4.9	5.0	5.8	5.6	6.4	7.3	7.7
1.0	1.2	1.3	1.1	1.3	1.7	1.7
1.2	1.0	1.1	1.2	1.3	1.3	1.9
1.1	1.3	1.6	1.4	1.6	1.6	1.5
0.6	0.6	0.9	0.9	0.8	1.0	1.0
1.0	0.9	1.0	1.1	1.4	1.7	1.7
99.8	96.2	99.5	101.2	103.0	105.6	109.9
1.6	1.7	1.7	2.1	2.1	2.2	2.5
17.8	14.7	12.1	9.6	8.9	7.6	6.0
1.2	1.4	1.3	1.9	2.1	2.5	2.4
36.1	38.7	43.0	45.6	47.8	49.7	53.3
18.8	18.5	19.6	20.1	20.3	20.2	20.0
1.2	1.4	1.6	1.6	1.9	1.8	2.3
2.1	1.8	1.8	1.9	1.8	2.5	3.2
3.8	3.2	3.0	3.3	3.0	3.3	3.4
12.4	12.0	12.9	12.9	13.3	13.6	14.0
4.9	2.7	2.6	2.3	1.7	2.2	2.8
16.7	22.5	28.9	34.7	41.7	49.4	53.7
0.7	0.6	0.7	0.6	0.7	0.8	0.7
0.5	0.5	0.9	0.9	0.7	0.8	0.8
15.4	21.1	26.9	32.9	40.0	47.6	52.1
0.2	0.2	0.3	0.3	0.2	0.3	0.2
0.7	0.7	0.8	0.8	0.8	1.0	0.9
18.2	21.5	22.8	22.8	24.9	29.6	36.4
10.7	13.1	16.3	18.3	21.7	25.4	29.4
0.2	0.3	0.4	0.4	0.5	0.5	0.5
0.3	0.4	0.3	0.2	0.2	0.2	0.2
2.2	2.2	2.1	2.6	3.4	3.6	3.1
85.4	86.5	96.9	113.3	120.2	115.7	123.8
64.4	63.8	64.9	63.9	65.5	65.0	63.3
3.9	3.8	4.0	3.8	4.0	3.9	4.2
17.8	16.9	16.1	13.9	12.8	12.1	13.2
19.7	20.2	22.2	24.0	27.9	29.3	27.6
0.3	0.3	0.4	0.4	0.3	0.2	0.3
22.7	22.4	22.1	21.7	20.2	19.3	17.9
0.1	0.2	0.2	0.2	0.2	0.1	0.1
19.2	19.8	20.5	20.7	22.8	23.9	25.8
7.2	8.1	8.2	8.0	8.9	9.9	9.8
11.9	11.7	12.3	12.7	13.9	14.0	16.1
1.1	1.1	1.3	1.2	1.3	1.3	1.5
11.1	12.5	14.8	19.3	25.7	25.5	20.3
7.0	6.4	6.3	5.5	6.5	7.8	10.1
2.3	1.9	2.3	3.0	4.6	5.7	4.1
10.3	12.3	13.1	12.0	10.5	6.9	5.5
26.3	27.2	29.2	32.3	38.1	42.7	44.3
1.7	1.5	1.5	1.9	2.1	2.3	2.5
9.4	11.0	12.4	14.2	14.8	16.0	16.3
0.3	0.3	0.5	0.5	0.8	0.9	0.9
6.1	5.8	5.8	6.2	6.1	6.3	6.7
8.7	8.5	9.0	9.6	14.3	17.2	17.9

Table 5.17: Average annual number of new cases by primary site and county, 2012–2016, **males**

ICD-10	Site	Norway	Østfold	Akershus	Oslo	Hedmark	Oppland	Buskerud	Vestfold
C00–96	All sites	17 284	1 122	1 867	1 536	736	687	979	971
C00–14	Mouth, pharynx	380	23	40	40	15	16	23	23
C00	Lip	68	4	6	4	3	4	4	3
C01–02	Tongue	83	5	11	9	3	2	5	5
C03–06	Mouth, other	59	3	7	6	3	3	4	5
C07–08	Salivary glands	36	3	3	4	2	1	2	2
C09–14	Pharynx	134	9	13	16	5	5	9	8
C15–26	Digestive organs	3 487	217	375	313	152	140	191	183
C15	Oesophagus	206	14	22	15	9	12	10	12
C16	Stomach	297	17	25	25	11	10	16	12
C17	Small intestine	100	6	12	7	4	3	4	5
C18	Colon	1 367	89	151	117	57	55	76	72
C19–20	Rectum, rectosigmoid	795	47	89	68	35	33	46	44
C21	Anus	24	2	3	3	1	0	1	1
C22	Liver	161	9	18	22	9	5	9	9
C23–24	Gallbladder, bile ducts	83	6	9	10	5	5	4	3
C25	Pancreas	391	21	40	39	16	14	22	20
C26	Other digestive organs	62	4	7	7	3	2	4	5
C30–34, C38	Respiratory organs	1 747	111	153	132	80	75	91	100
C30–31	Nose, sinuses	27	0	2	3	2	1	2	2
C32	Larynx, epiglottis	97	6	8	9	4	5	6	4
C33–34	Lung, trachea	1 613	105	142	120	73	69	83	94
C38	Heart, mediastinum and pleura	10	1	1	0	1	0	0	1
C40–41	Bone	29	3	2	3	2	2	0	2
C43	Melanoma of the skin	974	58	121	95	40	34	61	76
C44	Skin, non-melanoma	992	65	99	76	34	30	65	63
C45	Mesothelioma	66	3	6	6	3	2	5	5
C47	Autonomic nervous system	5	0	1	0	0	0	1	0
C48–49	Soft tissues	69	3	6	7	3	4	4	4
C50	Breast	28	2	3	3	1	1	0	1
C60–63	Male genital organs	5 358	400	605	460	229	219	297	288
C61	Prostate	4 989	375	571	414	216	207	281	269
C62	Testis	310	20	28	41	11	11	13	15
C60, C63	Other male genital	59	4	6	5	2	1	3	4
C64–68	Urinary organs	1 743	106	190	151	77	66	101	103
C64	Kidney (excl. renal pelvis)	563	33	61	54	23	23	36	32
C65–68	Urinary tract	1 180	73	130	97	54	43	65	71
C69	Eye	39	5	3	3	2	1	2	2
C70–72	Central nervous system	472	26	51	48	18	18	28	25
C73	Thyroid gland	110	5	11	15	4	3	6	4
C37, C74–75	Other endocrine glands	109	6	13	11	3	4	4	5
C39, C76, C80	Other or unspecified	144	9	12	12	4	8	12	7
C81–96	Lymphoid/haematopoietic tissue	1 532	81	174	160	68	66	86	80
C81	Hodgkin lymphoma	88	5	9	11	5	4	4	3
C82–86, C96	Non-Hodgkin lymphoma	561	33	60	55	24	26	27	27
C88	Immunoproliferative disease	40	1	7	4	1	1	3	4
C90	Multiple myeloma	224	8	25	24	13	11	12	11
C91–95	Leukaemia	617	34	72	66	25	24	40	35

Telemark	Aust-Agder	Vest-Agder	Rogaland	Hordaland	Sogn og Fjordane	Møre og Romsdal	Sør-Trøndelag	Nord-Trøndelag	Nordland	Troms	Finnmark
653	431	603	1 459	1 711	410	997	965	507	848	562	240
18	8	12	29	38	7	20	22	8	20	13	4
3	2	2	8	7	2	5	3	1	4	1	0
4	1	3	7	9	1	4	5	2	4	3	2
2	2	1	5	7	1	2	3	1	3	2	1
2	0	1	1	4	1	3	2	2	2	1	0
7	3	5	8	12	2	6	9	3	7	6	2
124	76	111	275	351	91	202	201	108	202	121	53
9	3	6	17	20	5	11	10	6	14	8	4
11	7	10	23	34	10	19	18	10	19	12	7
3	2	4	11	12	2	4	8	4	4	3	2
46	30	40	109	139	34	82	84	45	84	42	16
26	16	26	64	81	22	48	42	25	41	30	11
1	0	0	2	3	0	1	2	1	1	1	1
6	2	4	13	12	4	8	9	5	8	8	2
3	3	2	5	6	1	4	6	3	3	4	1
17	12	15	28	39	10	22	21	11	24	13	7
2	2	2	4	5	1	3	2	1	4	2	1
67	48	69	164	176	44	101	89	55	98	59	35
1	0	0	3	3	1	1	1	1	2	1	1
3	2	2	11	9	2	8	4	3	6	4	1
63	47	65	149	163	41	91	83	50	90	54	32
1	0	1	1	1	0	1	0	0	0	0	1
1	0	0	2	4	1	1	3	1	1	1	1
38	26	35	91	99	17	34	60	26	31	26	6
48	38	58	85	113	24	42	45	26	44	28	10
3	1	3	7	10	1	3	2	1	2	1	0
1	0	0	0	0	0	0	0	0	0	0	0
2	3	3	5	5	1	4	5	3	3	3	0
2	1	2	4	3	1	1	1	0	1	1	0
195	138	179	458	514	123	351	301	154	212	168	69
183	129	165	423	474	115	333	277	144	192	158	63
9	7	13	31	31	8	16	21	8	14	9	5
3	1	1	4	8	0	2	3	2	5	1	1
64	37	57	121	164	42	113	97	54	108	68	24
22	13	22	38	48	16	33	37	18	28	18	8
42	25	35	83	116	26	80	60	36	80	50	16
2	1	1	4	2	1	1	3	1	3	2	1
19	10	14	48	45	10	20	29	14	25	15	7
5	1	4	7	11	3	7	6	3	7	7	3
5	3	4	10	15	5	2	7	3	6	3	1
5	4	4	8	15	3	9	9	4	10	5	4
55	36	47	142	145	37	85	85	46	76	42	20
2	1	3	7	8	2	6	5	2	5	3	2
19	15	17	52	48	13	37	33	19	31	18	7
1	1	1	3	5	1	3	3	0	2	1	0
9	5	5	21	24	8	10	12	4	13	5	4
24	14	22	60	60	13	30	33	19	26	15	7

Table 5.18: Average annual number of new cases by primary site and county, 2012–2016, **females**

ICD-10	Site	Norway	Østfold	Akershus	Oslo	Hedmark	Oppland	Buskerud	Vestfold
C00–96	All sites	14 665	922	1 605	1 566	616	597	844	799
C00–14	Mouth, pharynx	210	11	24	27	10	9	9	13
C00	Lip	48	3	4	3	3	3	2	3
C01–02	Tongue	51	3	6	8	3	2	1	4
C03–06	Mouth, other	41	2	6	6	2	2	2	2
C07–08	Salivary glands	26	1	4	3	2	1	1	1
C09–14	Pharynx	43	3	5	7	1	2	2	3
C15–26	Digestive organs	3 071	195	333	288	132	125	169	155
C15	Oesophagus	70	3	7	9	4	5	4	6
C16	Stomach	170	9	14	15	7	6	9	9
C17	Small intestine	66	5	7	6	4	2	3	2
C18	Colon	1 500	97	159	133	57	57	90	73
C19–20	Rectum, rectosigmoid	549	36	63	50	24	27	29	30
C21	Anus	60	3	8	7	3	3	4	2
C22	Liver	90	4	9	10	6	2	3	5
C23–24	Gallbladder, bile ducts	94	4	13	10	5	6	6	4
C25	Pancreas	392	27	46	38	17	14	18	21
C26	Other digestive organs	81	7	8	11	4	3	3	4
C30–34, C38	Respiratory organs	1 460	111	157	138	70	59	75	87
C30–31	Nose, sinuses	19	1	2	2	1	1	2	2
C32	Larynx, epiglottis	20	2	1	2	1	1	1	1
C33–34	Lung, trachea	1 415	107	152	134	68	57	73	83
C38	Heart, mediastinum and pleura	6	1	1	0	0	0	0	0
C40–41	Bone	24	1	2	3	1	1	1	1
C43	Melanoma of the skin	967	58	119	105	36	35	54	70
C44	Skin, non-melanoma	872	59	82	73	30	24	69	45
C45	Mesothelioma	13	1	2	1	0	1	1	1
C47	Autonomic nervous system	4	0	1	0	0	0	0	0
C48–49	Soft tissues	83	4	9	10	4	4	5	4
C50	Breast	3 254	199	373	397	129	128	182	167
C51–58	Female genital organs	1 684	111	186	195	73	81	102	85
C51–52, C57.7–9	Other female genital	117	5	11	13	5	5	9	8
C53	Cervix uteri	336	24	37	50	15	13	17	19
C54	Corpus uteri	742	51	78	77	36	38	49	34
C55	Uterus, other	10	1	2	0	1	1	1	0
C56, C57.0–4	Ovary etc.	477	30	60	53	16	24	26	25
C58	Placenta	2	0	0	0	0	0	0	0
C64–68	Urinary organs	713	43	70	67	32	35	41	40
C64	Kidney (excl. renal pelvis)	263	17	31	23	10	13	16	13
C65–68	Urinary tract	450	27	39	45	22	22	25	27
C69	Eye	38	2	3	4	2	1	2	3
C70–72	Central nervous system	535	29	57	51	21	23	33	36
C73	Thyroid gland	260	11	23	44	8	8	10	13
C37, C74–75	Other endocrine glands	105	4	13	13	4	4	7	7
C39, C76, C80	Other or unspecified	163	11	14	17	8	8	10	8
C81–96	Lymphoid/haematopoietic tissue	1 210	72	137	132	56	52	73	63
C81	Hodgkin lymphoma	63	4	6	9	3	1	5	2
C82–86, C96	Non-Hodgkin lymphoma	444	28	46	45	23	17	24	21
C88	Immunoproliferative disease	25	1	4	3	1	1	2	1
C90	Multiple myeloma	186	9	24	19	11	9	13	11
C91–95	Leukaemia	491	29	57	56	18	24	30	28

Telemark	Aust-Agder	Vest-Agder	Rogaland	Hordaland	Sogn og Fjordane	Møre og Romsdal	Sør-Trøndelag	Nord-Trøndelag	Nordland	Troms	Finnmark
544	351	532	1 196	1 441	320	743	826	389	722	458	193
9	5	5	18	18	4	11	10	5	12	7	3
1	1	2	6	5	2	2	3	1	2	1	0
3	1	1	4	4	1	2	2	1	4	2	1
2	1	1	2	4	1	3	2	1	1	1	1
1	1	0	2	3	0	2	0	1	2	1	1
2	1	1	3	3	1	2	3	1	3	2	1
106	64	108	241	312	82	185	182	86	163	106	40
3	1	1	4	6	1	3	4	1	5	2	1
5	3	5	14	20	7	13	12	5	10	7	4
2	2	3	4	6	2	4	6	3	3	1	2
50	34	56	121	161	42	97	82	43	81	50	16
19	8	19	43	56	14	32	34	14	30	16	5
2	1	2	5	6	1	3	3	2	3	2	2
3	3	1	6	9	1	5	7	4	5	5	2
3	1	3	9	8	2	3	6	3	5	2	1
15	9	15	30	34	10	22	24	9	19	19	7
4	3	3	5	6	2	3	4	3	3	3	1
52	39	61	116	135	28	70	80	36	77	41	27
1	0	1	2	1	0	1	1	0	1	1	0
1	0	1	2	2	0	1	1	0	0	1	0
50	38	60	112	132	27	68	78	36	75	40	26
0	0	0	0	1	1	0	0	0	1	0	0
1	1	1	2	2	0	2	1	1	2	1	0
39	23	35	93	103	19	32	62	25	29	22	6
38	34	59	80	105	21	35	33	17	36	22	8
0	0	1	0	1	0	0	1	0	1	1	0
0	0	0	0	1	0	1	0	0	0	0	0
3	2	3	6	6	1	4	6	3	4	4	1
119	78	107	269	307	66	176	187	92	150	90	40
67	40	51	133	162	30	77	94	42	80	53	22
5	3	4	8	13	2	5	6	3	8	4	1
12	8	7	21	34	6	16	19	7	15	11	5
28	17	25	59	69	14	33	42	23	35	24	9
1	0	0	1	1	0	0	0	0	1	1	0
22	12	15	44	45	8	23	26	9	21	14	6
0	0	0	0	0	0	0	0	0	0	0	0
24	13	23	51	64	15	41	41	20	45	33	13
9	6	9	17	22	6	14	17	8	17	12	5
14	7	14	34	43	9	27	25	12	28	22	8
0	1	1	4	5	0	2	3	0	2	2	1
18	12	18	48	56	13	21	26	15	31	20	7
13	4	10	14	24	5	14	20	3	15	14	4
2	3	4	7	15	4	3	5	3	4	2	1
7	4	5	13	15	4	8	7	4	11	5	5
45	27	40	102	109	27	62	68	36	58	34	16
3	2	1	5	6	1	5	3	1	2	2	1
15	8	17	35	40	9	25	29	14	27	14	7
0	0	1	2	3	1	1	2	1	1	0	0
8	6	4	11	14	6	10	9	7	9	5	2
20	11	17	49	45	11	21	25	12	20	13	6

Table 5.19: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years by primary site and county, 2012–2016, **males**

ICD-10	Site	Norway	Østfold	Akershus	Oslo	Hedmark	Oppland	Buskerud	Vestfold
C00–96	All sites	728.7	784.0	735.7	672.2	670.5	661.8	739.3	812.4
C00–14	Mouth, pharynx	15.6	16.1	14.8	17.0	13.9	14.9	16.6	18.9
C00	Lip	2.9	3.1	2.5	2.2	2.9	3.9	3.0	2.5
C01–02	Tongue	3.3	3.2	4.0	3.7	2.3	2.1	3.3	3.6
C03–06	Mouth, other	2.4	2.0	2.5	2.7	2.3	3.3	2.7	4.4
C07–08	Salivary glands	1.5	2.0	1.2	1.8	1.6	1.3	1.5	1.6
C09–14	Pharynx	5.3	5.9	4.7	6.6	4.8	4.2	6.2	6.8
C15–26	Digestive organs	148.5	151.8	147.9	140.6	137.4	134.8	145.3	154.1
C15	Oesophagus	8.7	9.7	8.4	6.9	8.6	11.9	7.2	9.5
C16	Stomach	12.8	12.1	9.4	11.1	10.2	9.6	12.5	10.4
C17	Small intestine	4.2	4.1	4.6	2.9	3.8	3.1	2.9	4.4
C18	Colon	59.0	63.0	61.0	53.5	51.7	53.8	58.1	61.4
C19–20	Rectum, rectosigmoid	33.3	32.8	34.4	29.9	32.0	31.2	34.4	36.5
C21	Anus	1.0	1.6	1.1	1.5	0.7	0.4	0.7	1.0
C22	Liver	6.7	6.3	7.0	9.4	8.4	4.6	6.8	7.2
C23–24	Gallbladder, bile ducts	3.5	4.3	3.7	4.6	4.2	4.4	2.7	2.8
C25	Pancreas	16.7	14.9	15.5	17.7	14.7	13.3	17.1	16.8
C26	Other digestive organs	2.7	3.0	2.8	3.3	3.0	2.5	2.9	4.1
C30–34, C38	Respiratory organs	74.2	78.3	62.0	60.2	71.2	70.5	68.1	83.3
C30–31	Nose, sinuses	1.1	0.3	0.8	1.1	1.4	0.7	1.1	1.7
C32	Larynx, epiglottis	4.0	3.8	3.3	4.3	3.6	4.3	4.7	3.2
C33–34	Lung, trachea	68.6	73.5	57.3	54.7	65.6	65.0	62.1	77.8
C38	Heart, mediastinum and pleura	0.5	0.7	0.6	0.1	0.5	0.4	0.2	0.5
C40–41	Bone	1.1	1.8	0.9	0.9	1.4	2.0	0.4	1.3
C43	Melanoma of the skin	40.4	40.7	46.9	39.5	37.6	33.2	44.7	63.2
C44	Skin, non-melanoma	46.1	49.7	44.3	39.1	32.7	30.5	54.8	57.4
C45	Mesothelioma	2.8	2.2	2.5	3.1	2.8	2.2	3.6	4.1
C47	Autonomic nervous system	0.2	0.0	0.2	0.1	0.2	0.0	0.9	0.2
C48–49	Soft tissues	2.8	1.9	2.3	2.9	3.5	3.4	3.2	3.5
C50	Breast	1.2	1.7	1.3	1.3	1.0	1.0	0.1	1.1
C60–63	Male genital organs	221.6	273.6	234.9	197.9	206.2	208.6	219.4	237.0
C61	Prostate	207.2	256.1	222.6	185.3	191.8	195.2	207.8	221.0
C62	Testis	11.8	14.5	9.6	10.4	12.6	12.0	9.4	13.0
C60, C63	Other male genital	2.5	3.0	2.7	2.2	1.9	1.4	2.2	3.0
C64–68	Urinary organs	74.2	75.0	75.9	67.5	69.7	63.1	77.4	86.4
C64	Kidney (excl. renal pelvis)	22.8	22.7	23.0	21.8	20.4	21.8	26.3	26.4
C65–68	Urinary tract	51.4	52.3	53.0	45.7	49.2	41.3	51.1	59.9
C69	Eye	1.6	3.1	1.1	1.4	1.4	1.2	1.5	1.6
C70–72	Central nervous system	19.0	18.2	18.6	17.5	17.5	18.1	20.3	20.3
C73	Thyroid gland	4.4	3.6	3.7	5.3	4.0	2.9	4.4	3.3
C37, C74–75	Other endocrine glands	4.3	3.9	4.8	4.2	2.6	3.4	3.1	4.3
C39, C76, C80	Other or unspecified	6.5	6.6	5.3	5.7	4.0	7.4	9.9	6.0
C81–96	Lymphoid/haematopoietic tissue	64.2	55.9	68.2	68.2	63.4	64.9	65.5	66.4
C81	Hodgkin lymphoma	3.4	3.6	3.2	3.5	5.4	4.4	3.0	2.6
C82–86, C96	Non-Hodgkin lymphoma	23.3	22.6	23.2	23.2	22.2	25.0	20.7	22.0
C88	Immunoproliferative disease	1.7	0.5	2.8	1.8	0.7	0.8	2.2	2.9
C90	Multiple myeloma	9.6	5.7	10.0	11.2	12.0	11.0	9.5	9.9
C91–95	Leukaemia	26.1	23.4	29.0	28.4	23.2	23.6	30.1	29.1

Telemark	Aust-Agder	Vest-Agder	Rogaland	Hordaland	Sogn og Fjordane	Møre og Romsdal	Sør-Trøndelag	Nord-Trøndelag	Nordland	Troms	Finnmark
725.7	773.3	757.1	787.3	764.8	709.7	743.1	696.5	708.8	663.2	719.5	655.9
18.9	13.4	14.9	15.3	16.2	12.5	15.0	15.8	11.5	15.2	16.0	11.3
3.8	3.2	2.8	4.5	3.1	2.8	3.5	2.7	1.7	3.3	1.8	0.5
3.8	1.4	3.9	3.5	3.7	2.3	3.0	3.6	2.4	3.0	3.8	5.0
1.6	3.3	1.5	2.5	2.9	2.5	1.3	2.1	0.8	1.9	2.0	2.0
2.3	0.9	0.7	0.8	1.6	1.1	2.5	1.7	2.2	1.9	1.0	0.0
7.3	4.6	6.0	4.1	4.9	3.8	4.6	5.7	4.3	5.0	7.5	3.8
138.8	137.8	140.6	151.9	159.1	157.1	152.7	147.8	152.5	156.3	158.1	146.5
10.0	5.2	8.4	8.7	9.2	8.9	8.0	6.9	7.8	10.9	9.4	10.5
12.9	11.9	12.4	12.8	15.7	17.8	14.6	13.4	13.3	15.0	16.3	18.8
3.0	2.8	5.7	5.8	5.3	3.7	3.2	6.0	5.2	3.2	3.4	6.0
52.2	55.2	52.2	61.5	63.3	58.9	62.1	63.2	64.1	64.7	56.1	45.9
28.8	29.0	31.5	34.6	36.2	38.4	35.9	29.7	34.4	31.3	38.0	30.7
1.6	0.9	0.5	0.9	1.1	0.7	0.6	1.3	0.8	0.6	0.7	1.4
6.2	4.2	5.4	7.1	5.5	6.4	5.7	6.3	6.3	6.4	9.9	6.6
3.1	4.3	3.1	2.7	2.7	2.1	3.5	4.5	4.0	2.0	5.5	2.4
19.2	21.2	18.5	15.8	17.7	17.8	16.8	15.0	15.2	18.7	16.6	21.4
1.9	3.0	3.0	2.0	2.3	2.5	2.3	1.5	1.4	3.5	2.3	2.7
74.5	86.5	87.4	90.7	79.3	74.6	75.8	65.5	76.1	76.0	76.5	92.5
1.3	0.0	0.5	1.7	1.2	1.1	1.0	0.5	2.0	1.9	1.6	2.5
3.1	2.8	2.8	5.7	4.0	3.3	6.0	3.1	4.1	4.2	4.4	3.4
69.6	83.7	83.1	82.8	73.8	70.2	67.9	61.7	70.0	69.6	70.0	84.3
0.6	0.0	1.0	0.5	0.3	0.0	0.8	0.2	0.0	0.4	0.5	2.2
1.2	0.7	0.4	0.7	1.7	1.0	0.7	1.9	1.2	1.1	1.1	1.6
41.7	47.5	43.0	47.9	43.7	28.9	25.1	41.6	36.9	24.8	31.8	15.1
56.9	73.2	79.3	51.9	55.2	42.6	33.9	36.9	37.3	36.5	38.4	31.1
3.0	2.7	4.6	3.8	4.6	1.1	2.3	1.7	1.0	1.7	1.2	1.1
0.8	0.0	0.2	0.2	0.1	0.0	0.3	0.0	0.0	0.3	0.2	0.0
2.6	4.8	3.5	2.6	2.3	2.1	2.7	3.1	3.5	2.4	4.2	1.7
2.4	1.3	2.4	1.8	1.5	1.1	0.7	1.0	0.3	0.8	0.9	0.5
211.3	238.5	217.8	240.2	225.5	211.8	256.6	212.5	210.0	163.5	207.9	190.0
196.7	224.0	201.7	225.6	209.9	196.6	242.3	197.4	194.6	147.0	195.2	172.8
11.1	12.9	14.4	12.7	11.8	14.8	12.7	13.1	11.9	12.4	11.1	13.5
3.5	1.7	1.7	2.0	3.8	0.3	1.6	2.0	3.5	4.2	1.6	3.7
71.1	68.4	72.1	67.4	73.8	72.6	84.1	70.6	76.8	85.1	90.8	68.9
24.3	21.8	26.4	19.6	20.8	26.7	24.3	25.7	25.2	21.6	22.6	20.4
46.8	46.6	45.7	47.8	53.0	45.9	59.8	44.9	51.6	63.5	68.2	48.5
2.1	1.3	1.3	2.3	0.9	1.7	0.7	1.8	1.6	2.2	2.2	1.7
21.9	17.2	16.3	22.7	19.1	18.2	15.0	20.1	20.1	19.8	19.0	18.8
5.3	1.7	4.2	3.7	4.7	4.7	5.1	4.2	4.2	5.1	8.5	7.8
5.1	5.2	4.3	4.5	6.2	9.1	1.4	4.8	4.5	4.7	3.6	2.9
6.4	8.7	6.0	4.9	7.0	6.2	6.5	6.7	6.7	8.2	7.0	11.8
61.6	64.4	58.7	75.0	63.9	64.5	64.4	60.5	64.6	59.4	52.1	52.7
2.4	2.4	3.3	2.9	3.2	3.4	4.7	2.9	3.4	3.8	4.0	4.7
21.6	26.9	20.9	26.8	21.1	23.1	27.3	23.4	26.9	24.1	21.9	17.8
1.2	1.3	0.8	1.5	2.4	1.7	2.3	1.9	0.6	1.3	1.2	1.0
9.7	8.5	6.6	11.5	10.8	13.5	7.3	8.7	6.0	10.2	6.4	9.6
26.6	25.3	27.1	32.3	26.4	22.9	22.7	23.7	27.8	20.1	18.7	19.5

Table 5.20: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years by primary site and county, 2012–2016, **females**

ICD-10	Site	Norway	Østfold	Akershus	Oslo	Hedmark	Oppland	Buskerud	Vestfold
C00–96	All sites	540.6	560.3	544.5	546.6	501.0	518.2	557.1	571.8
C00–14	Mouth, pharynx	7.7	6.9	8.1	9.6	8.5	7.6	5.6	9.4
C00	Lip	1.7	1.8	1.4	1.2	2.1	2.1	1.4	2.2
C01–02	Tongue	1.9	1.7	2.0	2.8	2.3	1.3	0.9	2.9
C03–06	Mouth, other	1.5	1.3	2.0	2.0	1.7	1.5	1.6	1.7
C07–08	Salivary glands	1.0	0.6	1.3	1.0	1.5	1.2	0.4	0.6
C09–14	Pharynx	1.7	1.6	1.6	2.6	1.0	1.6	1.3	2.0
C15–26	Digestive organs	109.9	113.8	112.5	100.9	100.7	102.2	108.8	106.5
C15	Oesophagus	2.5	2.1	2.4	3.2	2.7	3.9	2.2	4.0
C16	Stomach	6.0	5.1	4.6	5.1	5.0	4.9	5.7	5.8
C17	Small intestine	2.4	2.7	2.2	2.1	3.4	2.2	2.0	1.6
C18	Colon	53.3	56.4	53.8	46.2	43.5	45.7	57.2	49.8
C19–20	Rectum, rectosigmoid	20.0	21.4	21.2	17.5	19.0	22.3	19.2	20.8
C21	Anus	2.3	1.6	2.8	2.6	2.3	2.4	2.7	1.4
C22	Liver	3.2	2.5	3.0	3.4	4.9	2.2	2.3	3.3
C23–24	Gallbladder, bile ducts	3.4	2.6	4.2	3.5	4.0	4.8	3.7	2.8
C25	Pancreas	14.0	15.4	15.5	13.5	12.6	11.4	11.6	14.1
C26	Other digestive organs	2.8	4.0	2.7	3.7	3.2	2.5	2.2	3.0
C30–34, C38	Respiratory organs	53.7	66.2	53.5	50.7	55.2	49.5	49.1	61.0
C30–31	Nose, sinuses	0.7	0.5	0.8	0.5	0.5	1.0	1.1	1.2
C32	Larynx, epiglottis	0.8	1.4	0.5	0.8	1.0	0.5	0.4	1.0
C33–34	Lung, trachea	52.1	63.9	52.0	49.2	53.6	47.6	47.6	58.6
C38	Heart, mediastinum and pleura	0.2	0.4	0.2	0.2	0.1	0.4	0.0	0.1
C40–41	Bone	0.9	0.8	0.8	1.0	0.7	0.6	0.4	1.1
C43	Melanoma of the skin	36.4	36.3	40.3	35.7	31.4	32.4	36.9	52.0
C44	Skin, non-melanoma	29.4	32.7	27.3	23.7	20.5	17.9	42.0	29.2
C45	Mesothelioma	0.5	0.5	0.7	0.5	0.3	0.6	0.8	0.4
C47	Autonomic nervous system	0.2	0.2	0.3	0.0	0.0	0.0	0.3	0.2
C48–49	Soft tissues	3.1	2.6	3.0	3.6	3.0	3.6	3.6	3.4
C50	Breast	123.8	125.4	126.3	141.7	110.5	117.3	123.5	123.1
C51–58	Female genital organs	63.3	69.7	63.6	66.9	62.6	73.1	68.5	62.6
C51–52, C57.7–9	Other female genital	4.2	3.2	3.6	4.5	4.2	4.3	5.8	5.3
C53	Cervix uteri	13.2	16.4	12.4	15.1	15.0	14.3	12.5	15.4
C54	Corpus uteri	27.6	30.7	26.7	28.1	29.4	32.0	32.6	23.8
C55	Uterus, other	0.3	0.5	0.5	0.1	0.5	0.4	0.4	0.2
C56, C57.0–4	Ovary etc.	17.9	19.0	20.4	19.1	13.6	21.9	17.1	17.7
C58	Placenta	0.1	0.0	0.0	0.1	0.0	0.2	0.1	0.2
C64–68	Urinary organs	25.8	25.8	23.7	23.7	24.6	28.8	26.6	28.0
C64	Kidney (excl. renal pelvis)	9.8	10.1	10.4	8.0	7.7	11.3	10.5	9.5
C65–68	Urinary tract	16.1	15.7	13.3	15.7	17.0	17.5	16.1	18.6
C69	Eye	1.5	1.4	1.0	1.6	1.9	0.7	1.4	1.9
C70–72	Central nervous system	20.3	18.6	19.7	17.4	18.1	21.9	22.9	26.9
C73	Thyroid gland	10.1	7.4	7.8	14.6	7.9	8.2	7.4	10.0
C37, C74–75	Other endocrine glands	4.1	2.6	4.5	4.0	4.3	3.8	5.0	6.1
C39, C76, C80	Other or unspecified	5.5	6.1	4.8	5.5	6.0	6.2	6.2	5.6
C81–96	Lymphoid/haematopoietic tissue	44.3	43.4	46.7	45.5	44.9	43.9	48.2	44.5
C81	Hodgkin lymphoma	2.5	2.4	2.3	2.9	2.7	1.1	3.4	1.9
C82–86, C96	Non-Hodgkin lymphoma	16.3	17.0	15.7	15.6	18.3	14.5	15.9	14.8
C88	Immunoproliferative disease	0.9	0.8	1.2	1.1	1.1	0.6	1.0	0.6
C90	Multiple myeloma	6.7	5.4	8.0	6.7	8.5	7.1	8.1	7.4
C91–95	Leukaemia	17.9	17.8	19.5	19.1	14.3	20.5	19.8	19.8

Telemark	Aust-Agder	Vest-Agder	Rogaland	Hordaland	Sogn og Fjordane	Møre og Romsdal	Sør-Trøndelag	Nord-Trøndelag	Nordland	Troms	Finnmark
532.0	569.1	569.9	563.6	557.8	511.1	505.2	527.0	503.4	514.3	532.3	498.3
8.4	7.2	5.8	8.3	6.9	6.8	7.3	6.4	6.3	8.2	8.5	7.7
1.3	1.8	2.3	2.9	1.8	2.8	1.3	1.7	0.7	1.4	1.1	0.5
2.5	1.2	1.1	1.9	1.7	1.8	1.6	1.3	1.5	2.7	1.8	2.1
1.9	1.6	1.1	1.1	1.3	0.8	1.5	1.0	0.8	0.8	1.6	1.5
0.9	1.0	0.5	0.8	1.1	0.3	1.4	0.2	1.6	1.4	1.7	1.5
1.8	1.6	0.7	1.5	1.1	1.1	1.5	2.1	1.7	1.9	2.4	2.1
97.8	102.2	113.2	113.1	117.1	122.6	118.1	112.9	105.2	110.4	119.1	100.1
2.4	2.1	1.1	2.0	2.1	2.3	1.9	2.6	1.8	3.3	2.3	2.6
4.5	4.1	4.8	6.5	7.4	10.7	8.2	7.1	5.9	7.0	7.5	9.7
2.2	2.5	3.7	1.8	2.3	2.8	2.5	3.8	3.8	2.0	0.9	4.0
46.0	54.5	58.3	56.3	60.2	62.1	61.4	50.6	51.6	54.1	56.0	40.3
17.9	13.2	20.0	20.5	21.6	20.9	21.4	21.6	17.3	20.9	18.6	13.3
2.0	2.0	1.9	2.3	2.3	1.3	2.1	1.7	2.0	2.4	2.8	4.1
2.5	4.2	1.3	2.7	3.4	1.6	3.2	4.4	4.4	3.4	5.4	4.9
2.3	1.0	3.6	4.4	3.0	2.9	2.1	3.6	4.1	3.2	2.3	1.5
14.7	14.3	15.4	14.0	12.7	14.4	13.7	14.9	10.9	12.4	20.5	18.3
3.3	4.2	3.1	2.5	2.3	3.7	1.7	2.7	3.4	1.8	2.7	1.5
49.2	63.3	66.2	56.0	52.8	45.1	46.6	51.1	45.4	53.2	47.0	68.3
0.7	0.7	0.6	0.7	0.3	0.7	0.6	0.7	0.5	0.6	0.9	0.5
0.6	0.3	0.9	1.1	0.8	0.8	1.0	0.9	0.2	0.2	0.7	1.0
47.7	61.9	64.4	54.1	51.4	42.8	45.0	49.4	44.7	52.1	45.4	66.3
0.2	0.4	0.2	0.1	0.3	0.8	0.0	0.1	0.0	0.4	0.0	0.5
0.6	1.7	1.1	1.0	0.8	0.8	1.5	0.7	1.0	1.3	1.0	0.0
40.6	38.1	38.8	43.7	40.9	33.3	22.0	40.6	34.5	22.1	27.0	17.4
32.7	50.7	58.5	35.9	36.6	29.4	21.0	19.6	19.5	23.0	24.7	20.3
0.3	0.0	0.6	0.2	0.5	0.5	0.2	0.4	0.0	0.6	1.2	0.0
0.3	0.0	0.0	0.2	0.3	0.3	0.5	0.1	0.3	0.0	0.0	0.0
2.8	3.1	3.0	2.7	2.2	1.9	2.8	3.9	4.0	3.3	4.7	2.2
121.5	130.7	119.1	127.5	123.6	111.6	126.7	122.1	124.4	112.7	107.7	104.8
69.1	66.9	55.8	63.1	64.4	50.4	54.8	60.6	56.5	59.1	62.9	56.3
4.3	4.3	3.7	3.5	5.0	3.4	3.2	3.6	3.4	5.6	4.1	3.0
14.4	14.5	8.7	9.4	13.9	10.9	12.5	12.7	10.6	12.5	13.8	15.0
27.9	27.7	27.6	28.8	27.5	23.3	22.4	27.2	29.1	25.1	28.2	23.7
0.5	0.7	0.0	0.4	0.2	0.2	0.1	0.3	0.4	0.4	0.7	0.0
22.0	19.8	15.7	21.0	17.7	12.6	16.5	16.5	12.3	15.1	16.1	14.6
0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.3	0.7	0.4	0.0	0.0
22.6	21.5	24.5	24.3	24.3	21.7	27.5	25.9	25.7	31.0	38.1	32.9
9.4	9.7	10.3	8.2	8.6	9.7	10.0	10.5	10.5	12.0	13.4	12.0
13.2	11.8	14.3	16.1	15.7	12.0	17.5	15.4	15.3	19.0	24.6	20.9
0.4	1.7	1.1	1.8	2.0	0.7	1.1	2.0	0.5	1.8	1.8	1.9
18.2	19.4	19.4	22.5	22.4	21.3	15.5	17.1	20.2	24.0	24.1	19.6
14.5	7.7	11.2	6.2	9.9	9.8	10.5	13.5	5.0	12.5	17.6	11.4
3.0	5.1	4.3	3.4	5.9	6.9	2.2	3.1	4.9	3.2	2.7	3.8
6.4	5.8	4.5	5.6	5.4	4.6	4.8	3.8	5.1	6.6	5.2	11.4
43.7	44.0	42.8	48.1	41.9	43.4	42.1	43.0	45.0	41.3	39.1	40.4
3.5	4.1	1.5	2.3	2.5	1.0	4.1	2.0	1.6	1.6	2.4	1.6
13.7	12.4	18.3	16.7	15.7	15.0	17.1	18.4	17.9	19.0	15.9	18.4
0.2	0.3	0.9	1.1	1.2	1.0	0.5	1.4	0.8	0.8	0.5	0.0
7.3	8.9	4.4	5.0	5.4	9.2	6.6	5.6	9.2	5.9	5.3	6.1
18.9	18.3	17.8	23.0	16.9	17.3	13.8	15.7	15.5	13.9	15.0	14.3

Table 5.21: Average annual number of new cases for selected cancers by stage and period of diagnosis, 1957–2016, **males**

ICD-10	Site	Stage	1957–61	1962–66	1967–71	1972–76
C00–14	Mouth, pharynx	Total	187	188	214	244
		Localised	128	134	137	161
		Regional	45	44	46	66
		Distant	4	6	10	10
		Unknown	10	5	21	6
C15	Oesophagus	Total	77	78	80	82
		Localised	49	46	42	38
		Regional	10	10	13	17
		Distant	13	18	18	22
		Unknown	5	4	8	4
C16	Stomach	Total	843	786	745	650
		Localised	238	220	185	165
		Regional	172	173	150	145
		Distant	360	342	328	296
		Unknown	74	51	84	43
C18	Colon	Total	246	306	369	416
		Localised	99	125	138	150
		Regional	67	72	87	119
		Distant	67	97	125	132
		Unknown	14	13	19	15
C19–20	Rectum, rectosigmoid	Total	153	186	271	328
		Localised	75	90	126	155
		Regional	38	50	71	89
		Distant	28	41	60	75
		Unknown	12	6	14	8
C22	Liver	Total	22	23	41	54
		Localised	11	11	20	25
		Regional	0	1	1	5
		Distant	8	10	16	21
		Unknown	2	0	4	3
C23–24	Gallbladder, bile ducts	Total	21	22	27	29
		Localised	8	8	9	8
		Regional	3	4	3	7
		Distant	8	9	12	13
		Unknown	1	1	2	1
C25	Pancreas	Total	148	185	226	251
		Localised	44	54	53	49
		Regional	17	21	29	34
		Distant	75	101	125	147
		Unknown	12	9	19	22
C33–34	Lung, trachea	Total	284	396	574	710
		Localised	85	136	187	225
		Regional	57	84	109	132
		Distant	121	154	242	303
		Unknown	21	22	37	50
C43	Melanoma of the skin	Total	56	80	117	161
		Localised	35	53	74	127
		Regional	8	11	15	16
		Distant	10	15	16	15
		Unknown	2	1	12	3
C61	Prostate	Total	689	871	1 057	1 281
		Localised	407	581	663	864
		Regional	31	31	40	73
		Distant	183	210	235	268
		Unknown	69	49	118	76

1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16	%2012-16
234	253	251	257	260	258	306	380	100.0
148	152	142	118	94	82	114	137	36.0
72	88	81	91	99	122	143	189	49.8
8	5	10	12	12	12	12	16	4.3
7	9	19	35	55	42	36	38	9.9
89	84	103	107	121	138	162	206	100.0
44	36	28	22	19	28	28	30	14.5
18	21	24	25	24	37	47	56	27.1
21	22	34	25	35	44	49	52	25.3
5	5	18	34	42	28	38	68	33.2
601	579	518	449	381	327	305	297	100.0
178	168	138	90	58	59	62	53	17.7
154	160	143	130	111	102	86	87	29.4
233	205	175	141	133	116	105	87	29.4
36	45	62	88	80	50	52	70	23.5
541	674	760	850	948	1038	1186	1367	100.0
153	200	235	219	163	187	175	254	18.5
216	275	280	359	460	524	631	688	50.4
152	174	210	221	248	262	320	338	24.7
20	25	35	50	78	64	59	87	6.4
449	513	527	563	601	661	697	795	100.0
203	218	209	200	163	167	129	189	23.8
153	184	195	211	238	282	363	382	48.0
83	91	98	104	121	131	148	147	18.4
11	20	25	48	80	80	56	78	9.8
49	68	60	59	70	81	110	161	100.0
25	33	27	20	22	25	42	49	30.6
4	6	3	3	5	8	12	19	11.6
15	19	12	11	17	20	29	35	21.9
5	10	17	26	27	29	28	58	35.8
38	47	49	53	61	63	69	83	100.0
11	16	16	11	10	11	13	11	13.0
9	10	9	10	13	22	25	40	48.3
16	16	14	15	16	18	20	21	25.2
2	5	10	16	22	13	11	11	13.5
271	297	294	281	276	310	344	391	100.0
44	59	56	33	17	24	28	29	7.4
35	41	26	34	39	72	76	83	21.1
161	155	160	130	136	164	190	201	51.4
31	42	51	84	85	50	50	79	20.1
915	1084	1147	1253	1295	1421	1541	1613	100.0
299	341	325	276	196	188	231	275	17.1
162	219	227	258	325	413	437	466	28.9
390	431	456	479	571	670	723	674	41.8
64	93	139	240	202	150	149	198	12.3
220	263	380	427	470	520	715	974	100.0
181	216	325	357	293	288	499	827	84.9
16	19	16	15	16	22	35	73	7.5
16	18	23	23	29	33	30	34	3.5
7	10	15	31	132	177	151	40	4.1
1524	1711	1921	2439	2952	3527	4501	4989	100.0
1024	1098	1201	1122	920	1568	2061	2462	49.3
65	63	60	104	120	249	895	1320	26.5
331	438	482	388	402	418	418	347	7.0
104	111	177	824	1511	1292	1127	860	17.2

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Table 5.21: Average annual number of new cases for selected cancers
by stage and period of diagnosis, 1957–2016, **males** (Continued)

ICD-10	Site	Stage	1957–61	1962–66	1967–71	1972–76
C62	Testis	Total	55	68	78	84
		Localised	37	44	50	45
		Regional	3	4	7	17
		Distant	13	19	18	20
		Unknown	2	1	3	1
C64	Kidney (excl. renal pelvis)	Total	106	128	158	177
		Localised	55	69	74	75
		Regional	10	17	23	39
		Distant	36	39	56	60
		Unknown	5	3	5	3
C65–68	Urinary tract	Total	215	302	358	499
		Localised	171	256	282	397
		Regional	17	24	37	61
		Distant	19	18	20	32
		Unknown	8	5	19	10
C70–72	Central nervous system	Total	125	135	150	168
		Non-malignant	33	36	44	47
		Malignant	92	100	106	121
C73	Thyroid gland	Total	20	26	35	36
		Localised	6	5	13	17
		Regional	10	13	13	14
		Distant	3	8	8	5
		Unknown	1	0	1	0

1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16	%2012-16
115	151	170	204	238	248	293	310	100.0
62	83	114	141	132	140	209	259	83.6
26	41	29	35	37	45	37	30	9.7
24	24	24	22	31	25	29	20	6.3
2	2	3	6	38	37	18	1	0.4
210	249	254	268	293	356	449	563	100.0
81	110	115	133	109	163	255	397	70.5
50	50	44	39	43	39	44	51	9.0
75	79	81	66	75	84	89	75	13.4
5	10	15	31	66	70	61	40	7.1
607	710	757	836	810	904	980	1 180	100.0
497	580	622	635	425	498	690	989	83.8
61	63	55	45	46	78	76	75	6.4
37	29	33	28	37	41	44	40	3.4
13	39	46	128	302	288	170	75	6.4
195	220	242	289	358	440	498	472	100.0
60	69	74	129	171	241	269	229	48.4
135	151	169	161	187	199	229	244	51.6
44	46	50	42	49	60	71	110	100.0
21	20	27	19	19	19	25	52	46.9
16	17	14	12	17	26	33	44	39.9
7	8	8	8	7	7	7	6	5.8
0	1	1	3	6	7	5	8	7.4

Table 5.22: Average annual number of new cases for selected cancers by stage and period of diagnosis, 1957–2016, **females**

ICD-10	Site	Stage	1957–61	1962–66	1967–71	1972–76
C00–14	Mouth, pharynx	Total	60	69	72	80
		Localised	34	41	40	42
		Regional	19	23	26	29
		Distant	3	3	3	4
		Unknown	4	2	3	5
C15	Oesophagus	Total	23	32	28	31
		Localised	14	21	17	15
		Regional	4	3	3	7
		Distant	3	4	6	6
		Unknown	2	3	3	3
C16	Stomach	Total	580	532	492	419
		Localised	159	156	110	103
		Regional	97	98	85	89
		Distant	240	218	233	193
		Unknown	85	60	64	34
C18	Colon	Total	286	359	438	513
		Localised	111	148	166	180
		Regional	72	84	117	154
		Distant	80	108	132	158
		Unknown	22	19	23	20
C19–20	Rectum, rectosigmoid	Total	120	140	216	261
		Localised	57	67	97	122
		Regional	29	37	58	76
		Distant	27	29	52	56
		Unknown	8	7	10	8
C22	Liver	Total	12	13	23	30
		Localised	5	6	10	16
		Regional	0	1	1	1
		Distant	5	6	10	11
		Unknown	2	1	2	1
C23–24	Gallbladder, bile ducts	Total	49	52	59	56
		Localised	14	15	15	16
		Regional	7	8	8	11
		Distant	25	27	35	26
		Unknown	3	2	2	3
C25	Pancreas	Total	105	124	167	189
		Localised	31	41	42	43
		Regional	9	12	19	24
		Distant	54	63	89	103
		Unknown	10	8	18	19
C33–34	Lung, trachea	Total	73	87	143	173
		Localised	17	28	46	51
		Regional	10	10	20	27
		Distant	38	43	65	84
		Unknown	9	5	11	11
C43	Melanoma of the skin	Total	60	93	128	200
		Localised	48	76	92	177
		Regional	6	7	8	9
		Distant	5	8	13	11
		Unknown	1	3	16	3

1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16	%2012-16
90	103	108	131	128	152	184	210	100.0
54	55	66	70	49	55	82	96	45.9
29	40	32	36	40	60	71	85	40.7
3	3	4	4	6	5	5	4	2.1
4	5	6	20	33	33	26	24	11.3
31	34	39	40	51	53	59	70	100.0
17	16	13	10	9	13	15	14	19.4
5	8	8	6	8	14	15	14	19.4
7	5	9	6	11	12	13	15	21.7
2	4	9	17	23	15	17	28	39.4
407	387	341	296	242	230	205	170	100.0
117	119	101	66	41	42	46	29	16.8
104	97	87	72	62	65	45	40	23.3
150	127	113	95	78	82	72	49	29.1
36	45	41	63	60	41	42	52	30.7
692	785	884	1 018	1 116	1 207	1 313	1 500	100.0
193	223	273	271	201	222	199	262	17.5
277	338	346	430	547	613	722	798	53.2
190	190	219	236	259	290	317	335	22.3
32	35	45	81	109	83	74	106	7.1
361	405	422	455	477	499	520	549	100.0
164	170	184	163	135	132	108	145	26.4
116	141	136	160	183	211	258	248	45.2
71	73	72	78	88	91	105	95	17.3
11	21	30	53	70	65	50	61	11.1
36	44	42	42	47	46	68	90	100.0
17	18	18	12	10	13	23	28	30.8
1	3	2	2	5	6	9	10	11.4
14	14	10	8	11	8	17	19	21.2
4	8	12	20	21	19	19	33	36.6
73	82	75	73	80	78	86	94	100.0
22	24	23	16	10	14	14	12	12.6
10	21	14	12	14	18	25	36	38.0
36	29	23	22	28	26	33	32	33.7
5	9	15	23	27	19	14	15	15.8
224	274	281	311	326	340	362	392	100.0
44	59	67	40	24	30	41	38	9.8
30	35	28	32	40	67	76	86	22.0
124	137	133	129	144	168	181	177	45.1
25	43	53	110	117	74	64	91	23.2
227	320	450	580	725	928	1 186	1 415	100.0
68	81	115	121	99	138	219	286	20.2
31	59	84	118	167	246	302	372	26.3
108	148	197	224	336	448	549	582	41.1
20	33	54	117	123	96	116	176	12.4
264	359	442	490	513	581	734	967	100.0
237	320	407	428	331	341	538	867	89.6
9	16	12	10	11	17	26	46	4.7
13	13	11	17	22	20	16	20	2.1
6	11	12	35	149	202	153	34	3.5

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Table 5.22: Average annual number of new cases for selected cancers by stage and period of diagnosis, 1957–2016, **females** (Continued)

ICD-10	Site	Stage	1957–61	1962–66	1967–71	1972–76
C50	Breast	Total	941	1 072	1 230	1 408
		I	414	506	590	714
		II	356	348	387	428
		III	49	93	78	108
		IV	93	97	120	112
		Unknown	29	27	54	47
C53	Cervix uteri	Total	348	361	403	440
		I	151	150	206	242
		II	116	135	124	112
		III	50	48	47	59
		IV	25	22	19	24
		Unknown	7	6	7	3
C54	Corpus uteri	Total	181	221	268	326
		Localised	145	184	212	271
		Regional	9	13	15	24
		Distant	19	23	36	29
		Unknown	8	2	6	3
C56, C57.0–4	Ovary etc.	Total	273	300	375	386
		Localised	87	100	123	139
		Regional	23	15	22	22
		Distant	150	177	218	219
		Unknown	12	9	12	7
C64	Kidney (excl. renal pelvis)	Total	78	90	117	118
		Localised	43	52	62	60
		Regional	9	9	16	23
		Distant	22	27	35	31
		Unknown	4	2	4	4
C65–68	Urinary tract	Total	123	135	156	209
		Localised	77	87	101	141
		Regional	14	22	22	30
		Distant	21	20	22	28
		Unknown	11	7	11	11
C70–72	Central nervous system	Total	111	119	131	151
		Non-malignant	46	56	57	60
		Malignant	66	62	73	90
C73	Thyroid gland	Total	53	61	90	110
		Localised	21	29	48	66
		Regional	17	22	27	28
		Distant	12	8	10	14
		Unknown	3	1	4	2

1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16	%2012-16
1 535	1 714	1 818	2 083	2 471	2 748	2 829	3 254	100.0
827	799	314	457	729	1 059	1 155	1 341	41.2
436	545	689	781	948	1 139	1 016	1 133	34.8
95	108	113	121	142	176	297	387	11.9
111	112	124	132	126	127	109	109	3.4
66	151	578	593	527	247	253	284	8.7
399	352	345	344	310	300	295	336	100.0
225	203	194	215	180	174	169	226	67.3
86	71	71	61	63	56	65	47	13.9
55	53	46	36	36	31	24	24	7.3
23	22	28	27	25	27	31	34	10.0
10	3	5	5	6	11	6	5	1.5
370	390	411	467	526	649	722	742	100.0
285	293	300	328	329	400	522	544	73.4
45	46	47	47	58	78	58	46	6.2
32	39	50	60	69	84	97	91	12.2
8	12	13	33	69	87	46	60	8.1
417	454	464	472	482	477	480	477	100.0
106	119	130	119	93	85	96	101	21.1
39	35	21	17	14	13	17	14	3.0
262	283	295	304	318	328	327	333	69.8
11	17	17	32	56	50	40	29	6.2
138	156	181	191	189	216	250	263	100.0
63	69	92	100	72	100	144	188	71.4
28	34	26	22	20	23	21	19	7.2
43	46	48	44	50	41	44	29	11.2
4	7	15	25	48	51	41	27	10.3
240	263	266	291	309	350	366	450	100.0
171	196	204	195	139	180	243	355	79.0
33	30	22	22	24	37	35	35	7.7
22	17	20	18	26	25	25	20	4.5
14	20	21	56	121	109	63	40	8.8
186	223	260	318	434	596	627	535	100.0
82	103	134	188	290	432	458	369	69.0
104	121	126	130	144	164	170	166	31.0
132	142	135	136	124	153	189	260	100.0
84	96	89	82	56	71	101	159	61.0
31	33	32	36	39	47	61	79	30.3
13	10	9	11	11	10	7	8	3.2
4	3	4	7	19	25	20	14	5.5

Table 5.23: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years for selected cancers by stage and period of diagnosis, 1957–2016, **males**

ICD-10	Site	Stage	1957–61	1962–66	1967–71	1972–76
C00–14	Mouth, pharynx	Total	15.5	14.5	15.2	15.8
		Localised	10.6	10.5	9.7	10.4
		Regional	3.5	3.2	3.3	4.3
		Distant	0.4	0.5	0.7	0.6
		Unknown	1.0	0.3	1.5	0.4
C15	Oesophagus	Total	6.8	6.1	5.8	5.5
		Localised	4.5	3.8	3.1	2.7
		Regional	0.7	0.7	0.9	1.1
		Distant	1.0	1.2	1.3	1.4
		Unknown	0.6	0.4	0.6	0.3
C16	Stomach	Total	71.9	61.1	54.4	44.3
		Localised	21.3	18.3	14.4	12.0
		Regional	13.0	12.3	9.9	9.3
		Distant	29.2	25.3	22.5	19.2
		Unknown	8.3	5.2	7.6	3.8
C18	Colon	Total	20.8	23.8	26.6	28.3
		Localised	8.5	9.9	10.2	10.3
		Regional	5.2	5.1	6.0	7.8
		Distant	5.6	7.4	8.7	8.9
		Unknown	1.5	1.4	1.7	1.3
C19–20	Rectum, rectosigmoid	Total	13.1	14.2	19.2	21.8
		Localised	6.7	6.9	9.2	10.5
		Regional	2.9	3.7	4.7	5.7
		Distant	2.3	3.0	4.1	4.9
		Unknown	1.2	0.7	1.3	0.7
C22	Liver	Total	1.6	1.6	2.8	3.4
		Localised	0.9	0.8	1.4	1.5
		Regional	0.0	0.1	0.1	0.4
		Distant	0.6	0.7	1.0	1.3
		Unknown	0.1	0.0	0.3	0.2
C23–24	Gallbladder, bile ducts	Total	1.7	1.6	1.9	2.0
		Localised	0.6	0.6	0.6	0.5
		Regional	0.3	0.3	0.2	0.5
		Distant	0.6	0.8	0.8	0.9
		Unknown	0.1	0.0	0.2	0.1
C25	Pancreas	Total	11.6	13.6	15.6	16.4
		Localised	3.5	4.1	3.7	3.3
		Regional	1.3	1.6	1.9	2.2
		Distant	5.8	7.2	8.6	9.5
		Unknown	1.0	0.7	1.4	1.5
C33–34	Lung, trachea	Total	20.4	26.6	36.2	42.6
		Localised	6.3	9.2	11.8	13.6
		Regional	3.9	5.4	6.6	7.6
		Distant	8.6	10.3	15.2	18.1
		Unknown	1.6	1.6	2.6	3.2
C43	Melanoma of the skin	Total	3.9	5.3	7.5	9.7
		Localised	2.5	3.6	4.7	7.6
		Regional	0.5	0.7	0.9	1.0
		Distant	0.7	0.9	1.1	1.0
		Unknown	0.1	0.0	0.8	0.2
C61	Prostate	Total	65.6	75.5	83.3	91.9
		Localised	38.7	50.3	51.8	60.9
		Regional	3.1	2.9	3.2	5.4
		Distant	16.8	17.6	18.0	19.2
		Unknown	6.9	4.7	10.3	6.4

1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16
14.6	15.0	14.6	14.3	14.0	13.0	14.0	15.6
9.3	9.0	8.3	6.5	5.1	4.2	5.3	5.7
4.3	5.1	4.6	5.1	5.2	6.0	6.4	7.6
0.5	0.3	0.5	0.7	0.6	0.6	0.6	0.7
0.5	0.6	1.2	2.1	3.0	2.2	1.7	1.6
5.6	5.0	5.9	6.1	6.6	7.3	7.6	8.7
2.9	2.2	1.7	1.3	1.1	1.5	1.3	1.3
1.0	1.2	1.3	1.4	1.3	1.9	2.2	2.3
1.3	1.2	1.9	1.4	1.9	2.3	2.3	2.2
0.4	0.3	1.1	2.0	2.3	1.6	1.8	2.9
38.4	35.6	30.7	25.7	21.2	17.5	14.7	12.8
12.1	11.2	8.6	5.2	3.2	3.3	3.1	2.3
9.4	9.2	7.9	7.2	6.0	5.3	4.0	3.7
14.3	12.0	10.1	7.8	7.3	6.1	5.0	3.7
2.6	3.2	4.0	5.6	4.8	2.9	2.6	3.1
34.7	40.9	44.9	48.4	52.2	54.7	57.5	59.0
10.0	12.3	13.7	12.4	8.9	9.9	8.4	10.8
13.6	16.3	16.5	20.5	25.2	27.5	30.7	29.6
9.5	10.4	12.4	12.3	13.5	13.6	15.3	14.4
1.6	1.9	2.4	3.3	4.6	3.6	3.1	4.2
28.5	30.7	30.5	32.0	33.0	34.5	32.9	33.3
13.4	13.3	12.1	11.3	8.9	8.8	6.1	7.8
9.2	10.5	11.1	11.7	12.9	14.5	17.1	15.9
5.1	5.4	5.6	5.8	6.6	6.8	6.9	6.1
0.9	1.4	1.7	3.2	4.6	4.3	2.8	3.4
2.9	4.0	3.5	3.1	3.8	4.2	5.2	6.7
1.5	2.0	1.6	1.1	1.2	1.3	2.0	2.0
0.2	0.4	0.2	0.1	0.3	0.4	0.5	0.8
0.9	1.1	0.7	0.6	0.9	1.0	1.3	1.5
0.3	0.6	1.0	1.4	1.5	1.5	1.3	2.5
2.5	2.8	2.8	3.1	3.5	3.3	3.3	3.5
0.8	1.0	1.0	0.7	0.5	0.6	0.6	0.5
0.5	0.5	0.5	0.6	0.7	1.1	1.2	1.6
1.1	0.9	0.7	0.8	0.9	1.0	0.9	0.9
0.1	0.3	0.6	1.0	1.3	0.7	0.6	0.5
16.8	18.1	17.1	16.0	15.3	16.3	16.6	16.7
2.9	3.9	3.4	2.0	0.9	1.3	1.3	1.2
2.1	2.4	1.5	1.8	2.1	3.7	3.6	3.5
9.7	9.0	9.1	7.1	7.4	8.5	9.0	8.4
2.0	2.8	3.1	5.0	4.8	2.7	2.6	3.6
53.0	61.5	63.9	69.3	69.7	73.4	73.0	68.6
17.4	19.4	18.1	15.1	10.5	9.6	11.0	11.6
9.1	12.2	12.4	14.0	17.2	21.2	20.7	19.5
22.3	24.4	25.3	26.4	30.5	34.5	34.0	28.5
4.1	5.5	8.1	13.7	11.4	8.0	7.4	9.1
12.9	14.8	21.0	22.7	24.2	25.6	32.6	40.4
10.6	12.1	17.9	18.9	15.0	14.2	22.6	34.2
0.9	1.1	0.9	0.8	0.8	1.1	1.6	3.1
0.9	1.0	1.3	1.3	1.6	1.6	1.4	1.4
0.4	0.6	0.9	1.7	6.8	8.8	6.9	1.7
101.8	105.8	114.1	140.8	166.7	188.3	214.2	207.2
67.4	67.3	70.9	63.9	51.2	82.5	96.0	99.7
4.2	3.8	3.5	6.2	6.9	13.3	42.9	55.0
22.3	27.4	28.4	22.4	22.8	22.6	21.0	15.6
7.9	7.4	11.2	48.3	85.9	69.8	54.3	37.0

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Table 5.23: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years for selected cancers by stage and period of diagnosis, 1957–2016, **males** (Continued)

ICD-10	Site	Stage	1957–61	1962–66	1967–71	1972–76
C62	Testis	Total	3.4	4.1	4.5	4.6
		Localised	2.2	2.6	2.9	2.4
		Regional	0.2	0.3	0.4	0.9
		Distant	0.8	1.1	1.0	1.1
		Unknown	0.1	0.1	0.2	0.1
C64	Kidney (excl. renal pelvis)	Total	7.8	9.2	10.2	10.8
		Localised	4.0	5.0	5.0	4.7
		Regional	0.7	1.1	1.4	2.3
		Distant	2.6	2.7	3.5	3.6
		Unknown	0.4	0.3	0.3	0.3
C65–68	Urinary tract	Total	17.6	22.8	24.6	32.3
		Localised	13.9	19.3	19.1	25.5
		Regional	1.3	1.8	2.7	3.9
		Distant	1.6	1.3	1.4	2.2
		Unknown	0.8	0.4	1.4	0.8
C70–72	Central nervous system	Total	7.6	7.9	8.4	9.2
		Non-malignant	2.1	2.2	2.6	2.6
		Malignant	5.5	5.8	5.8	6.6
C73	Thyroid gland	Total	1.5	1.8	2.2	2.2
		Localised	0.4	0.4	0.8	1.1
		Regional	0.7	0.8	0.7	0.8
		Distant	0.2	0.6	0.6	0.3
		Unknown	0.0	0.0	0.1	0.0

1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16
5.9	7.1	7.7	8.9	10.1	10.6	12.0	11.8
3.2	3.9	5.2	6.1	5.6	6.0	8.6	9.9
1.3	1.9	1.3	1.5	1.6	1.9	1.5	1.2
1.2	1.1	1.1	1.0	1.4	1.1	1.2	0.7
0.1	0.1	0.1	0.3	1.6	1.6	0.7	0.1
12.4	14.4	14.5	14.7	15.6	17.9	20.5	22.8
4.8	6.3	6.5	7.2	5.7	8.1	11.5	15.8
2.9	2.9	2.5	2.2	2.3	1.9	2.0	2.1
4.3	4.5	4.6	3.6	3.9	4.3	4.2	3.1
0.4	0.6	0.9	1.7	3.7	3.6	2.8	1.9
37.5	42.3	44.1	47.7	44.6	47.6	47.4	51.4
30.5	34.5	36.3	36.0	23.2	26.0	33.3	43.0
3.7	3.5	3.1	2.6	2.5	4.0	3.6	3.2
2.3	1.6	2.0	1.6	2.1	2.1	2.2	1.8
1.0	2.6	2.8	7.5	16.9	15.4	8.4	3.3
10.6	11.7	12.8	14.9	17.6	20.8	22.0	19.0
3.4	3.8	4.0	6.6	8.4	11.3	11.8	9.2
7.2	7.9	8.8	8.3	9.2	9.5	10.2	9.8
2.6	2.5	2.7	2.2	2.4	2.8	3.1	4.4
1.2	1.1	1.4	1.0	0.9	0.9	1.1	2.0
0.9	0.9	0.8	0.6	0.8	1.2	1.5	1.8
0.4	0.5	0.5	0.4	0.4	0.4	0.3	0.3
0.0	0.1	0.1	0.2	0.3	0.4	0.2	0.3

Table 5.24: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years for selected cancers by stage and period of diagnosis, 1957–2016, **females**

ICD-10	Site	Stage	1957–61	1962–66	1967–71	1972–76
C00–14	Mouth, pharynx	Total	4.4	4.5	4.3	4.4
		Localised	2.4	2.6	2.4	2.3
		Regional	1.5	1.6	1.6	1.6
		Distant	0.2	0.2	0.2	0.2
		Unknown	0.3	0.1	0.2	0.3
C15	Oesophagus	Total	1.7	2.3	1.7	1.6
		Localised	1.1	1.5	1.0	0.8
		Regional	0.2	0.2	0.2	0.4
		Distant	0.2	0.3	0.3	0.3
		Unknown	0.1	0.3	0.2	0.1
C16	Stomach	Total	43.6	36.8	29.4	22.9
		Localised	12.4	11.2	6.9	5.9
		Regional	6.4	5.9	4.7	4.6
		Distant	16.9	14.4	13.4	10.4
		Unknown	7.9	5.3	4.5	2.1
C18	Colon	Total	20.7	23.6	25.6	27.7
		Localised	8.1	9.9	9.9	9.8
		Regional	4.9	5.2	6.5	8.0
		Distant	5.7	6.8	7.6	8.5
		Unknown	2.0	1.7	1.7	1.4
C19–20	Rectum, rectosigmoid	Total	8.6	8.8	12.6	14.1
		Localised	4.1	4.2	5.8	6.6
		Regional	2.0	2.2	3.2	4.0
		Distant	1.8	1.8	3.0	2.9
		Unknown	0.6	0.5	0.7	0.5
C22	Liver	Total	0.9	0.8	1.3	1.5
		Localised	0.4	0.3	0.5	0.8
		Regional	0.0	0.0	0.0	0.1
		Distant	0.4	0.4	0.6	0.6
		Unknown	0.1	0.0	0.1	0.0
C23–24	Gallbladder, bile ducts	Total	3.4	3.4	3.4	3.0
		Localised	0.9	1.0	0.8	0.9
		Regional	0.5	0.5	0.5	0.6
		Distant	1.7	1.8	2.0	1.3
		Unknown	0.2	0.1	0.1	0.2
C25	Pancreas	Total	7.3	7.8	9.7	10.0
		Localised	2.2	2.6	2.4	2.3
		Regional	0.6	0.7	1.0	1.2
		Distant	3.7	4.0	5.0	5.4
		Unknown	0.7	0.5	1.2	1.1
C33–34	Lung, trachea	Total	4.9	5.3	8.1	9.0
		Localised	1.1	1.7	2.7	2.6
		Regional	0.7	0.6	1.1	1.4
		Distant	2.5	2.6	3.7	4.4
		Unknown	0.6	0.3	0.7	0.6
C43	Melanoma of the skin	Total	3.9	5.6	7.5	11.2
		Localised	3.1	4.5	5.3	9.9
		Regional	0.4	0.4	0.5	0.5
		Distant	0.3	0.5	0.7	0.6
		Unknown	0.1	0.2	0.9	0.2

1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16
4.6	4.9	5.0	5.8	5.6	6.4	7.3	7.7
2.8	2.6	3.0	3.1	2.1	2.3	3.2	3.5
1.4	1.9	1.5	1.6	1.8	2.6	2.9	3.2
0.1	0.1	0.2	0.2	0.3	0.2	0.2	0.2
0.2	0.3	0.3	0.9	1.4	1.3	1.0	0.8
1.6	1.6	1.7	1.7	2.1	2.1	2.2	2.5
0.9	0.8	0.6	0.4	0.4	0.5	0.6	0.5
0.3	0.4	0.4	0.3	0.4	0.6	0.6	0.5
0.3	0.2	0.4	0.3	0.5	0.5	0.5	0.5
0.1	0.2	0.3	0.7	0.9	0.5	0.6	1.0
20.2	17.8	14.7	12.1	9.6	8.9	7.6	6.0
6.0	5.5	4.4	2.7	1.6	1.6	1.7	1.0
5.0	4.3	3.8	3.0	2.5	2.5	1.7	1.4
7.3	5.8	4.8	3.9	3.3	3.3	2.7	1.8
2.0	2.2	1.7	2.5	2.2	1.5	1.5	1.8
34.5	36.1	38.7	43.0	45.6	47.8	49.7	53.3
9.6	10.3	11.9	11.4	8.2	8.7	7.6	9.4
13.6	15.4	15.1	18.2	22.4	24.3	27.5	28.4
9.4	8.8	9.8	10.2	10.8	11.7	12.2	12.1
1.8	1.7	1.9	3.2	4.2	3.1	2.4	3.4
18.0	18.8	18.5	19.6	20.1	20.3	20.2	20.0
8.3	7.9	8.1	7.1	5.8	5.4	4.3	5.3
5.6	6.5	6.0	7.0	7.8	8.6	10.1	9.1
3.5	3.3	3.1	3.4	3.7	3.8	4.1	3.5
0.6	1.0	1.3	2.2	2.8	2.5	1.8	2.1
1.8	2.1	1.8	1.8	1.9	1.8	2.5	3.2
0.8	0.8	0.8	0.5	0.4	0.5	0.9	1.0
0.1	0.2	0.1	0.1	0.2	0.2	0.4	0.4
0.7	0.7	0.4	0.3	0.5	0.3	0.7	0.7
0.2	0.4	0.5	0.8	0.8	0.8	0.7	1.1
3.5	3.8	3.2	3.0	3.3	3.0	3.3	3.4
1.1	1.1	1.0	0.7	0.4	0.5	0.5	0.4
0.5	1.0	0.6	0.5	0.6	0.8	1.0	1.3
1.7	1.3	1.0	0.9	1.2	1.0	1.3	1.1
0.2	0.4	0.6	0.9	1.0	0.7	0.5	0.5
10.9	12.4	12.0	12.9	12.9	13.3	13.6	14.0
2.1	2.7	2.8	1.6	0.9	1.1	1.5	1.4
1.5	1.6	1.3	1.4	1.7	2.7	3.0	3.1
6.0	6.2	5.7	5.6	5.9	6.8	7.0	6.4
1.3	1.9	2.2	4.3	4.3	2.7	2.2	3.1
11.4	15.4	21.1	26.9	32.9	40.0	47.6	52.1
3.3	3.7	5.3	5.6	4.5	6.0	8.9	10.6
1.6	2.9	4.0	5.6	7.7	10.6	12.2	13.8
5.4	7.2	9.5	10.7	15.5	19.5	22.1	21.5
1.0	1.5	2.4	5.0	5.2	3.9	4.4	6.1
14.1	18.2	21.5	22.8	22.8	24.9	29.6	36.4
12.7	16.3	20.0	19.9	14.9	14.7	21.8	32.8
0.5	0.7	0.5	0.5	0.4	0.7	1.0	1.7
0.7	0.7	0.5	0.8	0.9	0.9	0.7	0.7
0.3	0.5	0.6	1.7	6.6	8.6	6.1	1.2

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Table 5.24: Age-standardised (Norwegian standard) incidence rates per 100 000 person-years for selected cancers by stage and period of diagnosis, 1957–2016, **females** (Continued)

ICD-10	Site	Stage	1957–61	1962–66	1967–71	1972–76
C50	Breast	Total	61.1	65.6	70.2	77.0
		I	26.8	30.9	33.9	39.0
		II	22.2	20.6	21.6	23.3
		III	3.5	6.1	4.5	5.9
		IV	6.5	6.2	6.9	6.0
		Unknown	2.2	1.9	3.4	2.9
C53	Cervix uteri	Total	20.9	21.2	23.1	24.8
		I	8.9	8.7	12.1	14.2
		II	6.9	7.9	7.0	6.1
		III	3.1	2.9	2.6	3.2
		IV	1.5	1.3	1.1	1.3
		Unknown	0.4	0.4	0.4	0.2
C54	Corpus uteri	Total	11.3	12.9	14.7	17.1
		Localised	9.0	10.7	11.6	14.2
		Regional	0.6	0.8	0.8	1.2
		Distant	1.2	1.4	2.0	1.5
		Unknown	0.5	0.1	0.3	0.2
C56, C57.0–4	Ovary etc.	Total	17.2	17.7	20.9	20.5
		Localised	5.4	5.9	6.8	7.5
		Regional	1.5	0.9	1.2	1.2
		Distant	9.5	10.4	12.0	11.5
		Unknown	0.9	0.6	0.8	0.4
C64	Kidney (excl. renal pelvis)	Total	5.1	5.4	6.5	6.1
		Localised	2.9	3.1	3.5	3.2
		Regional	0.6	0.5	0.9	1.1
		Distant	1.4	1.6	1.9	1.6
		Unknown	0.2	0.1	0.2	0.2
C65–68	Urinary tract	Total	8.8	8.8	9.1	11.1
		Localised	5.4	5.6	5.9	7.4
		Regional	1.0	1.4	1.2	1.5
		Distant	1.5	1.2	1.3	1.5
		Unknown	0.8	0.5	0.8	0.6
C70–72	Central nervous system	Total	6.6	6.8	7.1	7.8
		Non-malignant	2.8	3.3	3.2	3.2
		Malignant	3.8	3.5	3.9	4.6
C73	Thyroid gland	Total	3.5	3.9	5.2	6.0
		Localised	1.4	1.8	2.8	3.7
		Regional	1.1	1.4	1.6	1.5
		Distant	0.8	0.5	0.6	0.7
		Unknown	0.2	0.1	0.3	0.1

1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16
80.1	85.4	86.5	96.9	113.3	120.2	115.7	123.8
43.1	39.4	15.1	21.9	35.2	48.7	48.8	52.0
22.7	27.5	33.3	36.8	43.5	49.7	41.6	43.1
4.9	5.2	5.3	5.2	6.1	7.2	12.0	14.6
5.6	5.5	5.8	6.2	5.5	5.3	4.3	4.1
3.8	7.8	27.1	26.8	22.9	9.3	9.1	10.0
21.5	17.8	16.9	16.1	13.9	12.8	12.1	13.2
12.4	10.3	9.5	10.0	8.1	7.5	7.0	9.0
4.5	3.7	3.6	2.9	2.8	2.4	2.7	1.8
2.9	2.6	2.3	1.7	1.6	1.3	1.0	0.9
1.2	1.0	1.4	1.2	1.1	1.2	1.2	1.3
0.5	0.2	0.2	0.2	0.3	0.5	0.2	0.2
19.1	19.7	20.2	22.2	24.0	27.9	29.3	27.6
14.8	15.0	15.0	15.8	15.3	17.4	21.3	20.4
2.2	2.3	2.3	2.2	2.6	3.3	2.4	1.7
1.6	1.8	2.3	2.8	3.1	3.6	3.9	3.4
0.4	0.6	0.6	1.5	3.0	3.6	1.8	2.2
21.5	22.7	22.4	22.1	21.7	20.2	19.3	17.9
5.5	6.1	6.4	5.7	4.3	3.8	3.9	3.9
2.0	1.8	1.1	0.8	0.6	0.5	0.7	0.5
13.4	14.0	14.2	14.3	14.3	13.9	13.2	12.5
0.6	0.8	0.8	1.4	2.4	2.0	1.5	1.0
6.7	7.2	8.1	8.2	8.0	8.9	9.9	9.8
3.1	3.3	4.1	4.4	3.2	4.3	5.8	7.1
1.3	1.5	1.2	0.9	0.8	0.9	0.8	0.7
2.1	2.1	2.2	1.9	2.1	1.6	1.7	1.1
0.2	0.3	0.6	1.0	1.9	2.0	1.6	0.9
11.8	11.9	11.7	12.3	12.7	13.9	14.0	16.1
8.4	8.9	9.0	8.3	5.8	7.3	9.3	12.7
1.6	1.3	1.0	0.9	1.0	1.4	1.4	1.2
1.1	0.8	0.8	0.8	1.1	1.0	1.0	0.7
0.7	0.9	0.9	2.3	4.8	4.2	2.3	1.4
9.5	11.1	12.5	14.8	19.3	25.7	25.5	20.3
4.3	5.1	6.5	8.7	12.9	18.7	18.6	14.1
5.2	6.0	6.0	6.0	6.4	7.0	6.9	6.3
6.9	7.0	6.4	6.3	5.5	6.5	7.8	10.1
4.5	4.8	4.4	3.9	2.6	3.0	4.2	6.2
1.6	1.5	1.5	1.6	1.7	2.0	2.5	3.0
0.6	0.5	0.4	0.5	0.4	0.4	0.3	0.3
0.2	0.2	0.2	0.3	0.8	1.1	0.8	0.5

Chapter 6 Prevalence

As of December 31st 2016, a total of 262 884 individuals were alive and previously diagnosed with cancer in Norway. The cancer prevalence in Table 6.1 provides the numbers of cancer survivors at a given number of years after diagnosis (< 1 , 1–4, 5–9 and ≥ 10 years), and approximates the number of patients in Norway (of both sexes) potentially requiring some form of cancer care. The highest prevalences were seen for prostate cancer (47 088), breast cancer (45 725), melanoma of the skin (24 594), and colon cancer (21 532).

Differences in prognosis, rather than incidence, and median age at diagnosis explain much of the site-specific variability in prevalence. In terms of new cases, there are

almost twice as many lung cancers as malignant melanomas in Norway, but the number of lung cancer survivors ten years after the diagnosis is less than 10% of surviving melanoma patients. This reflects the vast difference in prognosis for the two patient groups.

Table 6.2 shows the number of patients with metastases or local recurrence, alive at specific time points. Only patients with metastasis confirmed histologically are included. Patients with metastatic disease now live longer and have more often diagnostic work-up, surgery for metastatic lesions and are also given more chemotherapy than before. This patient group represents an increasing demand of personnel and costs in the health care system.

Table 6.1: Prevalence of cancers December 31st 2006 and December 31st 2016, both sexes

ICD-10	Site	Total no. of persons alive		Years after diagnosis			
		31.12.2006	31.12.2016	1	1-4	5-9	10+
C00-96	All sites	178 718	262 884	23 855	73 820	63 293	101 916
C00-14	Mouth, pharynx	3 429	4 992	550	1 576	1 206	1 660
C00	Lip	1 202	1 389	108	382	358	541
C01-02	Tongue	554	1 001	139	353	227	282
C03-06	Mouth, other	610	774	94	242	171	267
C07-08	Salivary glands	448	630	69	168	127	266
C09-14	Pharynx	645	1 272	163	464	337	308
C15-26	Digestive organs	27 896	39 117	5 029	12 771	9 179	12 138
C15	Oesophagus	289	647	188	276	116	67
C16	Stomach	1 994	1 987	307	568	403	709
C17	Small intestine	585	1 153	159	415	299	280
C18	Colon	15 322	21 532	2 591	7 036	5 145	6 760
C19-20	Rectum, rectosigmoid	8 663	11 789	1 218	3 728	2 892	3 951
C21	Anus	537	762	96	226	173	267
C22	Liver	221	529	134	222	88	85
C23-24	Gallbladder, bile ducts	297	469	95	178	92	104
C25	Pancreas	555	1 021	346	420	144	111
C26	Other digestive organs	116	191	64	60	20	47
C30-34, C38	Respiratory organs	5 711	8 979	2 041	3 461	1 751	1 726
C30-31	Nose, sinuses	268	351	37	106	92	116
C32	Larynx, epiglottis	1 074	1 108	97	319	263	429
C33-34	Lung, trachea	4 338	7 507	1 916	3 049	1 392	1 150
C38	Heart, mediastinum and pleura	59	66	11	8	11	36
C40-41	Bone	597	807	52	138	149	468
C43	Melanoma of the skin	15 882	24 594	2 044	6 443	4 964	11 143
C44	Skin, non-melanoma	10 224	15 425	1 981	5 421	3 745	4 278
C45	Mesothelioma	98	126	57	51	8	10
C47	Autonomic nervous system	231	245	2	28	29	186
C48-49	Soft tissues	1 171	1 599	126	408	329	736
C50	Breast	32 424	45 725	3 307	11 477	10 529	20 412
C51-58	Female genital organs	19 615	22 991	1 563	4 844	4 471	12 113
C51-52, C57.7-9	Other female genital	778	960	102	265	206	387
C53	Cervix uteri	6 769	7 173	318	1 110	1 041	4 704
C54	Corpus uteri	7 989	10 347	738	2 403	2 474	4 732
C55	Uterus, other	42	50	8	9	6	27
C56, C57.0-4	Ovary etc.	4 202	4 657	419	1 123	805	2 310
C58	Placenta	141	154	3	9	11	131
C60-63	Male genital organs	29 209	54 914	5 265	18 464	16 409	14 776
C61	Prostate	23 704	47 088	4 930	17 167	14 969	10 022
C62	Testis	5 219	7 483	284	1 230	1 385	4 584
C60, C63	Other male genital	355	552	81	150	124	197
C64-68	Urinary organs	14 055	20 531	2 344	6 789	4 994	6 404
C64	Kidney (excl. renal pelvis)	3 853	6 816	784	2 333	1 753	1 946
C65-68	Urinary tract	10 268	13 877	1 592	4 527	3 282	4 476
C69	Eye	885	1 086	66	265	204	551
C70-72	Central nervous system	8 878	13 165	701	2 745	3 289	6 430
C73	Thyroid gland	3 932	5 718	411	1 188	1 027	3 092
C37, C74-75	Other endocrine glands	2 362	3 900	121	841	1 094	1 844
C39, C76, C80	Other or unspecified	504	598	109	167	112	210
C81-96	Lymphoid/haematopoietic tissue	13 717	23 378	2 402	7 223	5 823	7 930
C81	Hodgkin lymphoma	1 961	2 799	159	520	526	1 594
C82-86, C96	Non-Hodgkin lymphoma	5 712	9 672	917	2 902	2 482	3 371
C88	Immunoproliferative disease	338	597	41	238	184	134
C90	Multiple myeloma	1 323	2 045	364	881	502	298
C91-95	Leukaemia	4 454	8 461	953	2 761	2 182	2 565

Table 6.2: Prevalence of patients diagnosed with metastases during lifetime, by health region, both sexes

Health region	Alive by					
	31.12.1991	31.12.1996	31.12.2001	31.12.2006	31.12.2011	31.12.2016
South East	4 219	5 248	6 534	8 222	10 342	12 219
West	1 616	1 793	2 376	2 886	3 516	4 338
Middle	1 143	1 348	1 588	2 044	2 444	2 857
North	734	846	1 008	1 373	1 666	1 937
Total	7 712	9 235	11 506	14 525	17 968	21 351

Chapter 7 Mortality

The mortality data is obtained from the Cause of Death Registry. Of note is that mortality data for 2016 was not complete when this report was published (October 2017), and we therefore report figures for 2015.

There were 10 944 deaths from cancer in Norway in 2015, of which 5915 were men, and 5029 women (Table 7.1). Cancers of the lung, colon, rectum, prostate and female breast account for half of the total cancer deaths.

Among men, lung cancer caused 1191 deaths in 2015. Prostate cancer (1045 deaths), colon cancer (547 deaths) and pancreas cancer (376 deaths) represent the second, third and fourth most frequent causes of cancer death among men, respectively.

Lung cancer mortality also ranks highest among women (984 deaths). Colon cancer (605 deaths), breast cancer (585 deaths), and pancreas cancer (385 deaths) represent the second, third and fourth most frequent causes of cancer death among women, respectively. Figure 7.1 shows the distribution of age-standardised mortality rates for selected cancer sites. There is at least a 100-fold difference in rates across these cancers. Given the very poor prognosis for pancreatic cancer, it ranks among the top four causes of cancer death among both men and women, even though pancreatic cancer only is a moderately common cancer.

The trends section in this report examines the mortality, incidence and survival for 23 selected cancer sites.

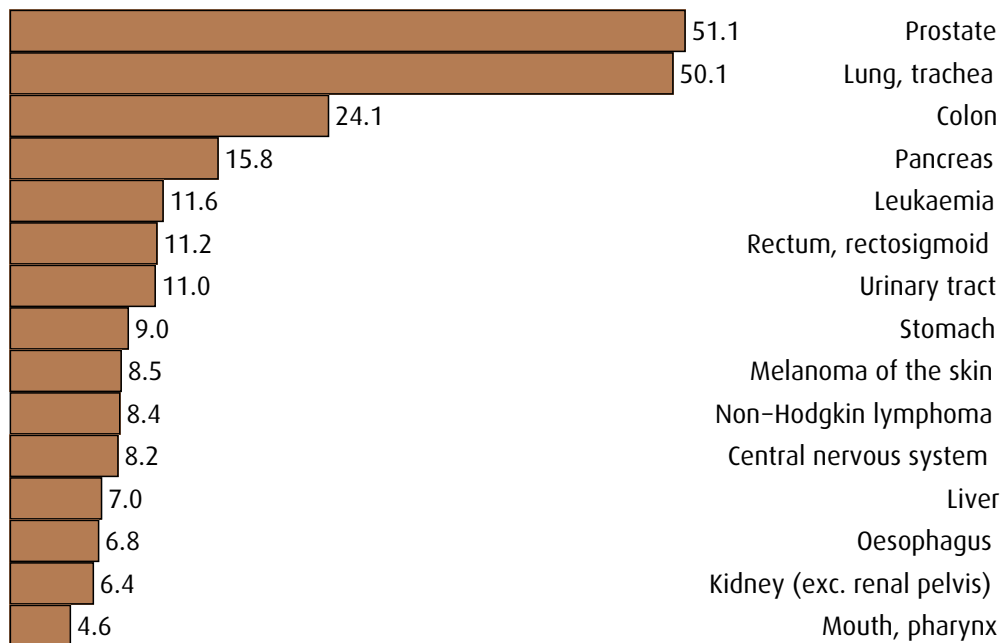
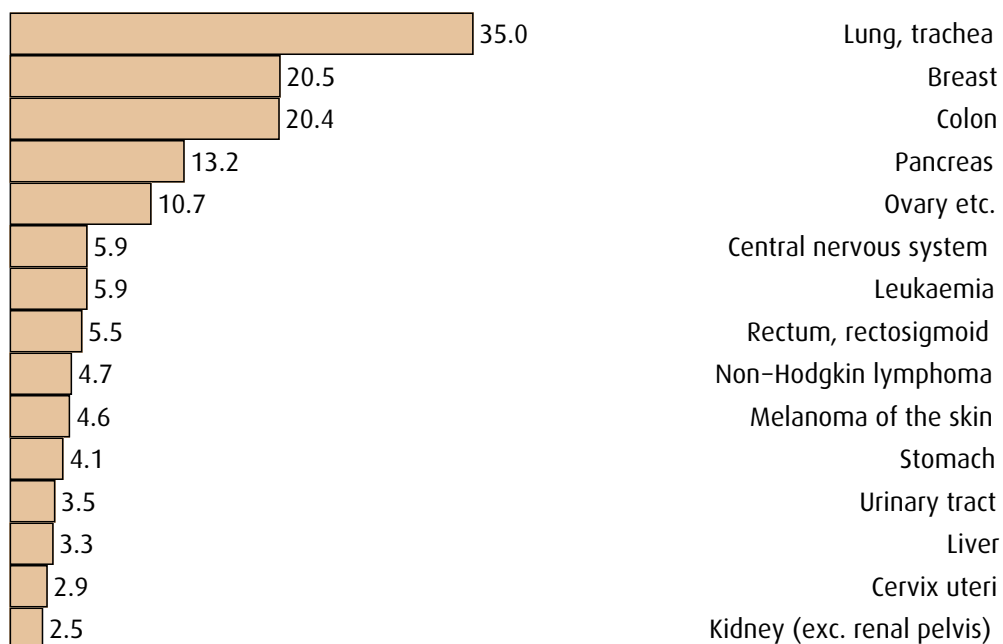
Figure 7.1: Age-standardised (Norwegian standard) mortality rates per 100 000 person-years for selected cancers, 2015**MALES****FEMALES**

Table 7.1: Number of cancer deaths by primary site and sex, 2015

ICD-10	Site	Males	Females	Total
C00-96	All sites	5 915	5 029	10 944
C00-14	Mouth, pharynx	112	54	166
C00	Lip	3	1	4
C01-02	Tongue	24	16	40
C03-06	Mouth, other	24	19	43
C07-08	Salivary glands	14	8	22
C09-14	Pharynx	47	10	57
C15-26	Digestive organs	1 794	1 552	3 346
C15	Oesophagus	160	56	216
C16	Stomach	204	121	325
C17	Small intestine	23	22	45
C18	Colon	547	605	1 152
C19-20	Rectum, rectosigmoid	258	164	422
C21	Anus	6	10	16
C22	Liver	166	96	262
C23-24	Gallbladder, bile ducts	24	55	79
C25	Pancreas	376	385	761
C26	Other digestive organs	30	38	68
C30-34, C38	Respiratory organs	1 241	1 002	2 243
C30-31	Nose, sinuses	8	2	10
C32	Larynx, epiglottis	34	10	44
C33-34	Lung, trachea	1 191	984	2 175
C38	Heart, mediastinum and pleura	8	6	14
C40-41	Bone	11	8	19
C43	Melanoma of the skin	201	129	330
C44	Skin, non-melanoma	23	26	49
C45	Mesothelioma	47	10	57
C47	Autonomic nervous system	0	0	0
C48-49	Soft tissues	32	43	75
C50	Breast	6	585	591
C51-58	Female genital organs	0	563	563
C51-52, C57.7-9	Other female genital	0	45	45
C53	Cervix uteri	0	79	79
C54	Corpus uteri	0	67	67
C55	Uterus, other	0	72	72
C56, C57.0-4	Ovary etc.	0	299	299
C58	Placenta	0	1	1
C60-63	Male genital organs	1 061	0	1 061
C61	Prostate	1 045	0	1 045
C62	Testis	5	0	5
C60, C63	Other male genital	11	0	11
C64-68	Urinary organs	382	181	563
C64	Kidney (excl. renal pelvis)	146	76	222
C65-68	Urinary tract	236	105	341
C69	Eye	0	3	3
C70-72	Central nervous system	203	165	368
C73	Thyroid gland	19	29	48
C37, C74-75	Other endocrine glands	7	8	15
C39, C76, C80	Other or unspecified	181	214	395
C81-96	Lymphoid/haematopoietic tissue	595	457	1 052
C81	Hodgkin lymphoma	8	6	14
C82-86, C96	Non-Hodgkin lymphoma	189	141	330
C88	Immunoproliferative disease	11	4	15
C90	Multiple myeloma	132	130	262
C91-95	Leukaemia	255	176	431

Chapter 8 Survival

Long-term estimates of survival are becoming increasingly relevant as life expectancy amongst cancer patients increases and cancer care continues to advance^[14]. Table 8.3 gives the 1-year, 5-year, 10-year and 15-year relative survival estimates (with 95% confidence intervals) for the follow-up period 2012–2016 by cancer site and sex. Less frequent cancer diagnoses and groups with low survival will have few cases left especially at 10 and 15 years after diagnosis, and the 95% confidence intervals should be taken into consideration in any interpretation of the relative survival estimates.

Given that cancer patients survive longer, there is a need to communicate information about prognosis not only at the time of diagnosis, but also later because prognosis tends to improve for those surviving the first year(s) after diagnosis^[16].

Figures 8.1–A to 8.1–X depict these two aspects of cancer survival in Norway for all cancers combined and for 23 specific cancer sites. Relative survival estimates are presented by sex and age, 1 to 15 years after diagnosis, with age strata determined specifically according to relevant biological and/or clinical criteria.

For some sites, the cumulative survival curves tend to level off a certain number of years after diagnosis, indicating that from this point forward, the cancer patient group has similar mortality to the group without cancer, or in other words, statistically, these patients appear to be “cured”^[18]. This concept of “statistical cure” involves attributes of survival observed among patients as a group, and should be distinguished from clinical cure, as is determined on the basis of a lack of specific symptoms in an individual.

Estimates of five-year relative survival conditional on being alive 1 to 10 years after diagnosis are included in the sex-specific figures, and better quantify the prognosis of cancer patients at time points beyond the initial diagnosis (Figure 8.1–A to 8.1–X, dashed lines). When conditional five-year relative survival is above 90–95% we usually say that there is little or no excess mortality — analogous to the notion of statistical cure that may be observed in the long-term relative survival estimates.

The overall profile of the sex- and age-specific survival of all cancer patients 1 to 15 years after diagnosis in Norway is presented in Figure 8.1–A. As mentioned in Chapter 9, the combined cancer group is an aggregate of

many different cancer types with different diagnostic and treatment possibilities. Survival estimates will be particularly influenced by PSA testing for prostate cancer and mammographic screening for female breast cancer.

The cumulative five-year relative survival described by cancer site, sex and age, and five-year conditional relative survival by site and age (Figures 8.1–B to 8.1–X) are fairly self-explanatory and highlight the wide variations in patient survival according to these three variables. The 90 percentage-point difference in five-year survival among patients with testicular cancer (Figure 8.1–Q) compared to patients with pancreatic cancer (Figure 8.1–I) strikingly illustrates the wide differential in prognosis according to type of cancer. Long-term survival following diagnosis of melanoma and cancers of the oral cavity, central nervous system and thyroid gland clearly varies between men and women. This may be due to biological or anatomical differences or may relate to sex-specific differences in stage at presentation, subsite or histological type, as well as levels of co-morbidity.

The overall cancer survival tends to diminish with increasing age at diagnosis, yet the age-specific differences are rather narrow for colon cancer (Figure 8.1–E) relative to, for example, cervix cancer (Figure 8.1–M) or non-Hodgkin lymphoma (Figure 8.1–W). For certain cancers, including breast and corpus uteri cancer, long-term survival among patients diagnosed under the age of 50 are slightly lower than for patients diagnosed at the age 50–59. This in part represents the diagnosis of more aggressive tumours in the younger age group, and, for breast cancer, the impact of screening in the older group.

The figures also illustrate a positive aspect of cancer survival; cancer patients who are alive a certain time after diagnosis show good prospects of surviving their cancer and being cured. In fact, for more than two-thirds of the cancer groups, the five-year conditional relative survival reaches 90% 2–5 years after diagnosis. In general terms, this means that survivors of these cancers will, within a few years of diagnosis, have mortality rates similar to that of the general population, and would be considered (statistically) cured. The extent to which survivors may be considered cured does however vary; five-year conditional survival from breast cancer reaches 90% 1 year after diagnosis (Figure 8.1–L) and slowly increases to about 93% 10 years from diagnosis. As is evident from the continual decline in long-term breast cancer cumu-

lative survival, there remains a persistent excess mortality for women with this disease.

Tables 8.1 and 8.2 provides the five-year relative survival estimates over the last four decades by stage and cancer site for males and females, respectively. While the stage-

specific count of cases by five-year period of diagnosis in Tables 5.21 and 5.22 are not equivalent to the size of the patient groups used in the survival calculations, the numbers do provide a reasonable indication of the absolute number of patients involved in the survival analyses at different time periods and their relative distribution.

Table 8.1: Five-year relative survival by primary site, stage and period of diagnosis, 1977–2016, **males**

ICD-10	Site	Stage	Relative survival (%)							
			1977–81	1982–86	1987–91	1992–96	1997–01	2002–06	2007–11	2012–16*
C00–96	All sites	Total	40.7	43.6	46.7	51.9	57.8	62.7	69.0	72.2
C00–14	Mouth, pharynx	Total	59.6	57.4	57.2	55.5	54.4	55.2	65.0	67.2
		Localised	79.8	77.7	80.6	81.8	78.9	79.0	83.2	84.9
		Regional	24.0	26.6	27.4	28.1	34.5	39.8	52.0	60.0
		Distant	-	-	-	13.4	5.6	13.5	9.8	7.2
		Unknown	-	-	35.5	53.3	56.1	60.3	74.4	55.9
C15	Oesophagus	Total	2.1	4.7	5.0	5.8	7.3	8.5	13.9	18.8
		Localised	2.7	7.2	11.7	15.4	26.4	22.5	32.7	46.9
		Regional	2.2	6.9	4.3	4.1	7.2	12.1	14.8	23.4
		Distant	0.8	0.0	0.5	0.8	0.6	0.0	1.6	3.9
		Unknown	-	-	3.6	3.5	7.9	4.9	16.7	14.7
C16	Stomach	Total	17.8	16.9	19.3	17.7	19.0	20.3	24.5	25.6
		Localised	41.7	39.2	50.5	58.3	56.1	57.0	60.4	65.2
		Regional	20.3	18.9	20.2	17.2	20.9	21.7	24.7	31.4
		Distant	1.4	1.5	0.8	0.6	2.0	1.5	3.7	2.8
		Unknown	2.3	6.3	4.6	9.7	19.8	27.5	24.6	16.0
C18	Colon	Total	43.5	47.9	47.2	51.5	55.5	57.4	60.0	62.0
		Localised	70.3	77.8	76.3	85.2	93.3	87.6	90.3	90.5
		Regional	53.4	55.3	56.4	62.7	68.6	72.0	77.6	79.9
		Distant	6.0	4.6	4.4	4.1	6.8	8.1	12.4	13.8
		Unknown	12.8	32.3	26.6	31.2	55.5	56.0	44.6	22.8
C19–20	Rectum, rectosigmoid	Total	41.2	43.7	47.3	51.1	57.4	60.5	65.7	68.5
		Localised	61.0	66.5	71.8	80.7	85.1	86.9	90.7	94.6
		Regional	37.6	39.3	45.6	52.4	65.5	69.6	79.9	81.6
		Distant	3.5	2.7	3.9	3.5	10.3	11.6	16.0	17.8
		Unknown	26.8	28.3	33.3	28.0	50.5	58.0	47.2	39.1
C22	Liver	Total	4.2	2.7	4.2	8.0	7.1	7.3	15.7	16.2
		Localised	5.9	5.0	7.8	16.1	19.9	12.6	27.9	38.2
		Regional	-	-	-	-	-	-	6.3	-
		Distant	3.3	0.0	-	-	0.0	2.8	2.4	-
		Unknown	-	-	2.2	3.9	2.6	7.4	14.6	9.6
C23–24	Gallbladder, bile ducts	Total	8.4	12.8	11.2	9.5	15.7	15.8	17.5	19.6
		Localised	11.4	26.7	16.9	20.1	-	44.4	29.2	51.0
		Regional	-	-	-	-	22.6	14.5	25.4	24.6
		Distant	2.6	1.5	1.6	1.9	1.9	3.8	2.5	-
		Unknown	-	-	-	1.3	14.9	10.8	-	-
C25	Pancreas	Total	1.6	1.5	1.8	2.5	2.6	5.2	5.8	8.0
		Localised	2.7	3.3	3.5	9.5	8.8	20.5	24.4	40.6
		Regional	3.7	1.6	5.9	6.1	5.4	6.5	9.1	11.4
		Distant	0.5	0.3	1.0	0.9	1.3	2.6	2.0	2.2
		Unknown	5.1	4.6	0.5	1.8	2.3	4.2	8.6	12.2
C33–34	Lung, trachea	Total	6.1	7.5	7.3	8.1	8.9	10.3	13.0	16.0
		Localised	13.8	17.4	16.1	22.5	33.7	41.1	44.6	53.3
		Regional	5.9	8.0	9.4	8.4	9.3	11.8	15.4	19.4
		Distant	0.7	0.5	0.8	0.5	0.7	1.1	1.9	1.8
		Unknown	4.0	3.0	5.6	5.8	8.0	11.2	12.2	8.9
C43	Melanoma of the skin	Total	61.0	66.9	69.0	75.6	75.4	75.5	78.6	83.7
		Localised	69.4	75.3	76.9	81.9	85.9	83.6	87.1	89.9
		Regional	20.2	30.0	35.0	37.0	40.0	38.2	38.9	53.1
		Distant	8.8	1.7	8.2	15.0	10.3	8.4	12.0	16.1
		Unknown	-	-	36.8	67.8	71.6	79.5	73.0	55.2
C61	Prostate	Total	56.5	56.4	59.1	68.0	79.8	85.1	91.7	93.6
		Localised	71.7	72.9	73.5	79.8	95.4	96.2	100.8	101.6
		Regional	40.3	41.4	54.7	63.5	74.1	82.1	93.1	94.0
		Distant	19.2	20.7	24.6	24.1	25.8	30.0	36.5	36.8
		Unknown	40.4	52.3	65.0	71.3	83.2	87.5	94.4	97.7

Continued on next page

Table 8.1: Five-year relative survival by primary site, stage and period of diagnosis, 1977–2016, **males** (Continued)

ICD-10	Site	Stage	Relative survival (%)							
			1977–81	1982–86	1987–91	1992–96	1997–01	2002–06	2007–11	2012–16*
C62	Testis	Total	84.9	92.4	94.9	96.0	96.4	97.0	98.1	98.6
		Localised	96.6	98.0	98.3	99.2	99.2	99.8	99.3	99.4
		Regional	89.0	95.6	96.3	96.8	97.8	95.0	97.0	97.9
		Distant	47.3	67.0	77.0	74.8	77.4	82.6	90.2	89.8
		Unknown	-	-	-	-	100.5	97.7	100.0	-
C64	Kidney (excl. renal pelvis)	Total	37.8	41.7	43.7	52.0	52.1	60.3	66.6	73.7
		Localised	68.0	71.4	69.5	76.9	79.8	85.0	86.8	89.6
		Regional	48.4	44.2	50.7	53.0	53.9	54.3	58.6	63.7
		Distant	4.1	6.8	6.0	6.2	7.1	8.8	9.3	10.5
		Unknown	-	-	50.9	33.4	56.9	68.8	70.0	43.7
C65–68	Urinary tract	Total	59.5	64.6	66.5	69.7	68.5	71.8	73.4	76.7
		Localised	68.6	72.2	72.8	76.1	79.3	84.3	82.6	83.6
		Regional	27.4	22.6	28.6	24.7	26.7	27.9	30.1	31.3
		Distant	0.0	3.9	7.7	7.0	4.8	5.4	5.1	-
		Unknown	31.1	62.9	66.9	67.2	67.3	71.9	72.7	77.0
C70–72	Central nervous system	Total	29.2	36.0	38.0	46.4	52.9	60.8	60.4	61.3
		Non-malignant	56.7	74.2	73.3	80.9	90.5	92.5	91.9	94.8
		Malignant	18.1	19.6	24.3	22.1	20.7	23.8	25.6	27.2
C73	Thyroid gland	Total	77.8	77.4	76.8	75.0	79.3	83.1	85.9	89.6
		Localised	94.0	96.4	90.9	99.4	98.0	97.2	100.0	102.7
		Regional	80.5	79.6	85.6	88.1	80.1	89.6	90.5	88.4
		Distant	-	-	-	-	-	-	-	-
		Unknown	-	-	-	-	-	-	-	-
C81	Hodgkin lymphoma	Total	59.1	66.4	75.1	81.1	86.2	84.8	84.5	85.8
C82–86, C96	Non-Hodgkin lymphoma	Total	40.0	41.5	43.5	47.5	50.7	59.9	67.5	72.6
C91–95	Leukaemia	Total	23.3	27.2	35.1	42.0	49.2	54.3	60.0	61.8

* For 2012–16 the 5-year relative survival estimates are based on the period approach (observation window 2012–16)

- Not estimated due to too few patients (see Chapter 4).

Table 8.2: Five-year relative survival by primary site, stage and period of diagnosis, 1977–2016, **females**

ICD-10	Site	Stage	Relative survival (%)							
			1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16*
C00-96	All sites	Total	50.7	53.1	56.2	58.9	62.2	65.6	69.0	71.6
C00-14	Mouth, pharynx	Total	57.7	56.4	62.6	61.1	58.2	65.5	72.2	73.7
		Localised	73.9	71.5	77.5	80.6	84.1	79.2	86.7	88.1
		Regional	31.4	39.0	40.9	36.1	38.1	49.8	54.4	58.2
		Distant	-	-	-	-	-	-	-	-
		Unknown	-	-	-	51.4	54.9	79.4	83.6	74.6
C15	Oesophagus	Total	11.4	7.3	9.2	10.4	8.4	8.7	14.4	18.7
		Localised	16.1	10.6	15.1	-	-	20.1	33.8	41.8
		Regional	-	-	-	-	-	8.1	13.4	23.5
		Distant	-	-	-	-	0.0	2.0	0.0	-
		Unknown	-	-	-	7.3	7.6	8.7	10.6	8.8
C16	Stomach	Total	16.3	20.2	21.7	22.1	23.2	23.6	24.1	25.5
		Localised	40.2	46.6	48.4	60.5	68.7	60.9	60.1	62.2
		Regional	16.1	21.0	22.5	27.9	29.8	24.2	22.2	24.9
		Distant	0.8	0.8	1.2	1.8	3.1	3.6	3.4	2.7
		Unknown	9.1	14.0	12.4	7.9	17.8	33.0	27.2	33.2
C18	Colon	Total	42.9	47.7	51.5	53.9	56.9	60.6	63.6	67.3
		Localised	67.5	76.9	80.2	85.4	88.0	93.1	95.2	96.8
		Regional	54.4	55.5	60.9	63.9	69.9	72.9	79.5	82.8
		Distant	4.4	3.9	4.5	5.5	8.3	11.3	13.4	16.0
		Unknown	23.8	20.0	30.4	41.9	53.7	60.0	40.4	20.5
C19-20	Rectum, rectosigmoid	Total	43.3	48.1	51.3	57.6	59.3	64.2	66.4	67.2
		Localised	65.6	72.9	73.8	86.4	93.0	90.9	95.7	96.1
		Regional	36.1	44.1	49.7	59.3	63.9	71.5	77.2	77.6
		Distant	6.2	4.3	2.0	5.3	7.1	11.3	18.4	20.6
		Unknown	-	28.4	42.6	42.5	53.6	63.5	47.9	36.4
C22	Liver	Total	1.2	6.5	7.5	8.6	7.6	13.5	17.2	22.6
		Localised	2.6	11.1	13.0	12.2	-	26.1	31.7	42.0
		Regional	-	-	-	-	-	-	-	5.6
		Distant	0.0	2.2	-	-	-	-	3.4	-
		Unknown	-	-	-	10.7	5.4	13.0	11.6	19.8
C23-24	Gallbladder, bile ducts	Total	10.6	11.8	9.6	9.4	12.5	11.8	16.5	18.5
		Localised	22.8	28.0	16.8	30.1	-	23.3	38.1	39.7
		Regional	10.5	10.6	13.4	12.4	17.6	20.3	26.4	30.1
		Distant	1.5	0.0	0.0	0.0	1.9	0.0	1.4	1.3
		Unknown	-	-	8.5	6.4	10.7	8.6	-	-
C25	Pancreas	Total	2.3	1.7	2.4	3.5	3.7	3.9	6.9	8.5
		Localised	2.8	4.0	6.3	13.0	21.0	17.2	29.6	43.0
		Regional	8.2	2.7	3.3	6.1	2.8	4.9	8.0	11.3
		Distant	1.1	0.7	0.3	1.0	0.9	1.6	2.3	2.1
		Unknown	0.0	0.9	3.4	2.5	5.6	5.1	8.1	3.5
C33-34	Lung, trachea	Total	10.8	7.0	9.6	11.4	11.8	14.3	18.3	22.0
		Localised	23.4	20.3	25.1	33.5	45.3	51.8	55.8	63.2
		Regional	13.5	6.4	9.9	12.8	11.9	14.7	19.9	24.7
		Distant	1.6	0.5	1.2	1.2	1.3	1.9	2.5	3.0
		Unknown	8.9	6.7	7.1	5.7	14.6	19.0	18.4	15.2
C43	Melanoma of the skin	Total	79.9	82.2	87.6	86.9	88.7	87.3	88.4	90.1
		Localised	85.6	88.1	91.8	91.1	94.8	93.8	93.3	93.5
		Regional	-	43.9	43.1	52.4	56.7	53.9	56.2	62.7
		Distant	11.0	5.2	17.2	20.3	19.4	22.2	30.7	34.8
		Unknown	-	76.0	67.7	80.7	89.3	86.4	83.8	69.2

Continued on next page

Table 8.2: Five-year relative survival by primary site, stage and period of diagnosis, 1977–2016, **females** (Continued)

ICD-10	Site	Stage	Relative survival (%)							
			1977-81	1982-86	1987-91	1992-96	1997-01	2002-06	2007-11	2012-16*
C50	Breast	Total	72.5	73.8	75.4	78.6	84.6	87.0	88.6	89.7
		I	86.8	86.9	94.3	96.0	97.9	99.1	100.4	100.3
		II	63.3	67.9	73.8	77.6	85.0	88.5	92.1	93.4
		III	48.8	50.1	46.6	56.7	61.5	65.5	75.6	77.6
		IV	15.4	14.9	20.6	18.5	17.7	19.9	25.9	28.5
		Unknown	75.6	84.9	84.9	84.9	88.5	81.1	70.4	72.9
C53	Cervix uteri	Total	72.4	70.3	69.0	72.8	74.9	77.8	79.0	80.5
		I	87.2	85.8	83.8	84.9	91.0	93.3	91.4	90.1
		II	60.7	55.7	59.7	59.6	61.1	77.3	77.1	78.6
		III	37.6	30.4	27.3	42.6	40.4	50.6	53.0	60.2
		IV	4.6	10.5	31.0	26.7	14.9	19.9	27.6	34.8
		Unknown	-	-	-	-	-	62.7	-	-
C54	Corpus uteri	Total	72.6	70.3	72.5	76.1	79.5	81.1	83.3	84.0
		Localised	82.5	82.0	83.7	88.1	91.5	91.6	94.7	95.7
		Regional	61.1	53.7	63.4	70.0	72.5	73.9	67.7	61.0
		Distant	17.7	23.5	25.3	35.5	32.2	38.3	39.7	38.1
		Unknown	-	42.7	56.2	51.3	80.0	83.9	75.5	65.8
C56, C57.0-57.4	Ovary etc.	Total	34.7	34.3	36.7	38.1	43.5	43.2	45.5	48.7
		Localised	76.8	77.5	80.4	83.9	91.5	82.9	89.0	93.7
		Regional	41.5	45.1	48.4	50.4	58.8	72.4	62.6	63.9
		Distant	17.2	15.5	17.8	20.6	27.9	30.0	32.0	35.3
		Unknown	-	35.8	31.0	40.6	60.0	61.2	52.0	46.4
C64	Kidney (excl. renal pelvis)	Total	41.4	44.8	51.7	52.9	56.2	63.1	71.6	74.8
		Localised	71.8	70.0	78.0	76.6	86.4	86.7	89.0	90.0
		Regional	45.7	49.3	49.1	51.6	48.5	48.9	47.7	51.3
		Distant	2.4	7.2	8.6	2.8	12.8	11.1	16.4	11.4
		Unknown	-	-	18.5	41.3	56.6	63.6	80.6	51.6
C65-68	Urinary tract	Total	49.0	56.3	60.2	60.2	60.4	61.6	65.7	69.3
		Localised	63.6	67.7	70.1	71.5	80.8	78.2	77.2	77.7
		Regional	12.0	15.3	17.8	21.0	27.2	21.0	22.7	27.5
		Distant	2.0	7.3	2.3	7.0	3.4	7.0	7.2	5.3
		Unknown	22.4	43.0	59.9	52.5	57.2	60.0	69.1	69.0
C70-72	Central nervous system	Total	41.5	50.3	56.1	60.9	69.3	75.7	77.0	76.4
		Non-malignant	73.2	84.0	82.7	87.9	90.9	93.6	95.2	96.3
		Malignant	16.6	21.3	28.2	24.6	26.4	27.4	27.9	29.6
C73	Thyroid gland	Total	85.8	86.3	88.6	90.4	87.3	90.0	92.6	94.2
		Localised	94.2	94.2	95.3	98.6	104.1	102.6	101.1	101.6
		Regional	83.4	80.3	87.3	87.9	82.7	87.9	90.6	92.7
		Distant	46.4	-	-	-	-	-	-	-
		Unknown	-	-	-	-	84.4	87.2	82.4	70.9
C81	Hodgkin lymphoma	Total	70.6	68.2	75.6	78.8	86.7	82.3	84.9	87.9
C82-86, C96	Non-Hodgkin lymphoma	Total	43.9	46.5	55.2	50.2	55.4	65.1	73.2	77.1
C91-95	Leukaemia	Total	26.8	27.4	36.0	45.0	50.4	58.2	64.7	67.2

* For 2012–16 the 5-year relative survival estimates are based on the period approach (observation window 2012–16)

- Not estimated due to too few patients (see Chapter 4).

Table 8.3: 1-, 5-, 10-, and 15-year relative survival proportion (95% confidence interval) by primary site and sex, period approach follow-up, 2012–2016

ICD-10	Site	Sex	1-year	5-year	10-year	15-year
C00–14	Mouth, pharynx	M	84.7 (82.8–86.3)	67.2 (64.3–69.8)	55.3 (51.2–59.2)	48.7 (42.4–54.7)
		F	87.9 (85.4–90.0)	73.7 (69.8–77.2)	64.1 (58.6–69.0)	53.4 (43.9–62.0)
C15	Oesophagus	M	46.9 (43.8–49.9)	18.8 (16.1–21.7)	14.6 (11.4–18.1)	11.6 (7.4–16.8)
		F	45.5 (40.4–50.5)	18.7 (14.2–23.7)	-	-
C16	Stomach	M	53.1 (50.6–55.6)	25.6 (23.1–28.1)	21.8 (18.9–24.9)	20.3 (16.3–24.6)
		F	50.1 (46.7–53.4)	25.5 (22.3–28.8)	22.9 (19.3–26.7)	21.8 (16.4–27.8)
C18	Colon	M	80.7 (79.6–81.7)	62.0 (60.3–63.5)	56.6 (54.2–59.0)	51.4 (46.8–55.7)
		F	82.1 (81.1–83.0)	67.3 (65.8–68.8)	62.6 (60.2–64.9)	58.4 (53.3–63.1)
C19–20	Rectum, rectosigmoid	M	88.5 (87.4–89.6)	68.5 (66.5–70.4)	60.0 (57.0–62.8)	58.4 (53.1–63.2)
		F	87.4 (85.9–88.7)	67.2 (64.9–69.3)	63.8 (60.7–66.7)	58.3 (53.7–62.7)
C22	Liver	M	39.8 (36.0–43.5)	16.2 (13.3–19.4)	-	-
		F	47.4 (42.6–52.0)	22.6 (17.8–27.8)	19.8 (14.3–26.1)	-
C23–24	Gallbladder, bile ducts	M	57.0 (51.6–62.0)	19.6 (15.2–24.4)	19.8 (14.4–25.8)	18.7 (10.6–28.8)
		F	45.0 (40.4–49.4)	18.5 (14.7–22.7)	17.7 (13.1–22.9)	-
C25	Pancreas	M	28.3 (26.3–30.3)	8.0 (6.6–9.6)	5.7 (4.3–7.3)	-
		F	27.1 (25.2–29.1)	8.5 (7.1–10.0)	7.0 (5.5–8.6)	-
C33–34	Lung, trachea	M	41.2 (40.1–42.3)	16.0 (15.1–16.9)	9.7 (8.8–10.7)	6.8 (5.7–8.2)
		F	49.1 (47.9–50.3)	22.0 (20.9–23.1)	15.0 (13.8–16.3)	11.3 (9.7–13.1)
C43	Melanoma of the skin	M	95.8 (94.9–96.5)	83.7 (81.9–85.3)	78.3 (75.1–81.1)	70.0 (64.1–75.1)
		F	97.8 (97.2–98.3)	90.1 (88.6–91.4)	87.2 (84.8–89.3)	86.0 (81.8–89.3)
C50	Breast	F	98.0 (97.7–98.3)	89.7 (89.0–90.4)	82.0 (80.9–83.0)	76.6 (75.2–78.0)
C53	Cervix uteri	F	92.7 (91.3–93.9)	80.5 (78.4–82.4)	75.8 (73.5–78.0)	71.4 (68.9–73.8)
C54	Corpus uteri	F	93.7 (92.8–94.6)	84.0 (82.3–85.5)	80.6 (78.0–82.9)	78.7 (74.1–82.5)
C56, C57.0–57.4	Ovary etc.	F	80.4 (78.8–82.0)	48.7 (46.5–50.9)	37.2 (34.9–39.5)	33.1 (30.5–35.7)
C61	Prostate	M	99.2 (99.0–99.4)	93.6 (92.9–94.2)	85.2 (84.0–86.2)	74.6 (72.6–76.5)
C62	Testis	M	99.1 (98.4–99.5)	98.6 (97.4–99.2)	98.6 (96.9–99.4)	98.2 (95.8–99.3)
C64	Kidney (excl. renal pelvis)	M	87.7 (86.3–89.0)	73.7 (71.5–75.8)	62.5 (59.2–65.6)	55.3 (50.2–60.0)
		F	87.1 (84.9–88.9)	74.8 (71.7–77.6)	68.0 (64.1–71.7)	58.8 (52.9–64.2)
C65–68	Urinary tract	M	89.4 (88.4–90.3)	76.7 (74.9–78.5)	66.8 (63.9–69.6)	59.6 (53.3–65.3)
		F	83.4 (81.6–85.1)	69.3 (66.6–71.9)	66.5 (61.8–70.8)	50.9 (43.9–57.4)
C70–72	Central nervous system	M	78.7 (77.0–80.3)	61.3 (59.2–63.4)	58.2 (55.6–60.8)	51.5 (48.2–54.7)
		F	86.3 (84.9–87.6)	76.4 (74.5–78.2)	72.7 (70.4–74.8)	69.1 (66.2–71.9)
C73	Thyroid gland	M	93.1 (90.2–95.2)	89.6 (84.8–93.0)	86.5 (77.4–92.1)	87.4 (68.5–95.4)
		F	95.8 (94.3–96.9)	94.2 (92.0–95.8)	91.3 (87.7–93.9)	86.5 (80.8–90.7)
C81	Hodgkin lymphoma	M	93.5 (90.7–95.5)	85.8 (81.8–89.0)	85.0 (80.2–88.7)	80.7 (74.4–85.5)
		F	96.7 (93.7–98.3)	87.9 (83.5–91.1)	85.7 (80.1–89.8)	83.9 (76.7–89.1)
C82–86, C96	Non-Hodgkin lymphoma	M	84.5 (82.9–85.8)	72.6 (70.4–74.7)	61.9 (58.5–65.1)	55.3 (48.6–61.4)
		F	86.8 (85.2–88.2)	77.1 (74.8–79.3)	66.6 (63.4–69.7)	58.1 (52.2–63.5)
C91–95	Leukaemia	M	80.9 (79.3–82.4)	61.8 (59.8–63.8)	48.7 (46.1–51.2)	39.3 (35.3–43.4)
		F	80.6 (78.8–82.3)	67.2 (64.9–69.5)	54.2 (51.2–57.2)	44.6 (39.1–49.9)

- Not estimated due to too few patients (see Chapter 4).

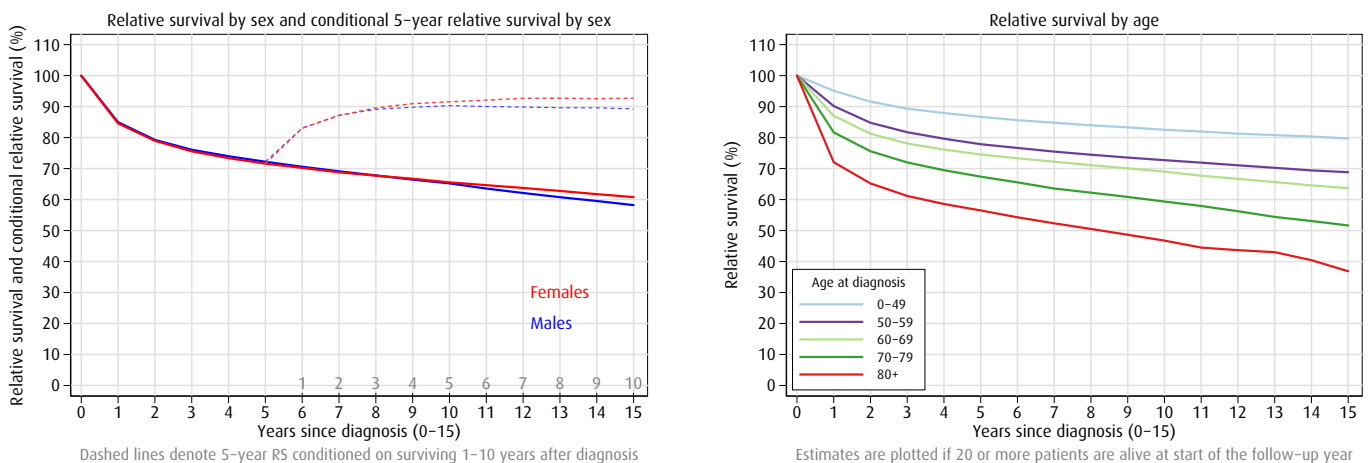
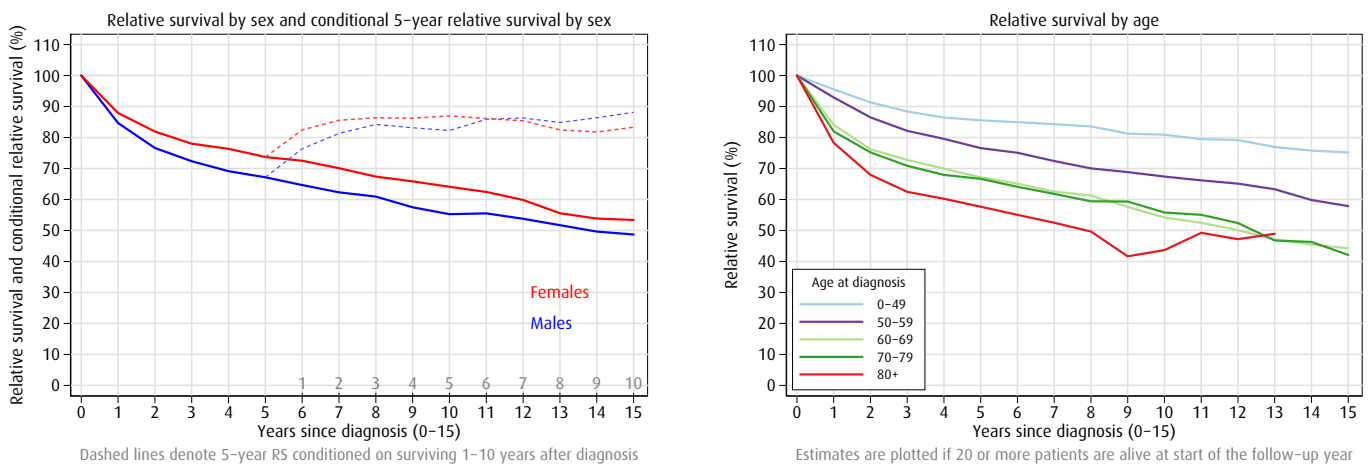
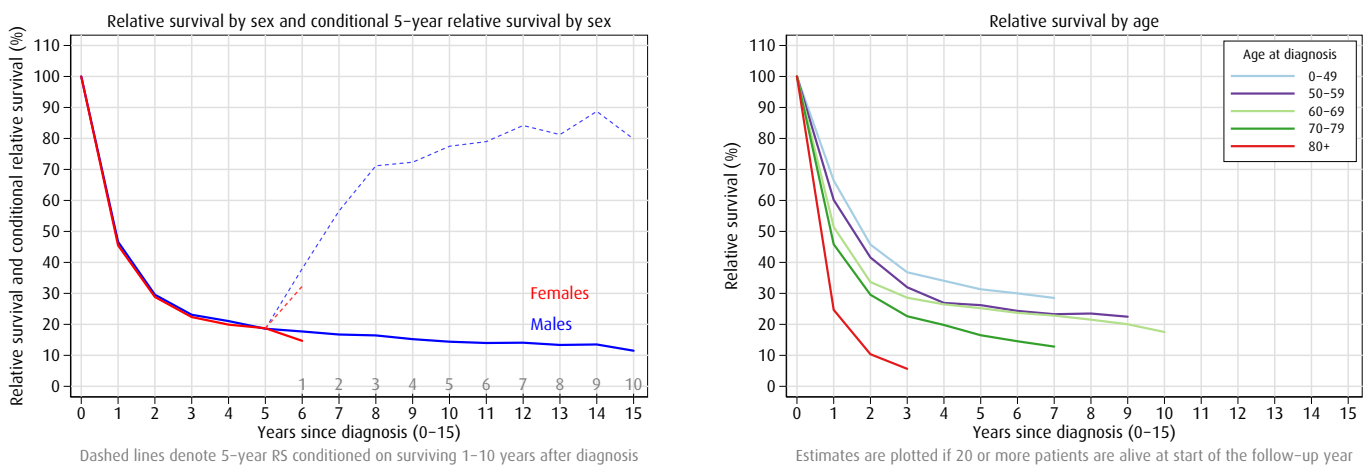
Figure 8.1: Relative survival (RS) up to 15 years after diagnosis by sex and age, 2012–2016**Figure 8.1-A: All sites (ICD-10 C00–96)****Figure 8.1-B: Mouth, pharynx (ICD-10 C00–14)****Figure 8.1-C: Oesophagus (ICD-10 C15)**

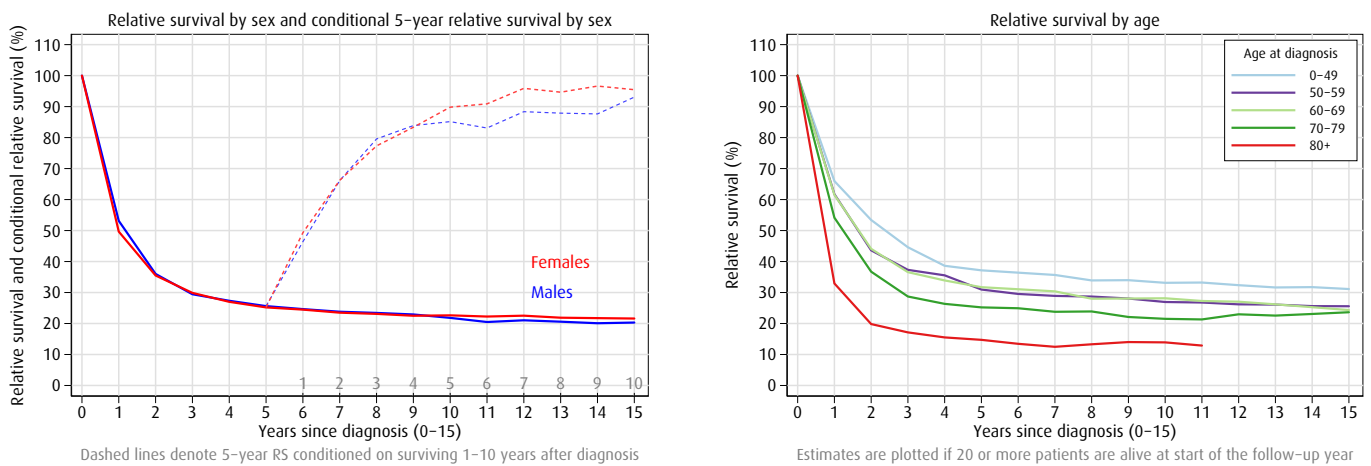
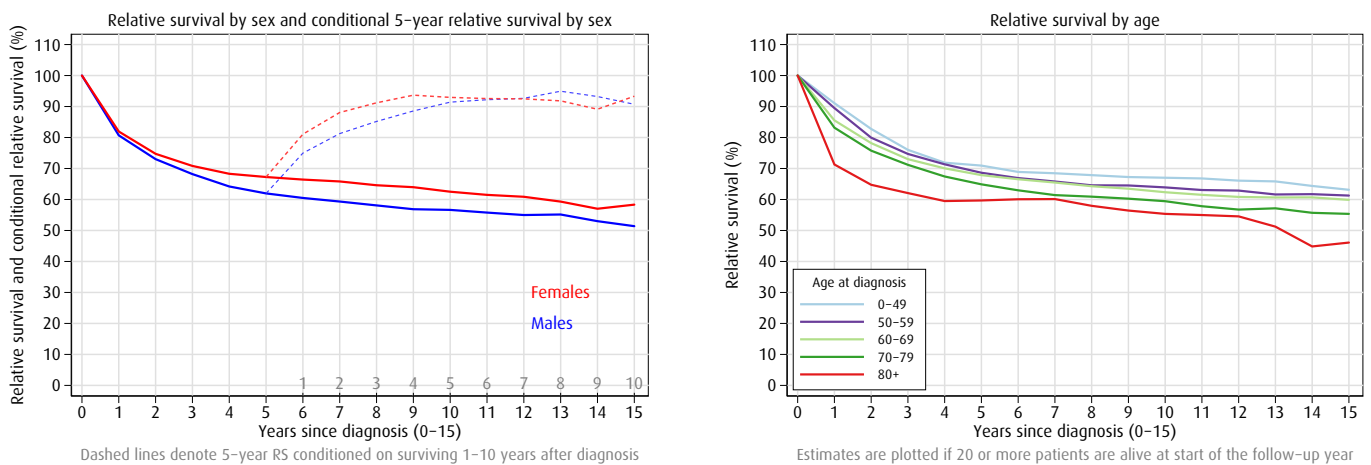
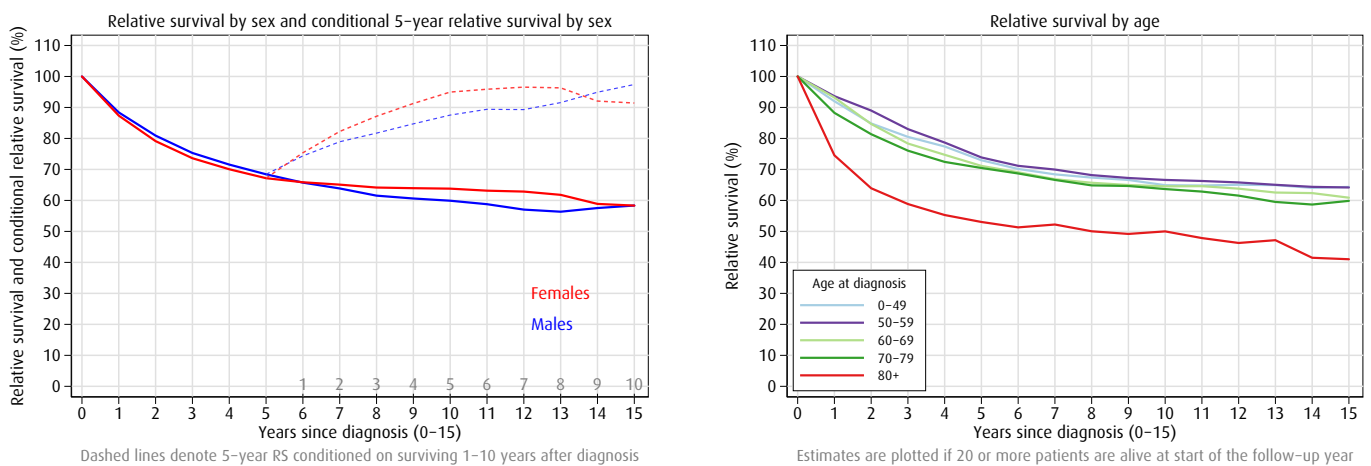
Figure 8.1: Relative survival (RS) up to 15 years after diagnosis by sex and age, 2012–2016**Figure 8.1-D: Stomach (ICD-10 C16)****Figure 8.1-E: Colon (ICD-10 C18)****Figure 8.1-F: Rectum, rectosigmoid (ICD-10 C19–20)**

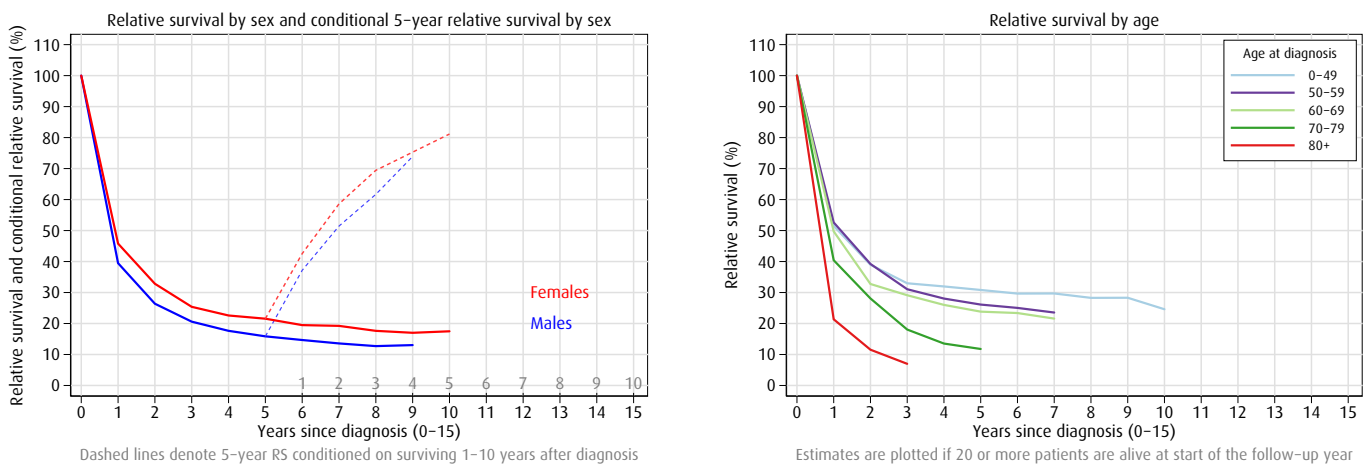
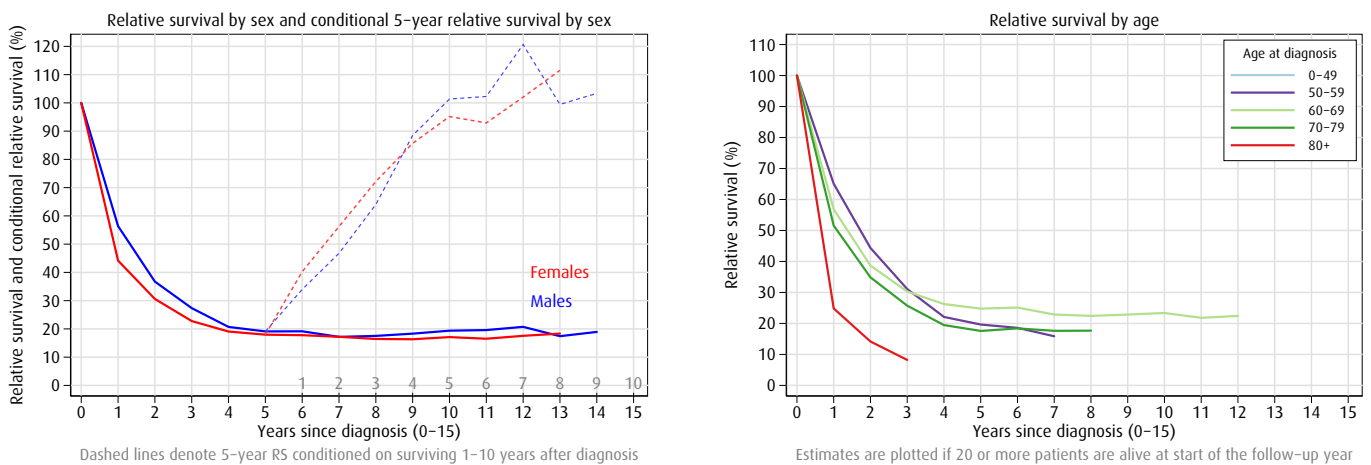
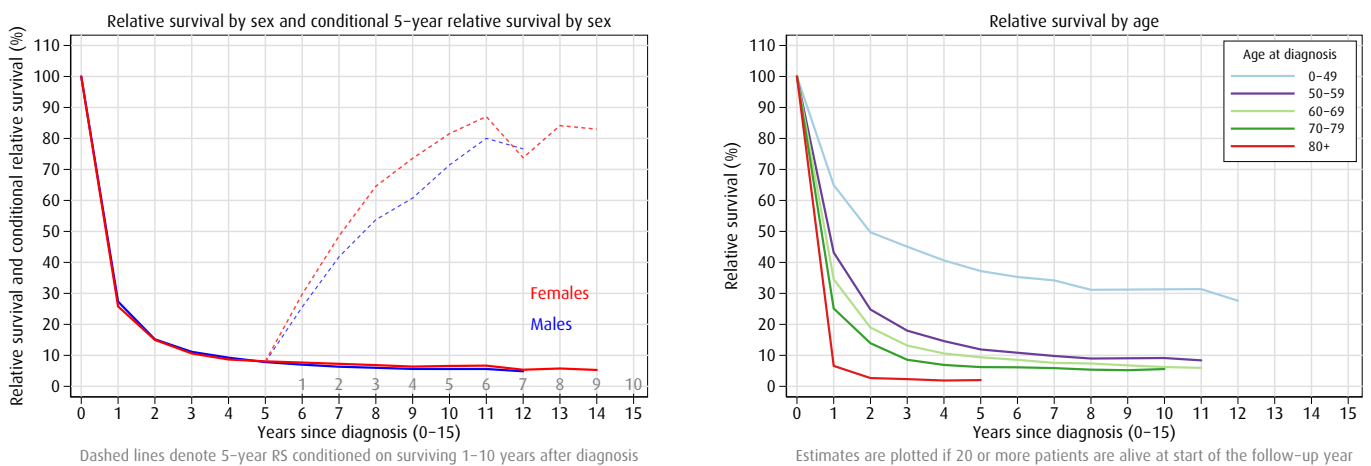
Figure 8.1: Relative survival (RS) up to 15 years after diagnosis by sex and age, 2012–2016**Figure 8.1-G: Liver (ICD-10 C22)****Figure 8.1-H: Gallbladder, bile ducts (ICD-10 C23–24)****Figure 8.1-I: Pancreas (ICD-10 C25)**

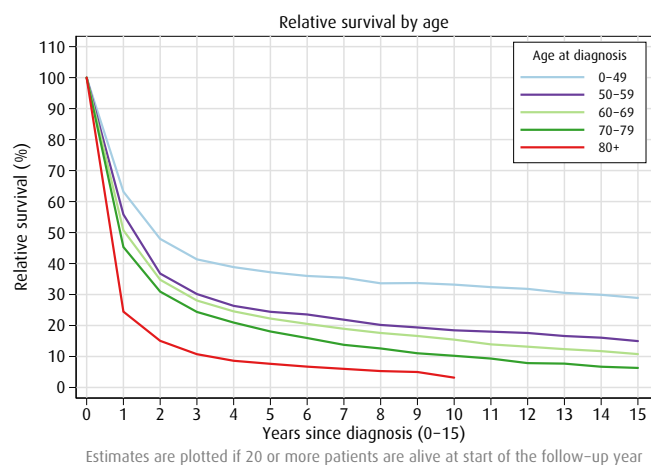
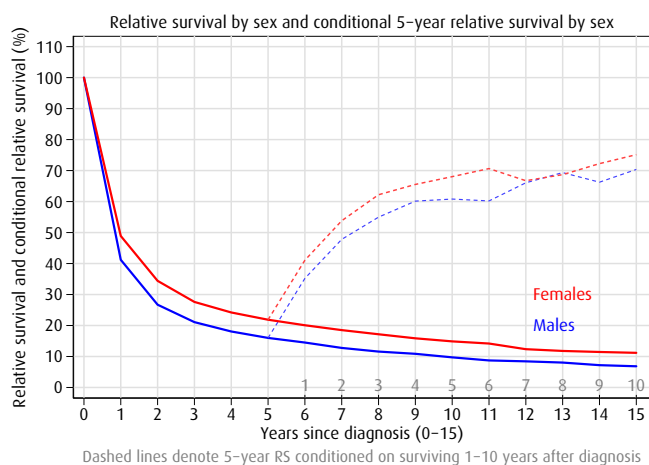
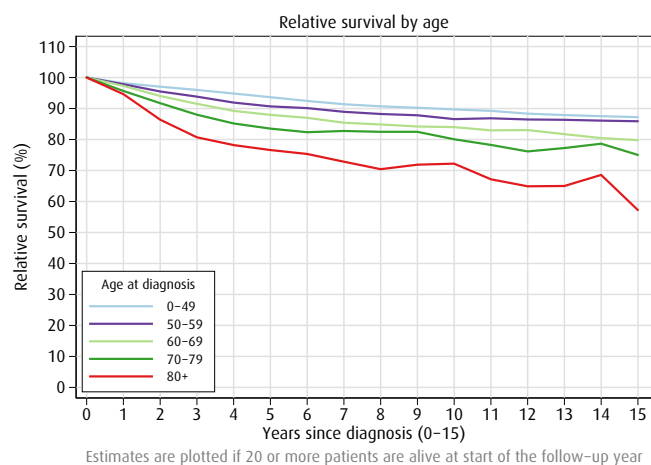
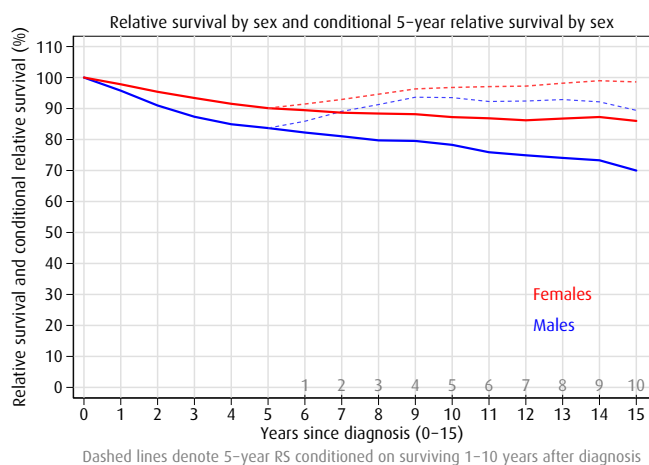
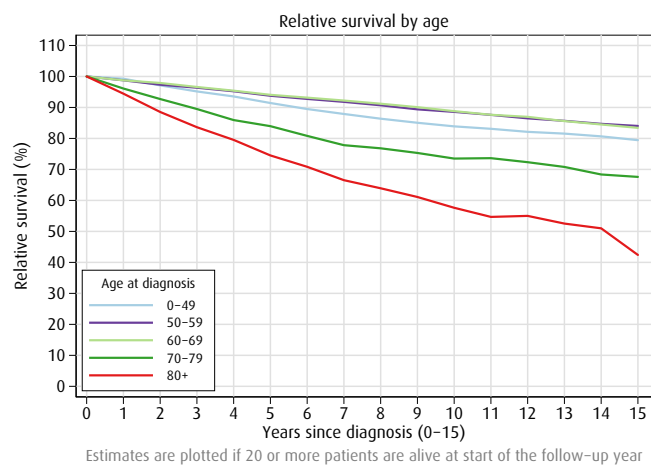
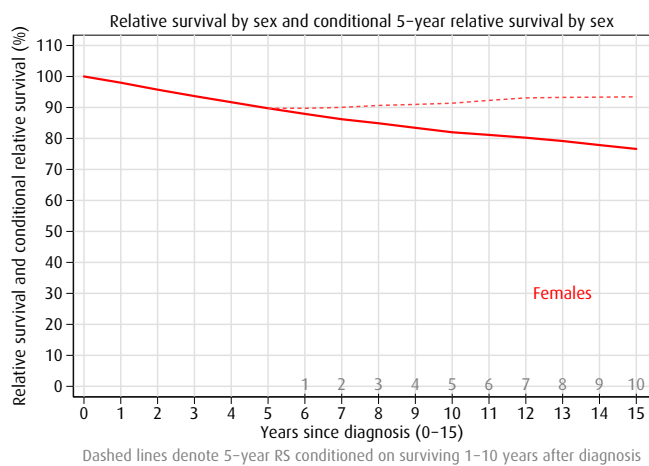
Figure 8.1: Relative survival (RS) up to 15 years after diagnosis by sex and age, 2012–2016**Figure 8.1-J: Lung, trachea (ICD-10 C33–34)****Figure 8.1-K: Melanoma of the skin (ICD-10 C43)****Figure 8.1-L: Breast (ICD-10 C50)**

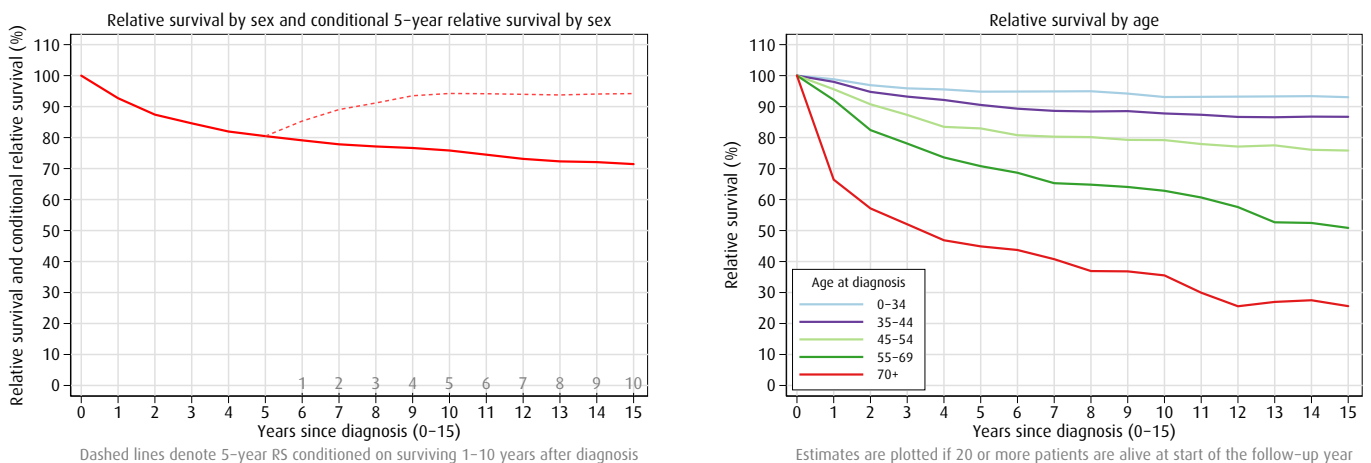
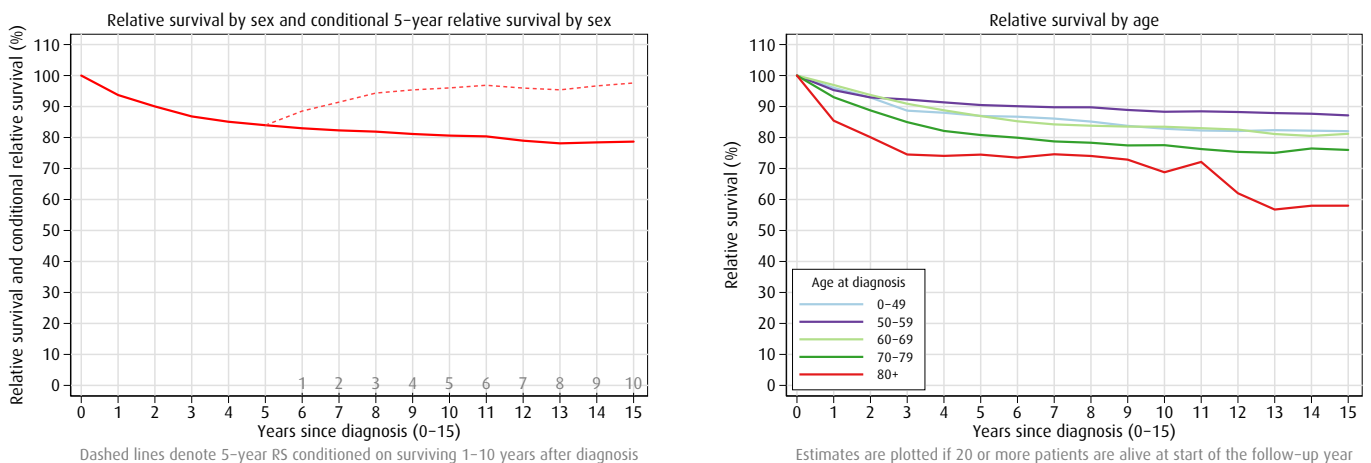
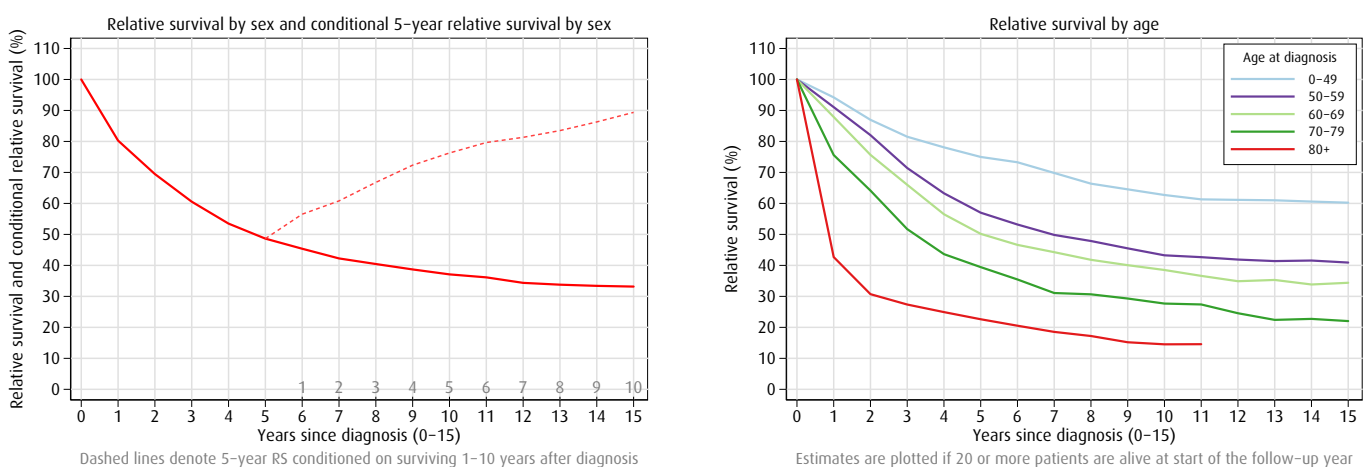
Figure 8.1: Relative survival (RS) up to 15 years after diagnosis by sex and age, 2012–2016**Figure 8.1-M: Cervix uteri (ICD-10 C53)****Figure 8.1-N: Corpus uteri (ICD-10 C54)****Figure 8.1-O: Ovary (ICD-10 C56, C57.0–4)**

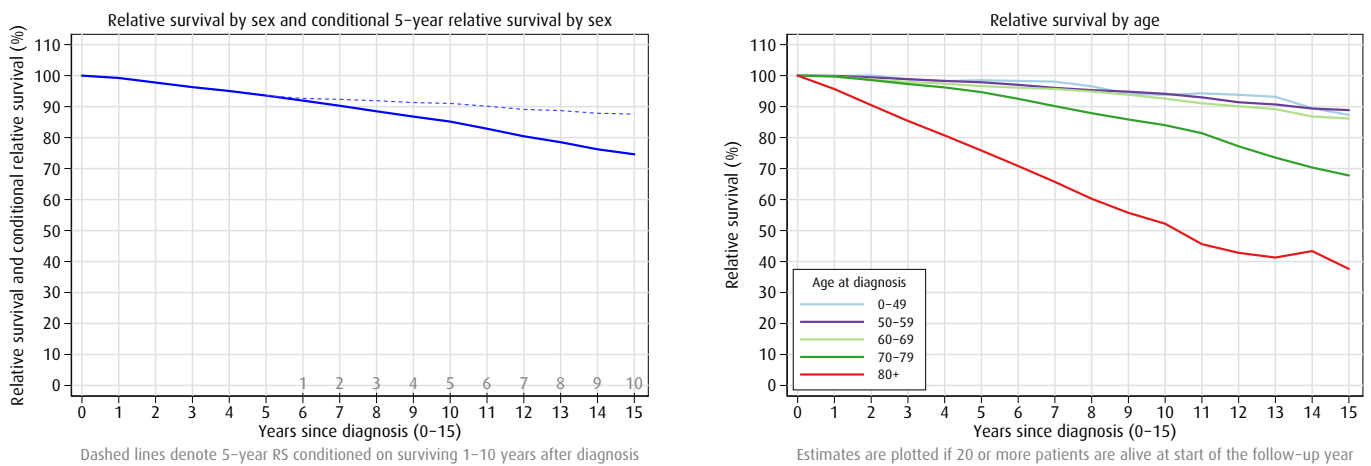
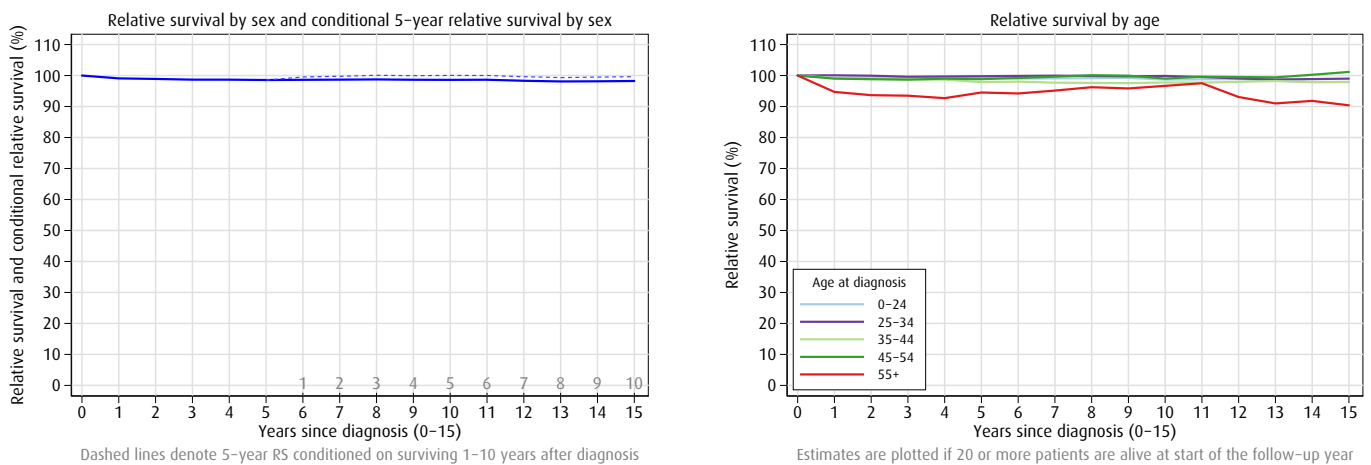
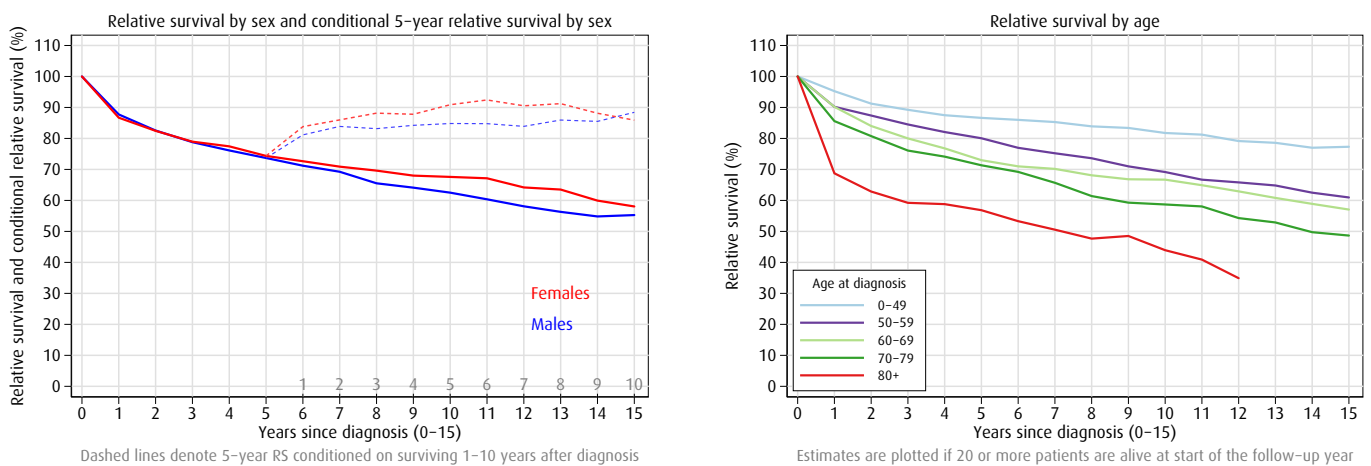
Figure 8.1: Relative survival (RS) up to 15 years after diagnosis by sex and age, 2012–2016**Figure 8.1-P: Prostate (ICD-10 C61)****Figure 8.1-Q: Testis (ICD-10 C62)****Figure 8.1-R: Kidney excluding renal pelvis (ICD-10 C64)**

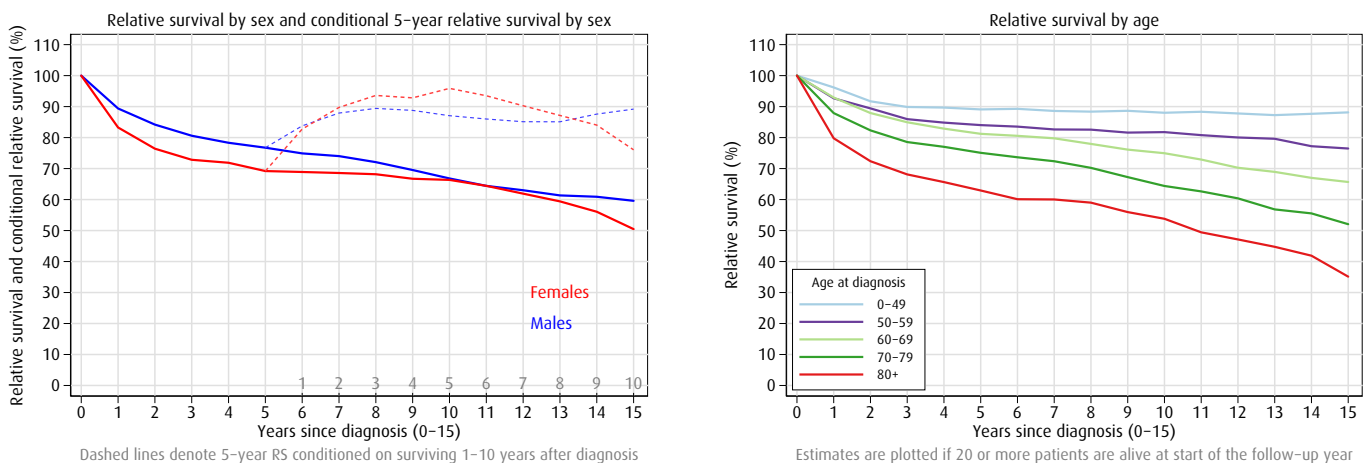
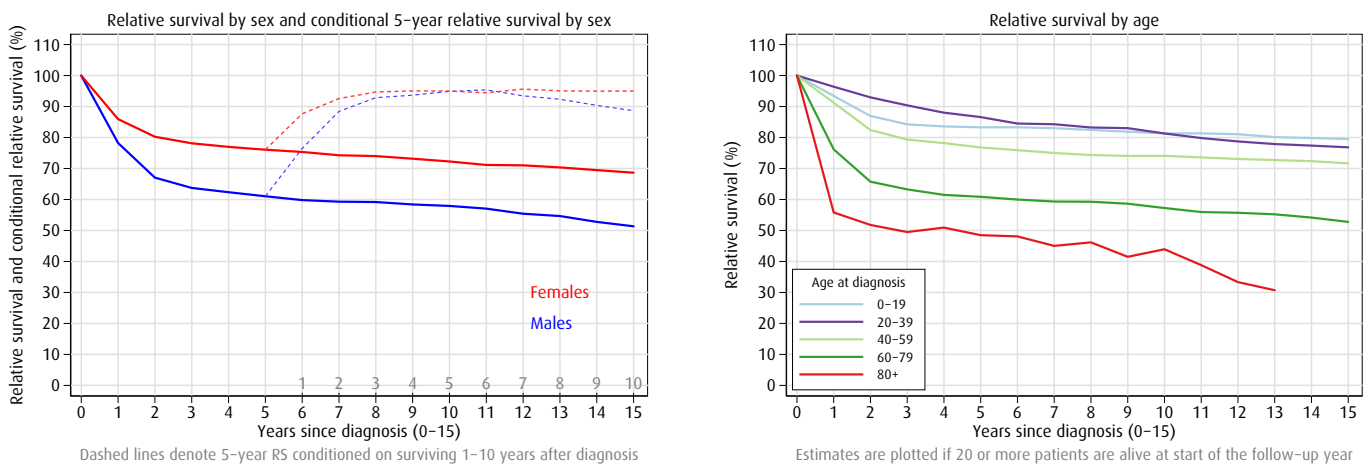
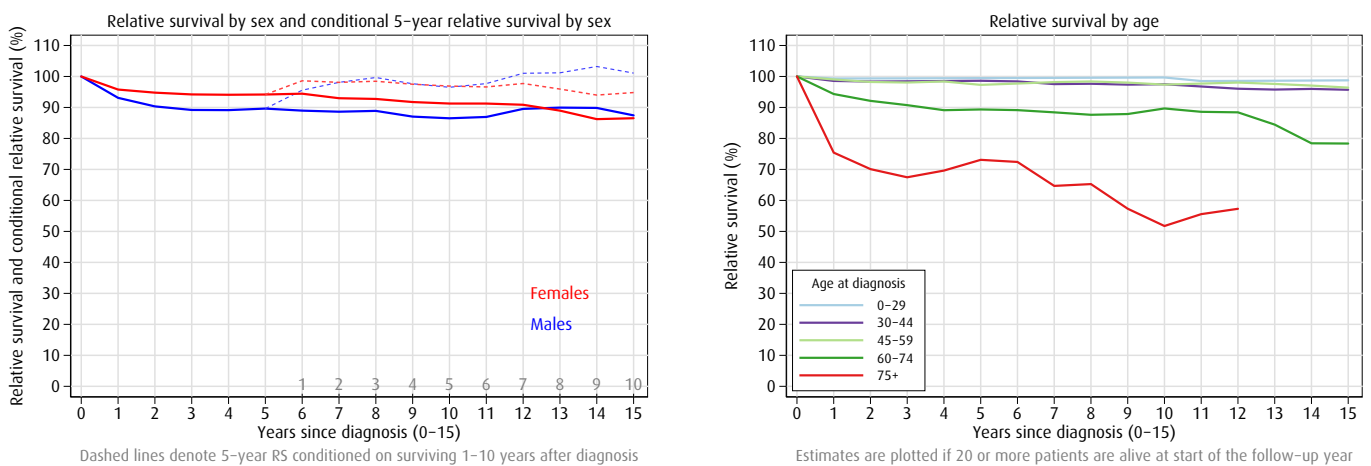
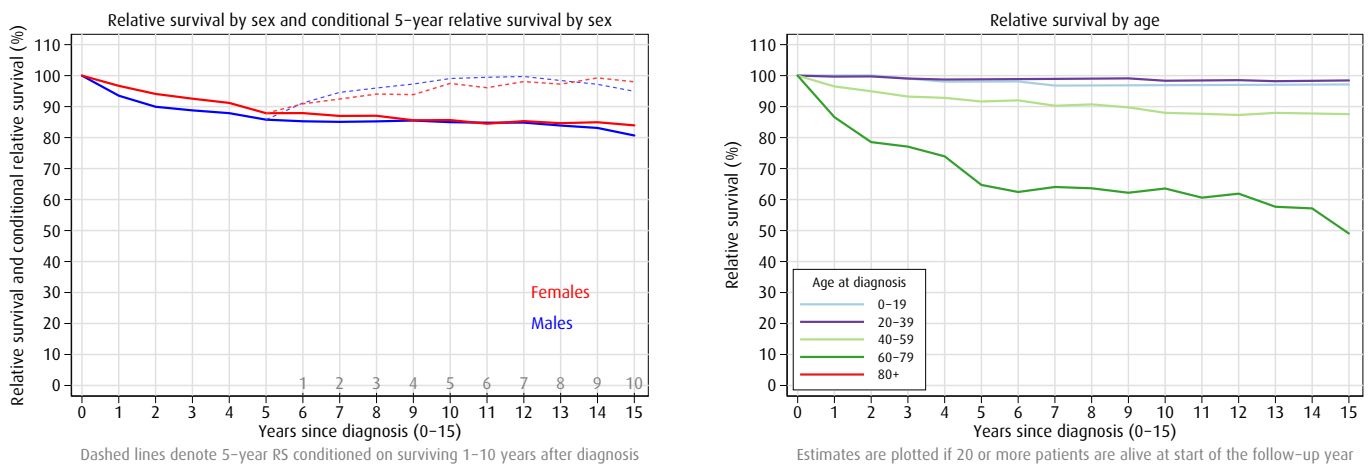
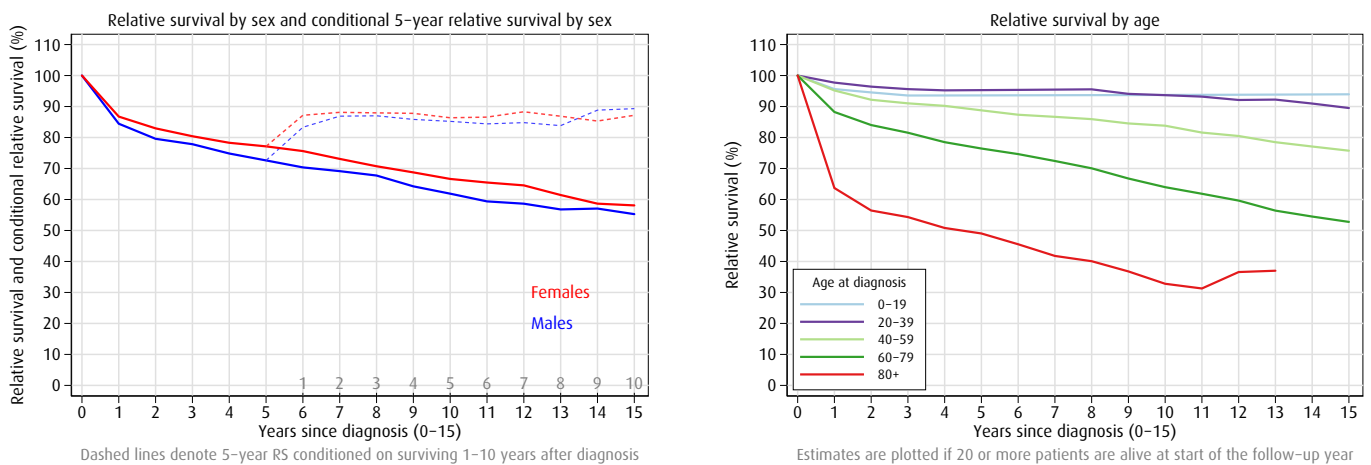
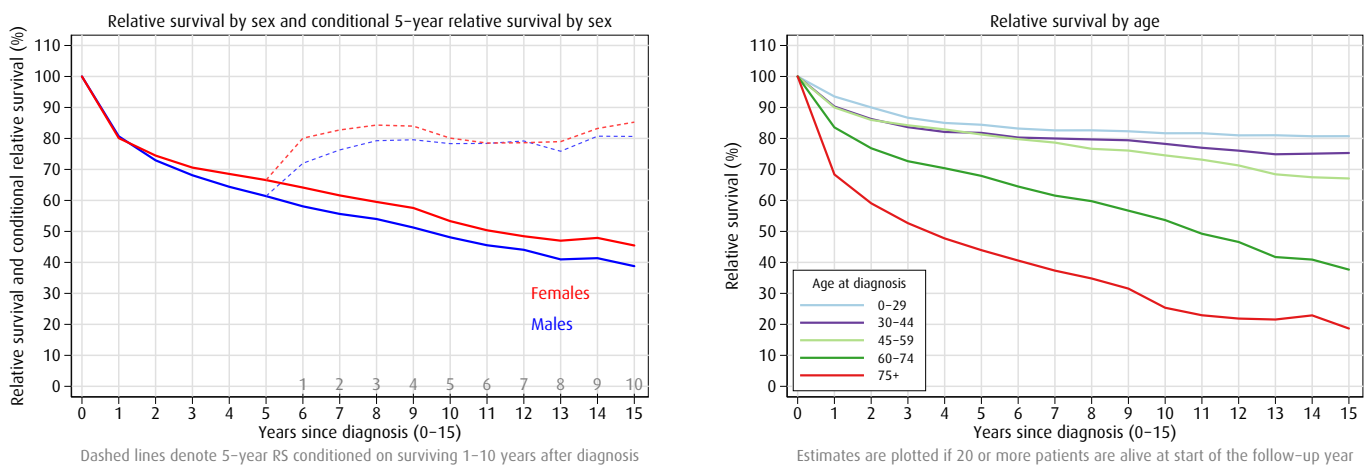
Figure 8.1: Relative survival (RS) up to 15 years after diagnosis by sex and age, 2012–2016**Figure 8.1-S: Urinary tract (renal pelvis, ureters, urinary bladder, and urethra) (ICD-10 C65–68)****Figure 8.1-T: Central nervous system (ICD-10 C70–72)****Figure 8.1-U: Thyroid gland (ICD-10 C73)**

Figure 8.1: Relative survival (RS) up to 15 years after diagnosis by sex and age, 2012–2016**Figure 8.1-V: Hodgkin lymphoma (ICD-10 C81)****Figure 8.1-W: Non-Hodgkin lymphoma (ICD-10 C82–86, C96)****Figure 8.1-X: Leukaemia (ICD-10 C91–95)**

Chapter 9 Trends in incidence, mortality and survival, Norway 1965–2016

There has been considerable discussion as to the relative merits of incidence, mortality and survival analysis in cancer research generally, and in time trend analysis specifically^[8;19–22]. Analysing trends in incidence may provide some insight into changes in the incidence and distribution of risk factors, and the impact of interventions and screening aimed at prevention and early diagnosis. Mortality rates and survival proportions are both key measures of disease outcome, and may alert us to the beneficial effects of screening, more effective therapies or better disease management.

The contribution of artefacts to the observed cancer incidence and mortality trends have been comprehensively addressed^[23;24]. Others have investigated the accuracy of death certificates^[25;26]. Apart from artefacts related to registration practices, many of the factors that affect incidence also apply to mortality, given that both rely on the accuracy of the initial cancer diagnosis. As with incidence, survival estimates may be affected by changes in diagnostic methods and disease classifications, as well as the extent of cancer screening that detect cases in an earlier stage of the disease.

There is a general consensus that a combined description of trends in incidence, mortality and survival aids our understanding of the underlying biological, epidemiological and clinical processes. As each indicator is subject to unique or shared artefacts that tend to vary according to cancer type over time, their simultaneous assessment often enables the identification of systematic deviations in one or more of the three measures. Figure 9.1–A to 9.1–X present time trends during 1965–2016 for age-standardised incidence and mortality rates and five-year relative survival estimates. It should be noted that these summary measures will often fail to reflect true underlying age-calendar-year interactions for specific cancers, such as differences in survival and mortality trends by age with respect to calendar time, or the presence of strong birth cohort influences in incidence trends.

The trends for All sites in Figure 9.1–A is a persistent increase in cancer incidence and survival in Norway over the last four to five decades, combined with a fairly stable mortality until the early 1990s. The decline in mortality that follows is more rapid in men than in women. The interpretation of these aggregated estimates

is complex, in that they comprise many different cancer types variable in terms of their capacity to be diagnosed as well as treated. Important contributions to the downward trend in men came from lung cancer, prostate cancer and stomach cancer.

Among men, nearly 30% of all cancers diagnosed in 2016 were prostate cancers. General screening for prostate cancer using the PSA test is not recommended in Norway. However, the proportion of cases where PSA testing has led to further examination is still increasing and it is the main cause for performing a biopsy. The increase in both incidence and five-year relative survival from 1990 (Figure 10–O) probably reflects the availability of the PSA test and the upsurge in its use and in the early detection of disease. However, mortality has declined from around 1996 and both early diagnosis and improved and more active treatment may have had an impact.

Breast cancer comprises more than 20% of all female cancer cases. There has been a monotonous increase in incidence rates up to 2005 with a steeper increase in the mid-1990s followed by a notable decline between 2005 and 2009 (Figure 9.1–M). The Norwegian Breast Cancer Screening Programme started as a four-year pilot project in four of the 19 Norwegian counties in 1996, and gradually expanded to become nationwide by 2005. The programme invites women aged 50–69 years to biennial screening. The implementation of the screening programme explains much of the increasing incidence trend from the mid-1990s to 2005.

During the last decade, there have been some fluctuations in the breast cancer rates, but no clear picture emerges when we examine the trends in age-specific rates. The fluctuations probably represent a combination of better diagnostic methods being used in the programme or locally in studies, or that women continue to have mammography after the age of 70, but it might also reflect random fluctuations. The breast cancer mortality was almost stable from 1995 up to the mid 1990s when it began declining (Figure 9.1–M). These good news most likely reflect improved diagnostics, better treatment, and the implementation of the systematic screening programme for breast cancer.

Trends in lung cancer incidence and mortality follow each other closely, reflecting the poor survival over time. The varying trends by sex reflect the different phases of the smoking epidemic in Norwegian men and women (Figure 9.1–J). Overall, lung cancer incidence and mortality rates among males began to level off in the early 1990s and declined the past three years. This is in contrast to the continuing increase in women. It is worth noting that the age-standardised lung cancer rates conceal a stabilisation in younger women (< 60 years). During the last two decades lung cancer has surpassed breast cancer as the most frequent cause of cancer death among women, and the incidence is now surpassing that of colon cancer. The lung cancer trends reflect the historical changes in smoking habits. In fact, the first strong evidence of the close relationship between smoking and lung cancer came 60 years ago, in the early 1950s. The trends year by year seemed to stabilise after 2010 for women, but the rates in 2014 and 2015 suggest a slight increase.

Both colon and rectal cancer incidence have been increasing for many decades, but the rectal cancer rates have levelled off since the 1990s (Figure 9.1–E and 9.1–F). Of particular note is the increasing survival and declining mortality from rectal cancer in both sexes, and the mortality is nearly half of what it used to be. The most important determinants are probably the national introduction of total mesorectal excision in the early 1990s, increasing specialisation, and use of preoperative radiation. However, our colon cancer incidence and mortality rates are among the highest in the Nordic countries, and remain a health concern.

Some other specific sites are also worthy of note. The long-term decline in stomach cancer incidence and mortality is most likely caused by better hygiene and increased intake of fresh or frozen food, which have reduced the prevalence of *Helicobacter pylori* infections. The survival of stomach cancer has increased moderately over time (Figure 9.1–D).

In contrast, the incidence rate of testicular cancer increased gradually during the last decades (Figure 9.1–Q).

An improvement in survival started in the 1970s with the introduction of cisplatin therapy for advanced germ-cell tumours, leading to greatly improved prognosis for testicular cancer in young and middle-aged men. This cancer now has the highest five-year relative survival.

A remarkable increase in incidence rates has been seen during the last years for malignant melanoma in both genders. The increase in incidence rates for malignant melanoma is probably explained by sun tanning, more frequent check-ups at the general practitioners' offices or in pharmacies. However, the moderate but steady increase in melanoma mortality indicates that some of the increase in incidence is caused by a higher risk of disease.

Finally, among more uncommon cancer sites, there has been a notable increase in the rates for liver and thyroid cancer in both genders. The rise of thyroid cancers during the last decade is also seen in the other Nordic countries, except in Iceland where the rates have been consistently higher than in Scandinavia since 1960. We do not know the exact reason for this increase, but it may be due to changes in the diagnostic workup with an increased use of ultrasound, CT or MRI for other indications, resulting in incidental findings of tumours in the thyroid.

We suspect that the increased rate of liver cancer is due to immigration from areas with higher incidence of this disease.

In summary, the overall trends in cancer survival probably reflect both artefacts, such as screening and improved diagnostics, and improved treatment. For prostate and breast cancer both early diagnosis and improvements in treatment are likely to have played a role. For rectal cancer, the improved survival is most likely caused by better treatment.

Note: The mortality rates used in the trends figures have some deviations from the incidence and survival estimates: Anal cancer is included in the mortality rates, and cases of topography ICD-10 D45–47 are not included in the mortality rates.

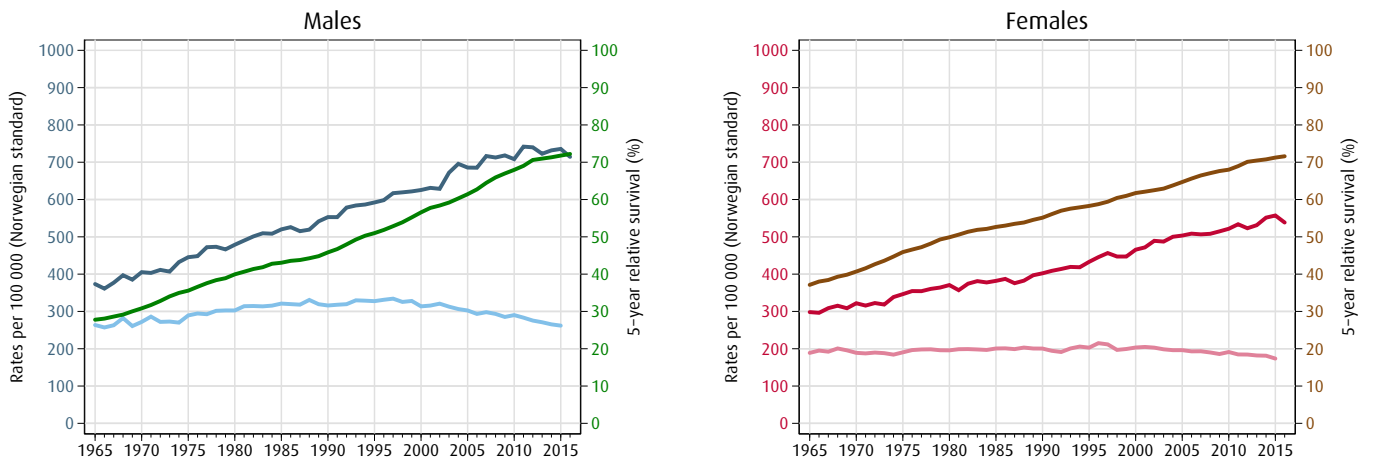
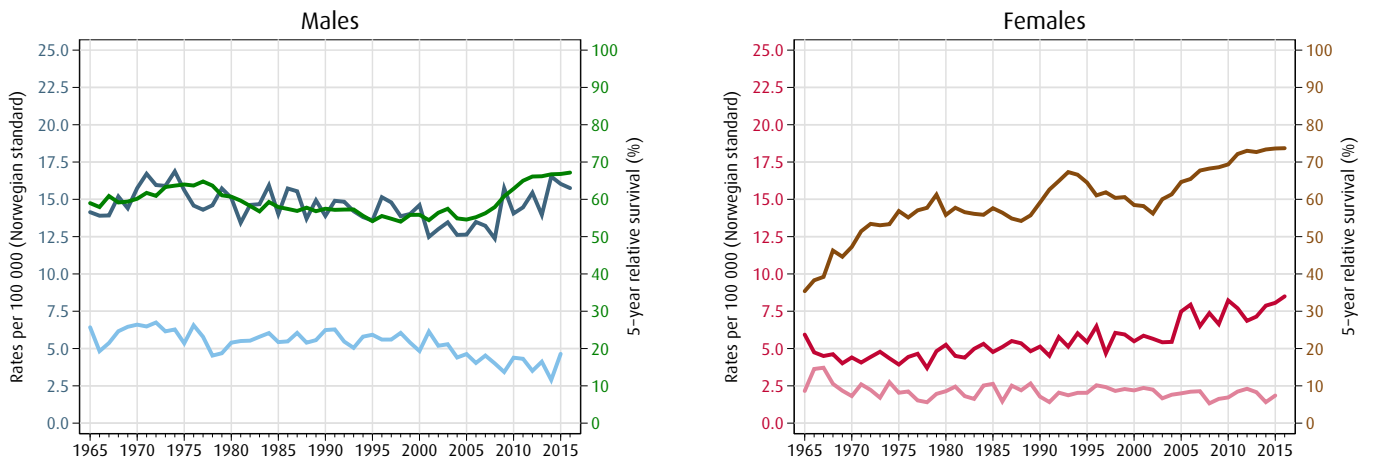
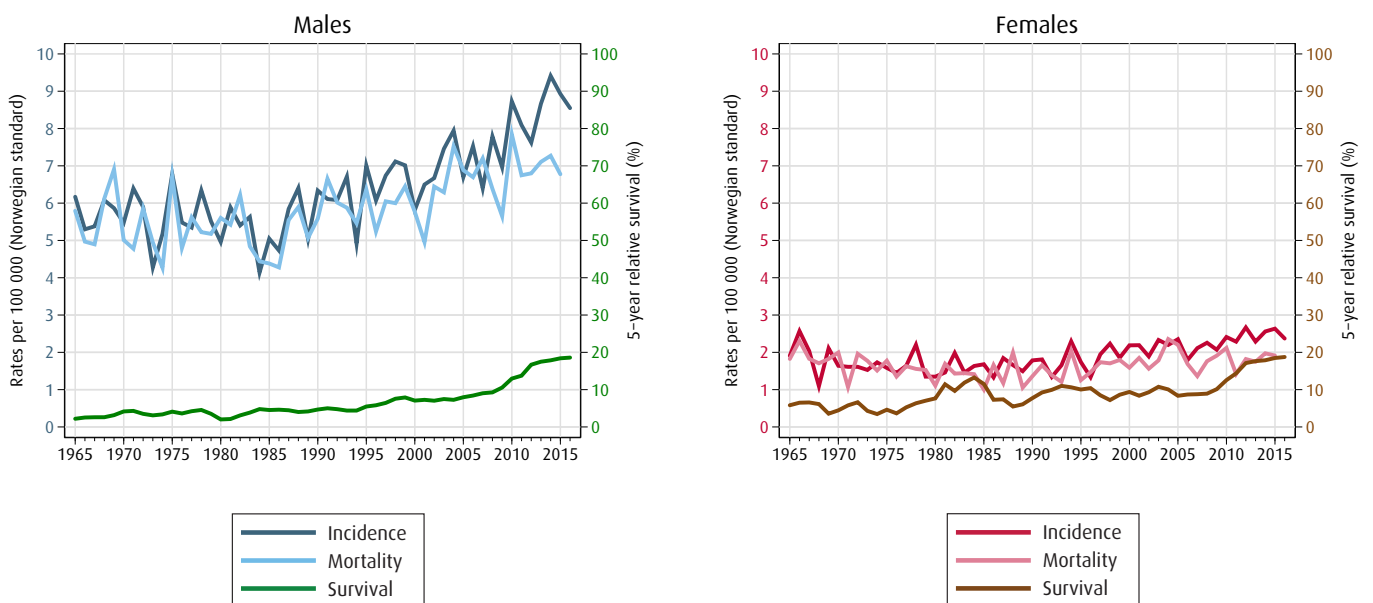
Figure 9.1: Trends in incidence and mortality rates and 5-year relative survival proportions**Figure 9.1-A: All sites (ICD-10 C00-96)****Figure 9.1-B: Mouth, pharynx (ICD-10 C00-14)****Figure 9.1-C: Oesophagus (ICD-10 C15)**

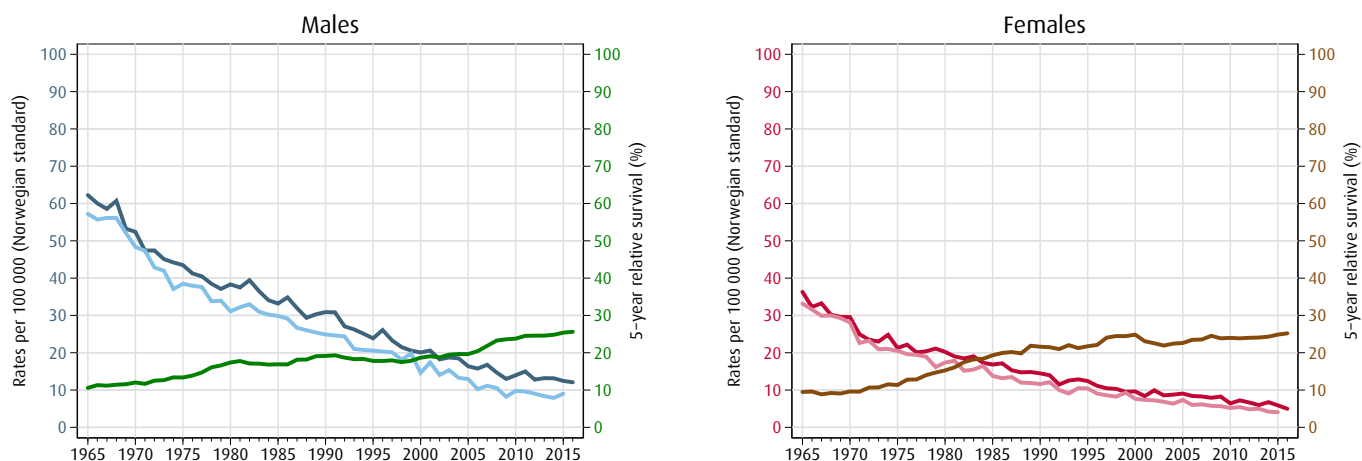
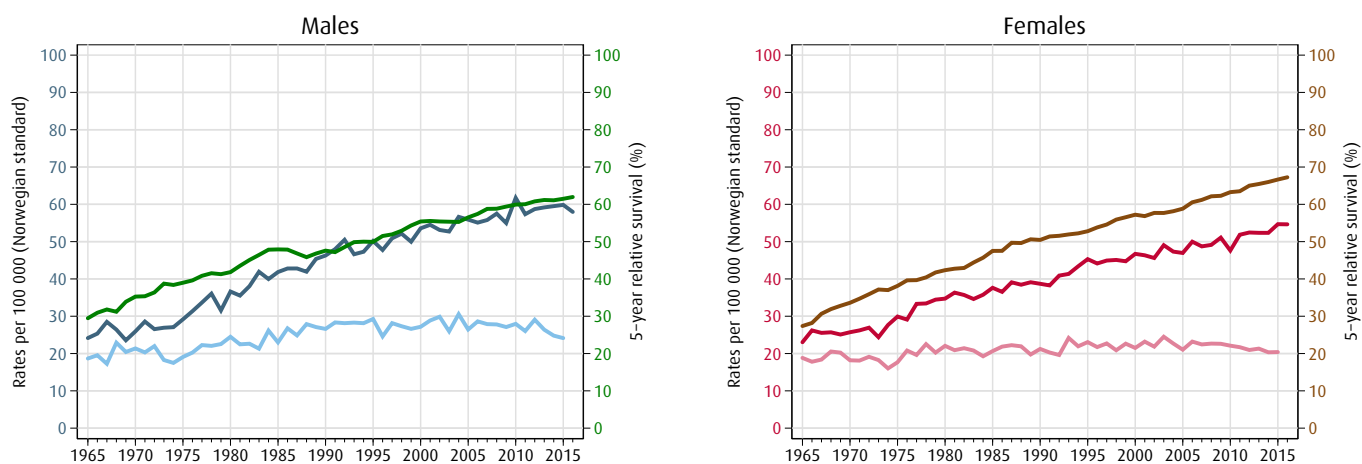
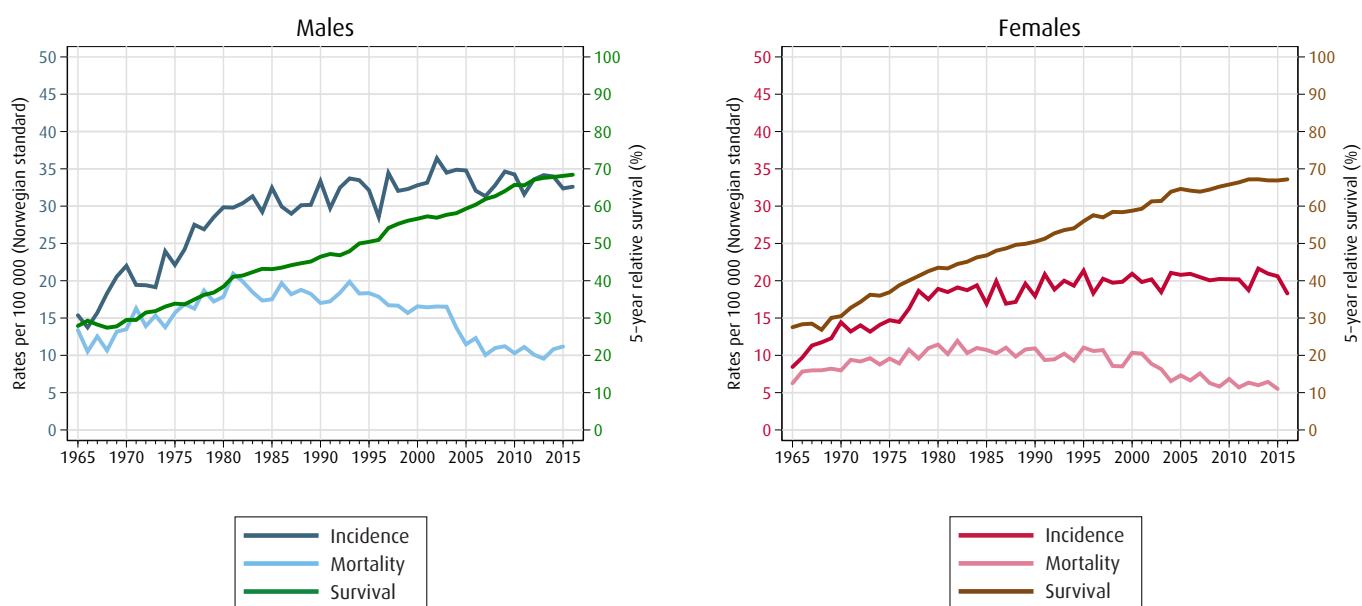
Figure 9.1: Trends in incidence and mortality rates and 5-year relative survival proportions**Figure 9.1-D: Stomach (ICD-10 C16)****Figure 9.1-E: Colon (ICD-10 C18)****Figure 9.1-F: Rectum, rectosigmoid (ICD-10 C19-20)**

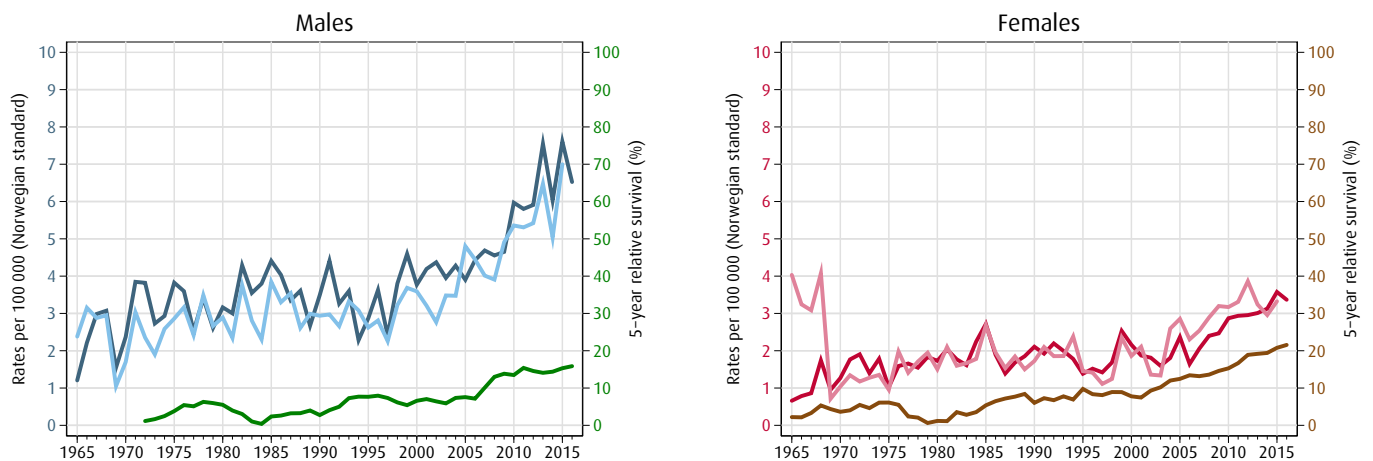
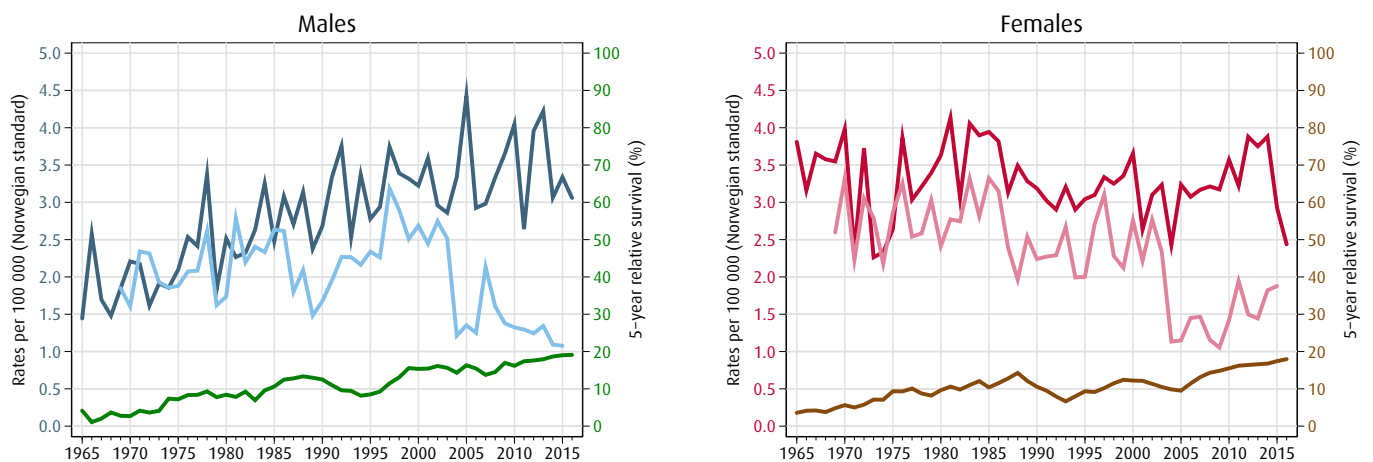
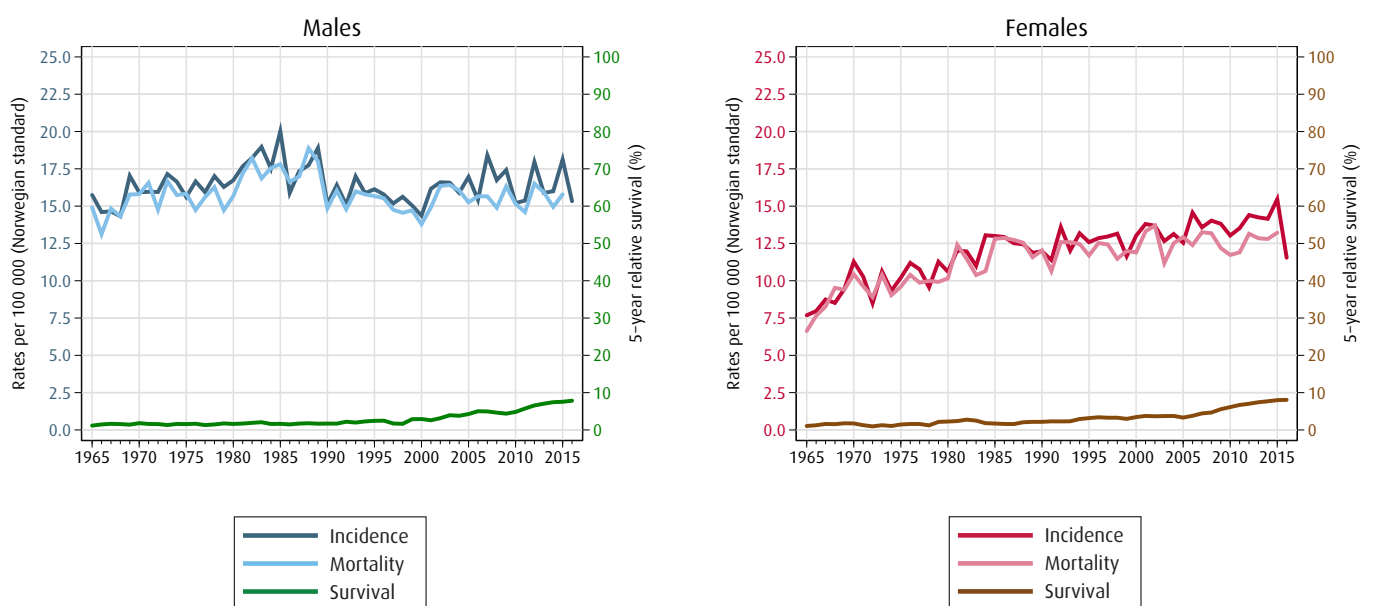
Figure 9.1: Trends in incidence and mortality rates and 5-year relative survival proportions**Figure 9.1-G: Liver (ICD-10 C22)****Figure 9.1-H: Gallbladder, bile ducts (ICD-10 C23-24)****Figure 9.1-I: Pancreas (ICD-10 C25)**

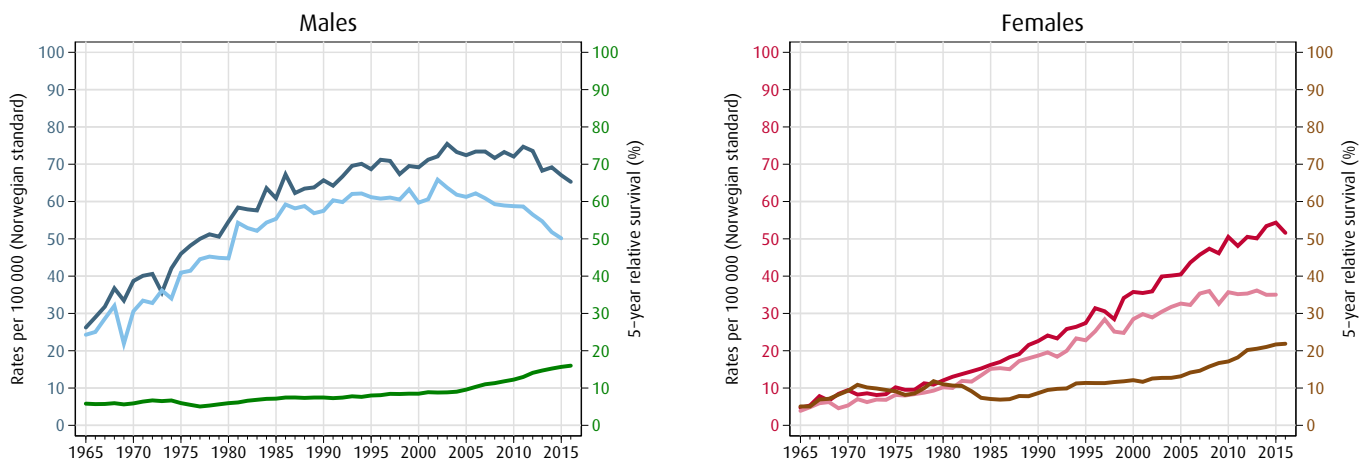
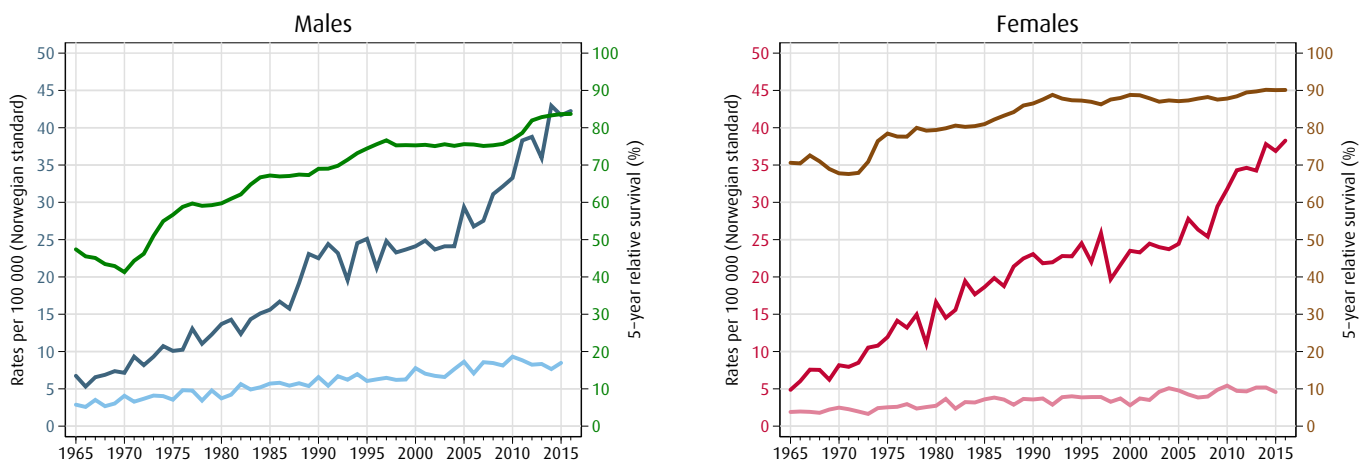
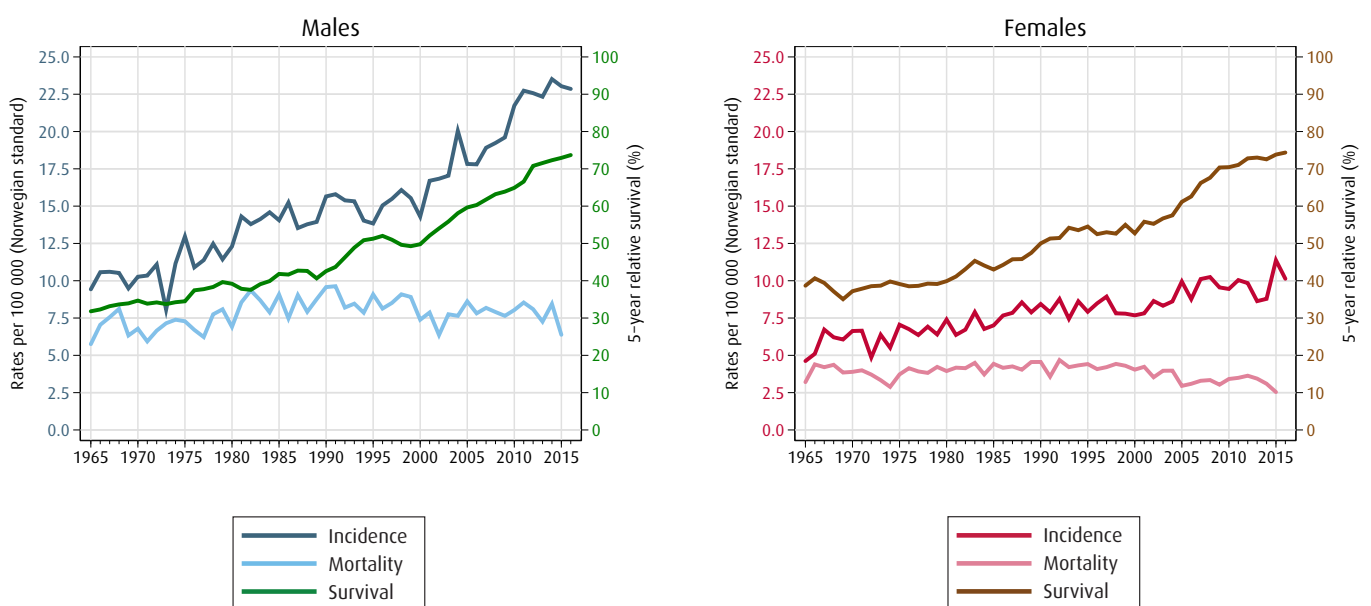
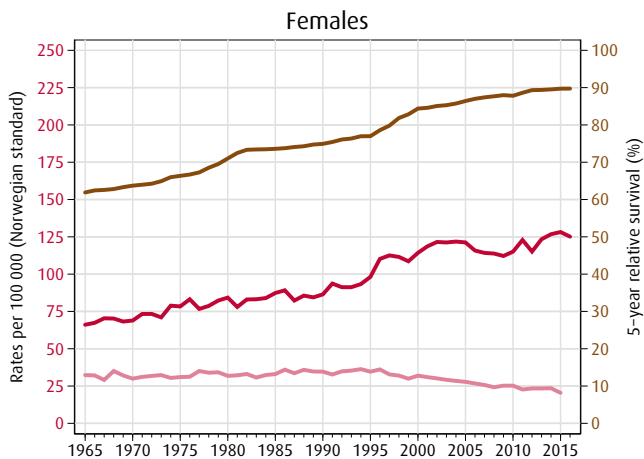
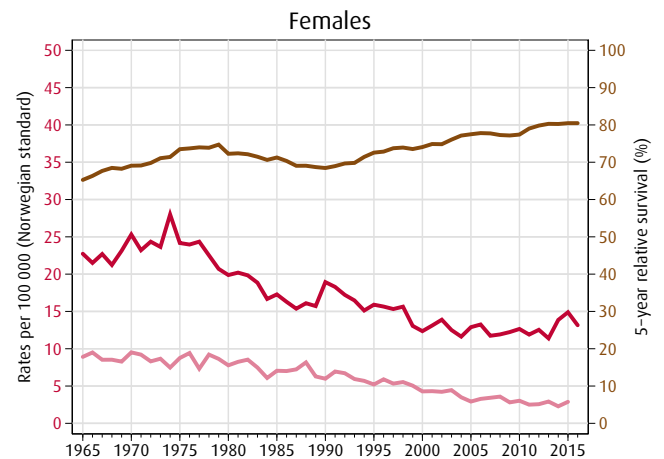
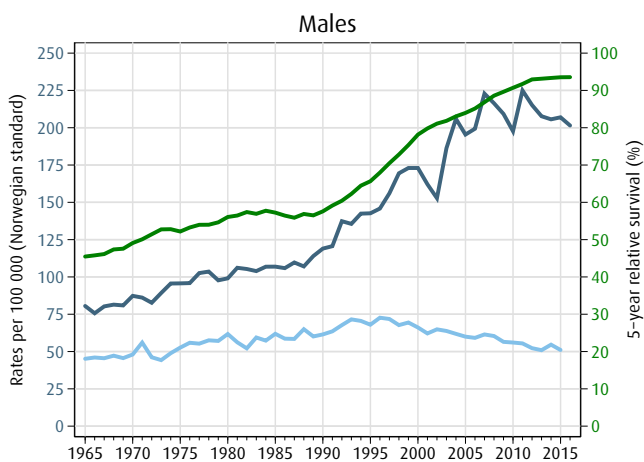
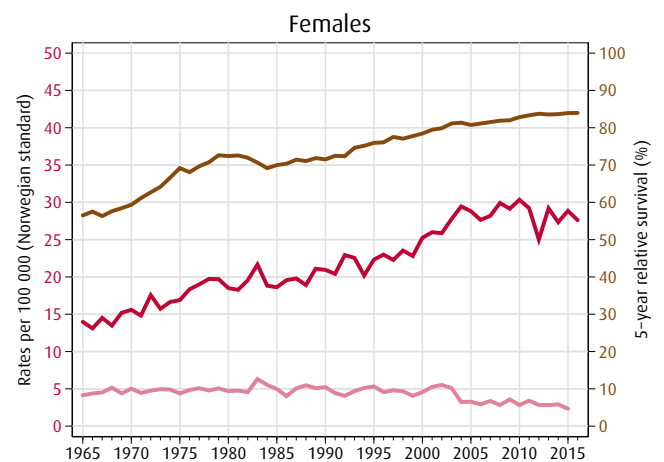
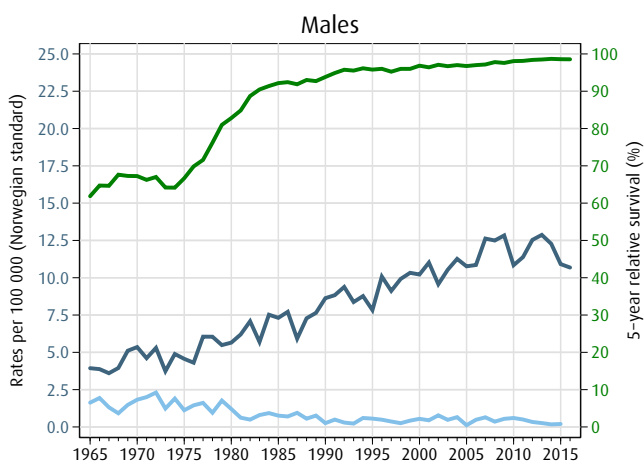
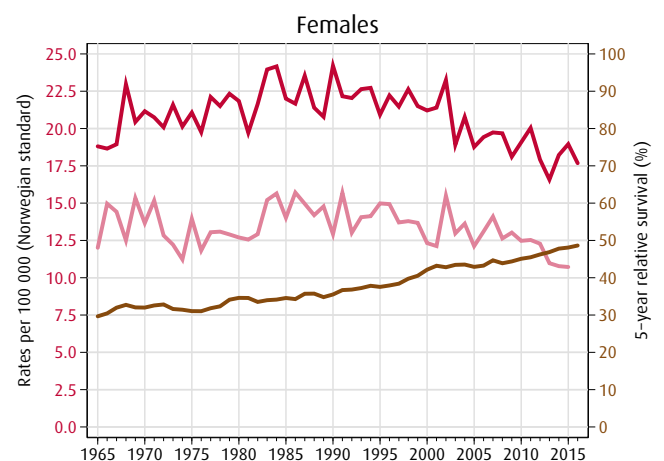
Figure 9.1: Trends in incidence and mortality rates and 5-year relative survival proportions**Figure 9.1-J: Lung, trachea (ICD-10 C33-34)****Figure 9.1-K: Melanoma of the skin (ICD-10 C43)****Figure 9.1-L: Kidney excluding renal pelvis (ICD-10 C64)**

Figure 9.1: Trends in incidence and mortality rates and 5-year relative survival proportions**Figure 9.1-M: Breast (ICD-10 C50)****Figure 9.1-N: Cervix uteri (ICD-10 C53)****Figure 9.1-O: Prostate (ICD-10 C61)****Figure 9.1-P: Corpus uteri (ICD-10 C54)****Figure 9.1-Q: Testis (ICD-10 C62)****Figure 9.1-R: Ovary (ICD-10 C56, C57.0-4)**

— Incidence
— Mortality
— Survival

— Incidence
— Mortality
— Survival

Figure 9.1: Trends in incidence and mortality rates and 5-year relative survival proportions

Figure 9.1-S: Urinary tract (renal pelvis, ureters, urinary bladder, and urethra) (ICD-10 C65-68)

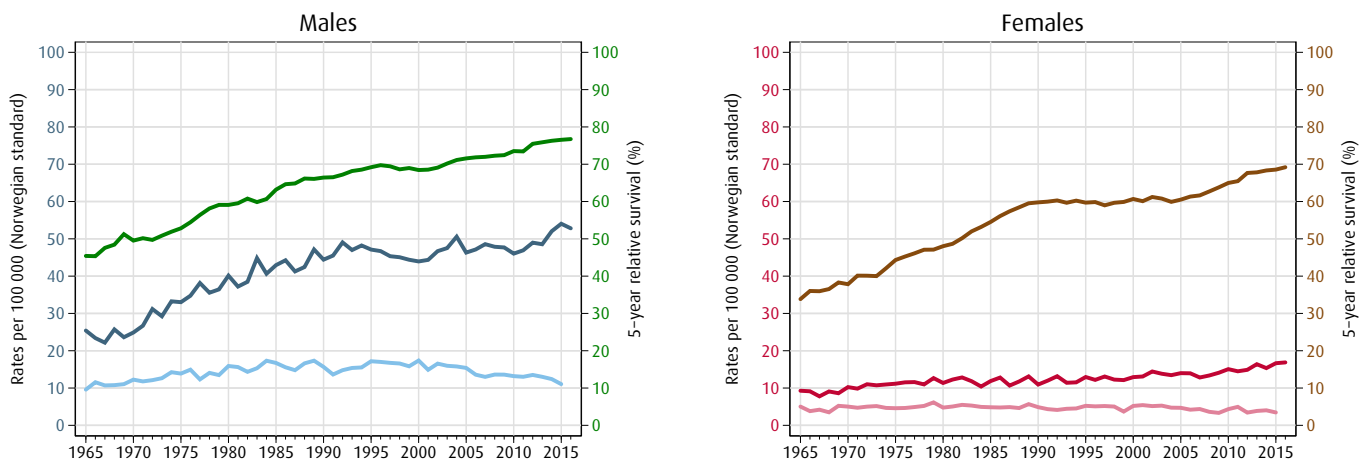


Figure 9.1-T: Central nervous system (ICD-10 C70-72)

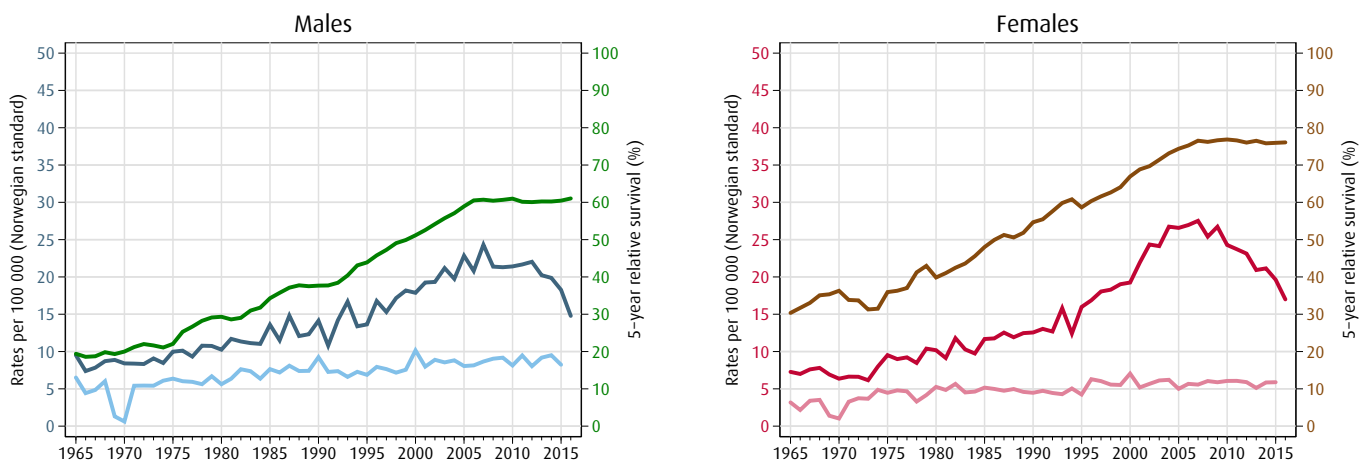


Figure 9.1-U: Thyroid gland (ICD-10 C73)

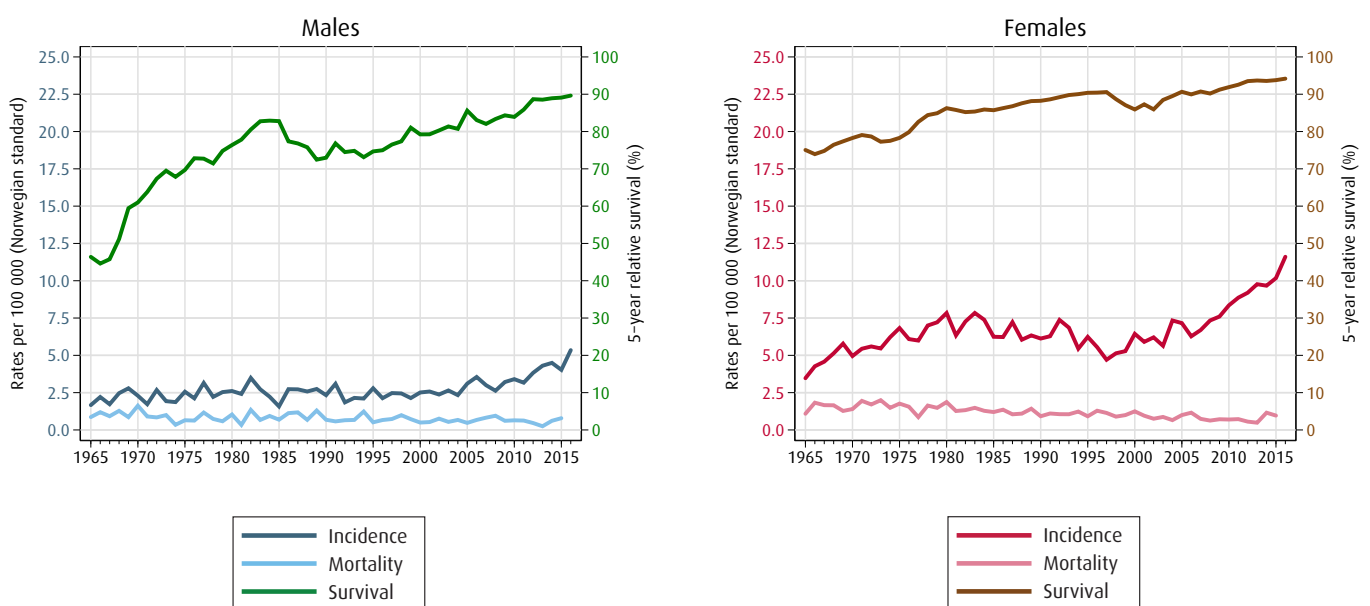
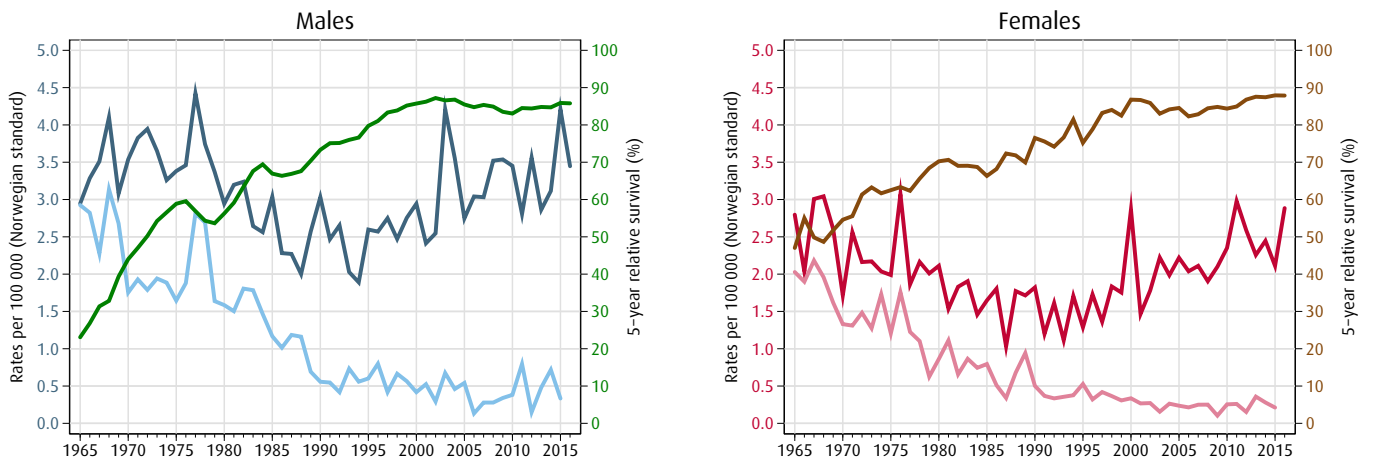
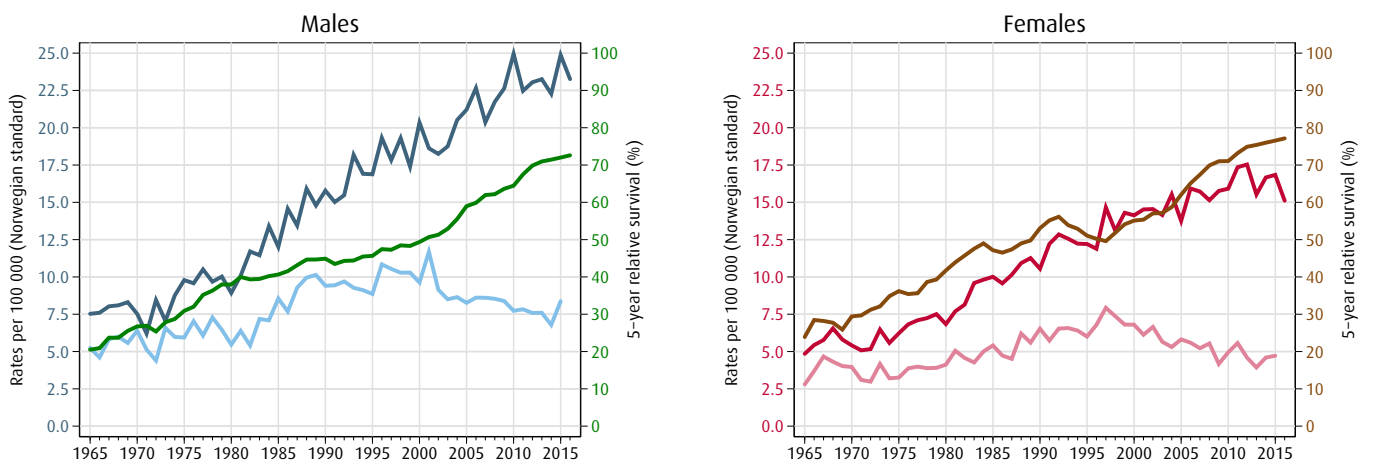
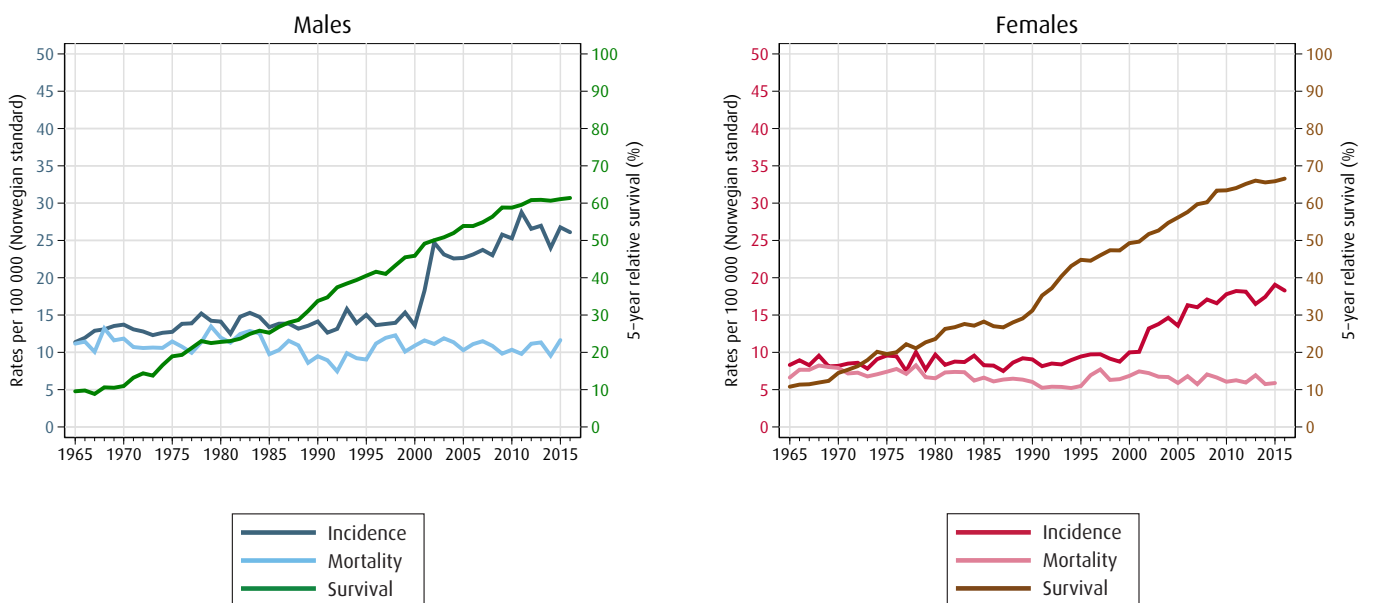


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Bibliography

- [1] Last JM, Spasoff RA, Harris SS, and Thuriaux MC. *A dictionary of epidemiology*. International Epidemiological Association, Inc., 2001. [Link to text: 1]
- [2] Syse A and Pham DQ. Befolkningsframskrivninger 2014-2100: Dødelighet og levealder. *Økonomiske analyser Statistisk Sentralbyrå*, 4:44–50, 2014. [Link to text: 3.1]
- [3] Larsen IK, Småstuen M, Johannesen TB, Langmark F, Parkin DM, Bray F, and Møller B. Data quality at the cancer registry of norway: an overview of comparability, completeness, validity and timeliness. *European journal of cancer*, 45(7):1218–1231, 2009. [Link to text: 3.2, 3.5]
- [4] Fritz A, Percy C, Jack A, Shanmugaratnam K, Sobin L, Parkin DM, Whelan S, et al. *International classification of diseases for oncology*. Number Ed. 3, 1st revision. World Health Organization, Geneva, 2013. [Link to text: 3]
- [5] Bray F and Parkin DM. Evaluation of data quality in the cancer registry: principles and methods. part i: comparability, validity and timeliness. *European journal of cancer*, 45(5):747–755, 2009. [Link to text: 3.5]
- [6] Parkin DM and Bray F. Evaluation of data quality in the cancer registry: principles and methods part ii. completeness. *European journal of cancer*, 45(5):756–764, 2009. [Link to text: 3.5]
- [7] Segi M. Cancer mortality for selected sites in 24 countries (1950-1957). *Sendai: Tohoku University School of Medicine*, 1960. [Link to text: 4.1]
- [8] Hakulinen T. Cancer survival corrected for heterogeneity in patient withdrawal. *Biometrics*, pages 933–942, 1982. [Link to text: 4.1, 9]
- [9] Doll R, Payne P, and Waterhouse J. *Table 38. In: Cancer incidence in five continents: a technical report. International Union against Cancer*. Springer, Berlin, 1966. [Link to text: 4.1]
- [10] Day NE. Cancer incidence in five continents. cumulative rate and cumulative risk. *IARC scientific publications*, (120):862, 1992. [Link to text: 4]
- [11] Brenner H and Hakulinen T. Maximizing the benefits of model-based period analysis of cancer patient survival. *Cancer Epidemiology and Prevention Biomarkers*, 16(8):1675–1681, 2007. [Link to text: 4.3]
- [12] Rosso S, De Angelis R, Ciccolallo L, Carrani E, Soerjomataram I, Grande E, Zigon G, Brenner H, EURO-CARE Working Group, et al. Multiple tumours in survival estimates. *European Journal of Cancer*, 45(6):1080–1094, 2009. [Link to text: 4.3]
- [13] Ederer F and Heise H. Instructions to ibm 650 programmers in processing survival computations. bethesda, md: National cancer institute. Technical report, Methodological note, 1959. [Link to text: 4.3]
- [14] Brenner H and Hakulinen T. Very-long-term survival rates of patients with cancer. *Journal of Clinical Oncology*, 20(21):4405–4409, 2002. [Link to text: 4.3, 8]
- [15] Hankey BF and Steinhorn SC. Long-term patient survival for some of the more frequently occurring cancers. *Cancer*, 50(9):1904–1912, 1982. [Link to text: 4.3]
- [16] Janssen-Heijnen ML, Houterman S, Lemmens VE, Brenner H, Steyerberg EW, and Coebergh JW. Prognosis for long-term survivors of cancer. *Annals of Oncology*, 18(8):1408–1413, 2007. [Link to text: 4.3, 8]
- [17] Gade FG. *Undersøkelser over kræftsygdommene i Norge, paa grundlag av den officielle mortalitetsstatistik 1902–1911 samt det av den norske komité for kræftforskning samlede materiale 1908–1912 [Investigations on cancer diseases in Norway, based on official mortality statistics 1902–1911 and material collected by the Norwegian Committee for cancer research 1908–1911]*. Dybwad, Kristiania (Oslo), 1916. [Link to text: 5.4]
- [18] Lambert PC et al. Modeling of the cure fraction in survival studies. *Stata Journal*, 7(3):351, 2007. [Link to text: 8]
- [19] Boyle P. Relative value of incidence and mortality data in cancer research. In *Cancer Mapping*, pages 41–63. Springer, 1989. [Link to text: 9]

- [20] Coleman MP. Trends in breast cancer incidence, survival, and mortality. *Lancet (London, England)*, 356(9229): 590–1, 2000. [Link to text: [9](#)]
- [21] Doll R and Peto R. The causes of cancer: quantitative estimates of avoidable risks of cancer in the united states today. *Journal of the National Cancer Institute*, 66(6):1192–1308, 1981. [Link to text: [9](#)]
- [22] Peto R, Boreham J, Clarke M, Davies C, and Beral V. Uk and usa breast cancer deaths down 25% in year 2000 at ages 20-69 years. *Lancet*, 355(9217):1822, 2000. [Link to text: [9](#)]
- [23] Saxén EA. Trends: facts or fallacy. *Trends in cancer incidence. Causes and practical implications*, pages 5–16, 1982. [Link to text: [9](#)]
- [24] Muir CS, Fraumeni Jr JF, and Doll R. The interpretation of time trends. *Cancer surveys*, 19:5–21, 1993. [Link to text: [9](#)]
- [25] Percy C, Stanek 3rd E, and Gloeckler L. Accuracy of cancer death certificates and its effect on cancer mortality statistics. *American Journal of Public Health*, 71(3):242–250, 1981. [Link to text: [9](#)]
- [26] Alfsen CG, Lyckander LG, Lindboe AW, and Svaar H. Kvalitetssikring ved dødsfall i sykehus. *Tidsskrift for Den norske legeforening*, 130(5):476, 2010. [Link to text: [9](#)]



The Norwegian Breast Cancer Screening Program 1996-2016

Celebrating 20 years of organised mammographic screening

Cancer in Norway 2016 – Special issue

The Norwegian Breast Cancer Screening Program 1996-2016

Celebrating 20 years of organised mammographic screening

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Foreword

This report represents part of our celebration of the 20th anniversary of the Norwegian Breast Cancer Screening Program. During these 20 years the program has been through an exciting journey with triumphs and challenges. This anniversary is an excellent opportunity to reflect on the program's past as well as its achievements and future challenges.

We are very proud today to offer women a high quality screening program run according to current Norwegian and European guidelines. Screening activity has been registered in the Cancer Registry of Norway since the program's inception and is nearly 100% complete. In addition to being used for program administration, these data have been accessible and used extensively in quality assurance and research projects. The high number of scientific papers published using data from the program has improved the screening program's quality and visibility, and has contributed to making the program and its employees attractive for national and international research collaboration. There have never been as many ongoing quality assurance and research projects, or such a wide range of hypotheses being explored, as there are today.

Women targeted by the program are devoted: 84% of the nearly one million women invited to screening have attended at least once, resulting in a 20-30% reduction in mortality overall, and about 40% reduction in breast cancer mortality among screened women.

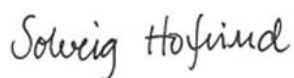
Today, the screening program faces a number of new challenges. Not only should the program keep up with evolving technologies and new diagnostic improvements, but it should also embrace new evidence-based developments. Any new developments that are incorporated into the program should be done in such a way that their effect can be monitored. Moreover, the need to provide understandable, evidence-based information about breast cancer and mammographic screening to women, other stakeholders, and the general population is paramount.

The aim of this report is to describe the program today, its history, and noteworthy developments. Much of the program's history has never been described, and we have attempted to gather the information here. Thank you to all who have contributed to this effort. This report also presents results from early performance measures, and shares some insights into the quality assurance, program evaluation, and research activities associated with the program, as well as our perspectives on the future development of breast cancer screening.

A 20 year old woman is full of energy, willingness to change, and has a bright future. So too is the Norwegian Breast Cancer Screening Program.

Enjoy this report!

Oslo, October 2017



Solveig Hofvind, PhD
Head, Norwegian Breast Cancer Screening Program



Giske Ursin, MD, PhD
Director, Cancer Registry of Norway

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1. Twenty years of organised mammographic screening in Norway

Breast cancer is the most common cancer among women worldwide and in Norway, and the second most common cause of cancer death (1, 2). Breast cancer survival is highly dependent on stage at diagnosis and mode of detection (3, 4). The causes of breast cancer are not known, but many risk factors are well established. Few of these risk factors are modifiable, however. Because of this, breast cancer screening is a well accepted strategy for the secondary prevention of breast cancer in western countries (5, 6).

The Norwegian Breast Cancer Screening Program targets women aged 50 to 69 for mammographic screening every other year. The program started as a pilot in 1995 and became nationwide in 2005. Internationally, the history of mammographic screening dates back to the early 1960s, when the first randomised trial in New York began (7). The results from this trial led to great optimism regarding the potential screening could have in reducing deaths from a disease, which at the time, had poor survival. Now, more than 50 years later, organised mammographic screening is one of the most evaluated and quality assured health care services offered in Norway, and internationally.

In Norway, an essential part of building the nationwide screening program was the establishment of specialised breast centres, with a focus on efficient work flow, centralised professional competence, and multidisciplinary teamwork. As a part of this process, systematic quality assurance tasks were developed and defined for all disciplines and institutions involved in the program. Another key factor in the program is the invitation system, which is based on personal invitations with scheduled appointments that are automatically sent to all women in the target group. This invitation system facilitates regular participation regardless of where women live.

The Norwegian model for breast screening has been successful and is quite unique internationally. This model is based on a centralised database and a shared IT system, which creates distinct opportunities for communication, quality assurance, and research. As a result, the Norwegian program is attractive to national and international researchers as well as program administrators.

Another strength of the program is its foundation in systematic quality assurance and research. A large part of this report is dedicated to early performance measures that are important for program surveillance in order to reduce future breast cancer mortality. These measures are a part of the continuous quality assurance of the program, and are regularly shared with professionals working at the breast centres.

It is well known that the concept of mammographic screening has spurred debates about its potential benefits and harms during the past decades (8–11). In recent years, international publications have strengthened the evidence for mammographic screen-

ing. A systematic review by the European Commission Initiative on Breast Cancer concluded in 2016 that there is strong evidence to recommend mammographic screening for women aged 50–69 (5). Similarly, several other institutions and research groups, such as the World Health Organization's International Agency for Research on Cancer (2015) and the UK Independent Panel on Breast Cancer Screening (2012), have concluded that there is sufficient evidence to support the benefits of mammographic screening for women aged 50–69 (6, 11, 12).

The release of an independent research-based evaluation in 2015 was an important milestone for the organised screening program in Norway. This evaluation summarised previous research and produced new evidence about the program. Highlights from this report included confirmation that the program reduced breast cancer mortality by 20–30% among invited women and affirmation of the program's cost effectiveness (13).

Today, discussions are ongoing about which age groups should be offered screening, how the service should be organised, and how women should be informed (6). The Norwegian screening program has achieved its main goal of reducing breast cancer mortality and now aims to maintain and continue to develop the quality of the program as well as increase its benefits and reduce its harms. The program faces a number of challenges today such as new screening modalities, the detection and treatment of dormant or slow growing asymptomatic tumours, stratified screening, and personalised treatment. However, changes in the program should be evidence-based and extensive research is needed in order to fill knowledge gaps before action can be taken. Political and economic support is required to make this a reality.



Figure 1.1: Mobile screening unit from the late 1960s; 70 women could be screened per day. Reproduced, with permission, from: Gold RH, Bassett LW, and Widoff BE. Highlights from the history of mammography. *RadioGraphics* 1990;10(6):1111-31

2. The Norwegian Breast Cancer Screening Program

The Norwegian Breast Cancer Screening Program is a part of the public health care services offered in Norway and targets women aged 50-69 for biennial screening. The program started in 1995 as a pilot, and became nationwide in 2005. The Cancer Registry of Norway administers the program, while the regional health authorities, through the local health trusts, perform screening and follow-up. Screening examination, interpretation, and any further assessment and treatment is performed at 16 specialised breast centres and 30 connected screening units. A national quality assurance manual is published by the Cancer Registry. A steering group is headed by the Norwegian Directorate of Health. This chapter presents the principles behind screening and gives a summary of the roles and areas of responsibility held by the Cancer Registry, the regional health authorities and local health trusts, as well as a description of the steering and advisory groups linked to the program.

Principles of screening

The goal of screening is to detect a disease in an early stage and thereby reduce the incidence (primary prevention), mortality (secondary prevention), and/or morbidity (tertiary prevention) of that disease. Breast cancer screening is a secondary preventative strategy to reduce breast cancer mortality by detecting the disease

in an early stage. Mammography is the recommended screening technique, and the only one that has been demonstrated to reduce breast cancer mortality (6).

In 1968, the World Health Organization published the ten-point Wilson-Junger criteria for evaluating screening programs (Figure 2.1) (14). These criteria were published five years after the first randomised controlled trial with mammography started in New York, and have served as a general guideline for the establishment of screening programs since (7). In 2014, the Norwegian Directorate of Health added six new points to this list for Norwegian screening programs (15).

Cancer screening involves testing otherwise healthy people for signs of a developing cancer. The potential ethical challenges of doing so must be considered. With respect to mammographic screening, this relates to, among other things, the effectiveness of the program, the balance between benefits and harms, and how information is communicated to women to ensure an informed choice whether to participate. This also relates to how the health service is organised, taking care of both women's autonomy in their decision whether to participate, and providing an effective invitation model that ensures a cost effective program with equal and equitable access to screening regardless of where women live.

1. The condition sought should be an important health problem
2. There should be an accepted treatment for patients with recognised disease
3. Facilities for diagnosis and treatment should be available
4. There should be a recognisable latent or early symptomatic stage
5. There should be a suitable test or examination
6. The test should be acceptable to the population
7. The natural history of the condition, including development from latent to declared disease, should be adequately understood
8. There should be an agreed policy on whom to treat as patients
9. The cost of case-finding (including diagnosis and treatment of patients diagnosed) should be economically balanced in relation to possible expenditure on medical care as a whole
10. Case-finding should be a continuing process and not a "once and for all" project
11. *The health benefits should outweigh the harms*
12. *The protection of personal privacy and adherence to the law be ensured*
13. *The program should be ethically acceptable*
14. *Information about participation should be evidence-based and empower making an informed choice about participation*
15. *The program should be cost-effective*
16. *There should be a plan for program administration, quality assurance and evaluation*

Figure 2.1: Modified Wilson-Junger criteria for appraising screening programs (14, 15)

The Cancer Registry of Norway

The Cancer Registry is a part of the South-Eastern Norway regional health authority, organised under the Oslo University Hospital Trust. The Cancer Registry is responsible for administering the program which includes planning, design and dissemination of information, dispatch invitations, IT solutions, collection and registration of data. The data collected by the screening program are used in program evaluation and research.

Legal regulations

The Cancer Registry is a health registry (16). The activities at the Cancer Registry are performed in accordance with the provisions set out in the Regulations on the collection and processing of personal health data at the Cancer Registry of Norway (the Cancer Registry Regulations) of December 21, 2001, No 1477: *Forskrift om innsamling og behandling av helseopplysninger i Kreftregisteret (Kreftregisterforskriften)* (17, 18).

The Cancer Registry Regulations give the Cancer Registry legal basis to collect and process personal health data about individuals who participate in the screening program (17). The local health trusts and health care personnel have a statutory duty to report health data to the Cancer Registry (16, 17). Screening is considered a health service and breast centres must therefore comply with current legislation such as that pertaining to medical record keeping (19, 20).

Women with negative screening results have the right to request that personal data be erased from the Cancer Registry after the quality of the data has been assured (16, 17). See page S22 for more details. Information about this right is explicitly stated in the invitation letter. Additional information about data processing, confidentiality, and privacy, including the right to opt out is available on the Cancer Registry's [website](#).

Invitation and response routines

The Cancer Registry ensures that invitations, reminders, and response letters from the program are sent to women targeted by the program. The Registry also provides information about the program and the screening examination together with the invitation. Details can be found in the quality assurance manual (21).

The planning of invitations for each screening round is performed in close cooperation with each breast centre. Plans are made for each municipality to specify which women should be invited to each screening unit in regular intervals. These plans are updated regularly to ensure a sufficient number of examinations are being performed.

The breast centres provide the Cancer Registry with information about appointment availability for each screening unit five weeks in advance. A custom IT program, the "Invitation Program", automatically assigns all eligible women a specific time and place for screening. This program prioritises finding appointments for women who have least recently attended screening, and ensures that women from municipalities with long distances to screening units are not allocated to appointments that are, for example, early in the morning.

Invitations are automatically generated and sent three weeks before scheduled appointments. Women who have a secure digital mailbox receive their invitations digitally, while all others receive their invitations by regular mail. As of August 2017, about 40% of women receive their invitations digitally.

If a woman does not attend her appointment, she will receive a reminder five to six weeks after her missed appointment. She must then contact her breast centre to reschedule.

All participants are notified of their screening result by a letter. Letters with information about normal results (negative findings) are sent by the Cancer Registry, while notification letters about positive screening results are sent by the breast centres.

Women who do not wish to participate in the screening program, whether entirely or for a specified time, can contact the Cancer Registry or their breast centre to register an "invitation stop" (see page S22 for more details).

Data registration

Data from the screening program are collected and stored in a national screening database at the Cancer Registry. The Cancer Registry collects, registers, and ensures the quality of these data. A network connects all of the breast centres to the Cancer Registry, and all information related to screening activities is transferred electronically over this network, with the exception of reports from some pathology laboratories. This nationwide electronic solution ensures nearly 100% data completeness.

The Cancer Registry records data on an individual level, which makes it possible to follow each woman throughout an entire screening episode, including assessment and diagnosis. Data is also captured for women who are diagnosed outside the screening program. This makes data from the Norwegian Breast Cancer Screening Program unique, both nationally and internationally.

In 2010, the national clinical registry for breast cancer (previously referred to as the Norwegian breast cancer registry) was established as a part of the Cancer Registry. Since then, this registry has been used to collect information about all breast cancers, including ductal carcinoma *in situ*, before being mapped to the screening database. Before this, pathology reports were scanned and registered separately for the Cancer Registry database and the screening program database.

Data collected by the screening program currently consists of over 200 unique variables about women's screening history (including information about invitations, attendance, interpretations of the screening mammograms, recalls, associated outcomes, and pathology results), and about premalignant breast lesions, breast cancers, and treatment.

Quality assurance of the program

A quality assurance manual published by the Cancer Registry provides a foundation for the program. The manual is based on European Guidelines (5, 22). The first manual was published in 1996. Revisions were released in 1998 and 2003 (21). Selected chapters have since been revised and are available online (23–25). Both the Norwegian and European recommendations and quality assurance guidelines for breast cancer screening and diagnosis are currently undergoing comprehensive reviews.

According to the manual, the Cancer Registry is responsible for the quality assurance of screening activities and provides regular feedback to health personnel at the breast centres. Currently, this is primarily done through reports produced three to six times yearly presenting results for each breast centre. Additionally, each breast centre is equipped with a quality assurance software, “Med-Stat”, to monitor their own performance. In cases where the Cancer Registry identifies a deviation from set targets in the manual, a notice is sent to the breast centre. Deviations that are not followed up are reported to the steering group.

In 2017, responsibility for technical quality assurance was transferred from the Norwegian Radiation Protection Authority to the Cancer Registry and the regional health authorities. The Cancer Registry now has a coordinating role for certain aspects of this quality assurance. For more details, see page S12.

Evaluation and research activities

The quality assurance manual specifies that the Cancer Registry should evaluate a number of parameters and conduct ongoing research about the screening program. Over 160 peer-reviewed articles have been published using data from the screening program. Most of these publications evaluate early performance measures such as false positive screening results, cancer detection rates, interval cancer, or stage distribution. The Cancer Registry has been the primary driving force behind this research.

Studies from the program presenting various models to estimate the cumulative risk of a false positive screening result, and models to estimate tumour growth have had considerable impact internationally. Further, the Norwegian program has made a substantial contribution to generating evidence that led to the transition from analogue (screen film) to full field digital mammography, and is now playing a leading role in evaluating digital breast tomosynthesis as a screening technique (26–28).

Current research initiatives focus on women’s expectations and experiences of mammographic screening, risk factors that may lead to stratified screening, interval breast cancer, overdiagnosis, and overtreatment. Several studies with international collaborators are ongoing and there are currently four PhD students and one post doc working with data from the screening program. See page S57 for more details.

Representatives from the Cancer Registry have been active in European and international research networks since the inception of the program. The current leader of the screening program is active in several international breast screening networks. She is also an active member of the European guidelines development working group in the European Commission Initiative on Breast Cancer, which is in the process of updating their recommendations for breast cancer screening and diagnosis.

IT systems

The Cancer Registry is responsible for the management and development of software and database solutions for the screening program, and for ensuring that the IT systems satisfy the information security requirements as set out in the Personal Data Act. The program developed its own IT solutions between 1994 and 1996 to securely share personal information about women between the Cancer Registry, breast centres, and screening units. These solutions are also used to send invitations and response letters to women.

The IT department at the Cancer Registry manages the oversight and administration of users, networks, security, database backups, and more. IT administrators currently support roughly 120 users and 30 servers.

The IT systems currently used by the screening program were originally developed for the four-year pilot project, which covered four screening areas and roughly 160,000 women. These systems grew with the program, and by the end of 2016 they had been used to send 4.4 million invitations to nearly 1 million women.

The screening program’s IT systems are based on distributed, replicated databases. Each breast centre has a database server. MedOutlook, a radiology information system (RIS) application, is used to connect to this database server. This server contains all data registered by the breast centre and its associated screening units (see Table 2.1 for an overview of breast centres and screening units). Every night these databases replicate to a main central database server at the Cancer Registry that contains all data for all centres in the program.

Information from the Cancer Registry’s database is also distributed to the breast centre databases every night. This includes information about invitations, those who have requested that data related to their identity be erased after the quality of the data has been assured, user IDs in the system, and more. Information used for invitation planning is updated every month from the National Registry. The National Registry contains information about changes in names, addresses, immigration status, and deaths for past and present residents.

A DICOM work list server at the Cancer Registry provides work lists for the stationary screening units. This server synchronises continuously with the databases at the breast centre database servers and mirrors the booking lists in MedOutlook.

All screening mammograms are stored in the local health trusts’ picture archiving and communication system (PACS) where images from each screening examination are tagged with a unique number. This number is the same as the number generated for each invitation and makes it possible to link mammograms to the MedOutlook RIS information for interpretation (using Med-Broker Sync).

Mobile units use a laptop with a desktop database to connect to the MedOutlook RIS. This information is sent to the breast centre via the Cancer Registry. The laptop is encrypted and uses a certificate, user name, and password to authenticate the connection to the Cancer Registry. A mobile broadband with a virtual private network (VPN) to the Cancer Registry is used to transfer data between the mobile units and breast centres. Further connection to the local database server at the breast centre from the Cancer Registry occurs in a closed environment. DICOM images are transferred to the breast centres using encrypted USB sticks.

Important components of the IT systems are:

- *Invitation program* – ensures regular invitations are sent to women across the country. Last major update was in 2005.
- *MedOutlook* – a modular radiology information system to register information about scheduled appointments, patient history, screening dates, interpretation and any consensus/arbitration results. Information is synchronised between the screening units, breast centres, and the Cancer Registry. Last major update was in 2004.

- *MedKod* - a program to register information about recall examinations and subsequent follow-up, and record which women have opted out of receiving invitations or have not consented to their negative screening data being stored at the Cancer Registry. Last major update was in 2015.
- *MedBroker* - a two-part integration solution used in screening. Used to transfer daily work lists to/from screening units (MedBroker Sync) and to synchronise workstations at the breast centres with the radiology information system (MedBroker Work List). This service is owned by Keymind, an external company, and user agreements are secured between Keymind and the local health trusts.
- *MedStat* - a data extraction and analysis program that serves as a foundation for quality assurance and program evaluation. Used by the breast centres and the Cancer Registry.
- *Teknisk kvalitetskontroll (TKK)* - a program for management of data from technical quality control procedures performed on analogue mammography equipment. Has been phased out due to the adoption of digital mammography. There is a need for a replacement.

The platforms used in the 1990s to support the screening program's IT systems are now outdated. This presents a significant challenge with respect to making changes and upgrades to meet current privacy and technology standards. Indeed, many temporary changes made during the transition from analogue to digital mammography (2000-2011) are still in use today. Modernisation and updates to the screening program's IT systems are needed.

Information

The Cancer Registry is responsible for providing information to women targeted by the program, health professionals and other program stakeholders, and the general population. This is done using a number of channels.

The main purpose of information shared with women is to provide them with balanced, high quality information about mammographic screening to enable them to make an informed choice whether to participate. This information should also ensure that women have the practical information they need to make use of their screening invitation. The current information material was developed using the principle of levelled information. In this way, the most important information is presented to all in the invitation letter, while more in depth information can be obtained by visiting the Cancer Registry's [website](#). A small portion of the Norwegian website has been translated to English. Additionally, fact sheets about the screening program are available online in Arabic and Urdu.

The screening program conveys information to women through personally addressed invitations and response letters. All letters are nationally standardised. In some screening areas, an information letter is sent to women prior to their first screening invitation to increase awareness about the program. The Cancer Registry has also established routines to provide municipalities with a standardised information package when mammographic screening takes place.

Since 2014, a Facebook page, "[Kreftsjekken](#)", has been used to interact with women targeted by the Norwegian Breast Cancer Screening Program and the Cervical Cancer Screening Program. Kreftsjekken had 6500 followers during the fall of 2017. The breast

screening program uses this page mainly to provide women with practical and community-specific information regarding mammography screening.

The Cancer Registry's website contains information on a variety of topics related to the screening program, such as the benefits and harms of mammographic screening, practical aspects related to participation, and the program's organisational structure, key results, and research activities. This makes the website central to all outreach activities. The website aims to educate women, health professionals, journalists, researchers and the general public about mammographic screening, the Norwegian Breast Cancer Screening Program and breast cancer. The screening program is actively working to increase information outreach through digital channels and applications.

Health professionals are an important target group for information outreach. The Cancer Registry aims to provide health professionals in the program with relevant, up to date information. A dedicated website, [Mammonett](#), is used to share organisational and professional news to those working at the program. Employees at the screening program also take an active role in the professional education of radiographers and radiologists, and breast surgeons.

Information material developments

The screening program has provided women in the target group with nationally standardised information since the start of the pilot in 1995. The content of this information has evolved over time to reflect changes in knowledge about the program and awareness toward the potential benefits and harms of mammographic screening. Four different design themes have been used (Figures 2.2, 2.3, 2.4, and 2.5), and a fifth design update is in progress. The program logo has changed slightly during each design phase.

The first brochure from 1995 was eight pages with black and white photographs. This brochure provided information about why an invitation was being offered, why early stage diagnosis is important, what to expect at screening, how results would be shared, and the possibility of recall for further assessment.

The program's second brochure was released in 2003. Women were provided with more extensive information, which included the possibility of interval breast cancer, false positive screening results, the risk of being recalled due to breast implants, and what to do if concerned about hereditary breast cancer. More information about what to expect at screening was also added.

A third brochure was released in 2009. The information was further extended and it was made more explicit that participating in the screening program is voluntary. The leaflet provided additional information about the benefits and harms of screening, including some information on overdiagnosis/overtreatment together with additional information about the registration and use of personal data.

The fourth version was launched in 2017. A fact sheet accompanying the invitation letter replaced the brochure. This fact sheet presented the program and described what to expect during screening. An infographic was added to the fact sheet and emphasis was placed on making women aware that mammographic screening has potential benefits and harms to encourage women to make an active and informed choice whether to attend.



Figure 2.2: First information brochure produced by the Norwegian Breast Cancer Screening Program (c. 1995): "A mammography examination can save lives."



Figure 2.3: Updated information brochure from 2003: "Mammography can save lives."



Figure 2.4: Information brochure from 2009: "Mammography can save lives."

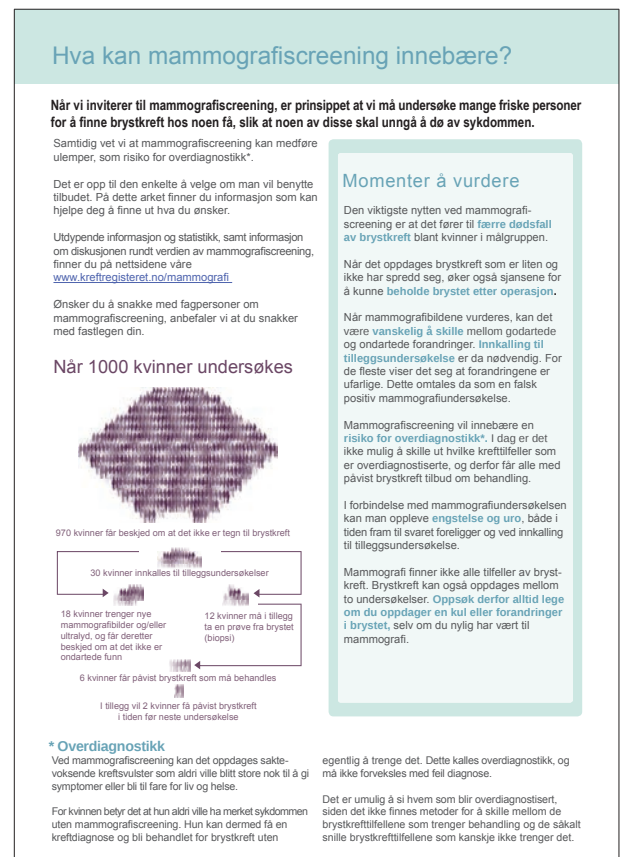


Figure 2.5: Information leaflet from 2017, "What can mammography involve?"

The regional health authorities and local health trusts

The regional health authorities are responsible for offering specialised health services. This includes facilitating mammographic screening examinations and any further assessment, including diagnostic examinations as well as treatment. For all practical purposes, the local health trusts are responsible for performing screening examinations and ensuring that adequate facilities and capacity, including personnel, are available for screening and assessment.

Breast centres and screening units

Currently, the four regional health authorities offer mammographic screening through 16 breast centres and associated screening units. These breast centres are responsible for the breast care of all women in their jurisdiction and are staffed by a professional multidisciplinary team that includes radiographers, radiologists, surgeons, nurses, pathologists, oncologists, and administrative personnel.

Women targeted by the Norwegian Breast Cancer Screening Program are currently invited to 26 stationary and 4 mobile screening units associated with the 16 breast centres (Table 2.1). Screening areas largely correspond to county borders, except for Vestre Viken, Akershus, Agder (Øst and Vest Agder), Trøndelag (Nord and Sør Trøndelag), and Troms og Finnmark. Women from some communities are invited to screening in a neighbouring county in the case that it substantially decreases their travel time.

The interpretation of screening mammograms and any further assessment takes place at the breast centres. All mammograms are independently read by two radiologists and a score between 1 and 5 is assigned to each breast. A score of 1 indicates negative for abnormality; 2, probably benign; 3, intermediate suspicion; 4, probably malignant; and 5, high suspicion of malignancy. If both radiologists give a score of 1, the screening examination is considered negative. If either radiologist gives a score of 2 or higher, a consensus or arbitration meeting is held to determine whether to recall a woman back for further assessment. Further assessment includes additional imaging (such as mammography, tomosynthesis and/or ultrasound) and potentially needle biopsy. Results from these assessments are discussed at a multidisciplinary meet-

ing with radiologists, surgeons, and pathologists where a decision is made regarding further follow-up and treatment. Women diagnosed with breast cancer are followed-up and treated according to national guidelines (29).

Mobile screening

Three mobile screening units (Emma, Frøya, and James) were acquired between 1995 and 1996, and a fourth (Kaiia) was acquired in 1999, with funds from the Ministry of Health and Care Services. The local health trusts independently decide whether to offer screening at mobile units. The “department for electro-medical services” (*avdeling for mobile elektromedisinske tjenester*, Vestre Viken Health Trust) is responsible for these units.

The costs associated with staffing and running the mobile units are covered by the local health trusts’ budgets. The “department for electro-medical services” is responsible for technical quality assurance and control activities, maintenance, and transportation of the mobile units between screening locations (21).

The results of early performance measures from mobile units compared to stationary units are presented on page S50.

Local quality assurance

The local health trusts must have authorisation for the medical use of x-ray apparatus in accordance with the Act on Radiation Protection and Use of Radiation (30). The breast centres and screening units are responsible for technical quality control and for quality assurance of their activities according to the manual (see page S8). The MedStat program facilitates some of these tasks.

The quality assurance manual specifies that health care personnel and other employees involved in the screening program must possess knowledge regarding the program’s organisation and operations and must be familiar with the responsibilities of other health professionals (21).

The local health trusts are responsible for promoting multidisciplinary collaboration. Such cooperation is recommended in the quality assurance manual for delivering high quality breast care, as it lays the foundation for establishing, maintaining, and improving quality and expert knowledge of screening, diagnostics, and treatment (21).



Figure 2.6: Waiting room the Danmarks plass screening unit, Bergen (2017). Photo by Berit Hanestad, Hordaland breast centre



Figure 2.7: Mobile screening unit Emma with radiographers Kirsten L. Jensen (L) and Inger J. Melsbøe (R) in Hammerfest (2011). Photo by Sonja Stormo, UNN Tromsø breast centre

Table 2.1: Target population, breast centre, and screening units for past and present breast screening areas in the Norwegian Breast Cancer Screening Program

Screening area	Target population		Breast centre	Screening units
	First round	Latest round		
Rogaland	31,091	51,469	Stavanger universitetssjukehus	Gamle Stavanger sykehus Haugesund sykehus
Hordaland	38,437	56,104	Haukeland universitetssjukehus	Danmarks plass, Bergen Haukeland universitetssjukehus ¹ Mobile screening unit
Oslo	46,338	65,169	Oslo universitetssykehus	Aker sykehus Galleri Oslo ¹ Majorstuen ¹
Akershus ²	44,655	-	Radiumhospitalet	Akershus Universitetssykehus ¹ Galleri Oslo ¹ Løkketangen, Sandvika ¹ Lillestrøm sykehus ² Mobile screening unit
Telemark	17,760	22,805	Sykehuset Telemark Porsgrunn	Sykehuset Telemark Porsgrunn Down Town kjøpesenter ¹ Rjukan ¹
Agder	25,908	35,506	Sørlandet sykehus Kristiansand	Arendal sykehus Flekkefjord sykehus Kristiansand sykehus Røntgensenteret AS, Kristiansand ¹ Mobile screening unit
Troms og Finnmark	22,101	32,592	UNN ³ Tromsø	UNN ³ Tromsø UNN ³ Narvik UNN ³ Harstad Mobile screening unit
Østfold	29,126	37,050	Sykehuset Østfold Kalnes Fredrikstad sykehus ¹	Sykehuset Østfold Kalnes Fredrikstad sykehus ¹
Nordland	25,334	27,774	Nordlandssykehuset Bodø	Nordlandssykehuset Bodø Mobile screening unit
Buskerud ⁴	26,797	-	Drammen sykehus ⁴	Drammen sykehus ⁴
Trøndelag	41,455	52,866	St. Olavs Hospital	St. Olavs Hospital, Trondheim Levanger sykehus Namsos sykehus Kjøpmannsgata 17, Trondheim ¹ Mobile screening unit
Oppland	21,218	26,520	Sykehuset Innlandet Lillehammer	Sykehuset Innlandet Lillehammer Mobile screening unit
Møre og Romsdal	25,221	32,091	Ålesund sjukehus	Ålesund sjukehus Molde sjukehus Mobile screening unit
Sogn og Fjordane	11,138	13,315	Førde Sentralsjukehus	Førde Sentralsjukehus
Vestfold	25,686	33,797	Sykehuset i Vestfold, Tønsberg	Sykehuset i Vestfold, Tønsberg
Hedmark	23,017	26,813	Sykehuset Innlandet Hamar	Sykehuset Innlandet Hamar Mobile screening unit
Akershus Øst ²	39,703	48,678	Akershus universitetssykehus	Ski sykehus Lillestrøm sykehus Romerike Helsebygg ¹
Akershus Vest ^{2,4}	18,383	-	Radiumhospitalet	Sandvika storsenter ¹
Vestre Viken ⁴	52,177	58,557	Drammen sykehus	Drammen sykehus Bærum sykehus Mobile screening unit

¹ No longer a screening location² The Akershus breast screening region was split into Akershus Øst and Akershus Vest in August 2007³ Universitetssykehuset Nord-Norge⁴ Buskerud and Akershus Vest were merged to form a new screening area, Vestre Viken, in August 2011

Financial management

Until 2004, the financial management of the screening program was centralised at the Cancer Registry. When the regional health authorities were established in 2004 as part of a larger restructuring of the health care system, the management of finances changed to match this new organisational structure.

Since 2004, the regional health authorities have, through the local health trusts, been responsible for financing screening activities, including follow-up assessment, diagnostics, and treatment performed within their jurisdiction. As of September 2017, women pay their local health trust a fee of NOK 245 for screening and any further assessment.

The Cancer Registry pays the wages of internal employees who work at the screening program. As of October 2017, there are nine full-time employees in the mammography section. Database management, and the development of software and database solutions for the program are integrated tasks in the IT department.

Leadership and advisory groups

Past leadership

Over the past 20 years, four individuals have been responsible for the daily operation of the screening program.

Steinar Østerbø Thoresen led the program until 2004, throughout the entire initiation and planning phase, as well as during the pilot and its later expansion to a nationwide program. He was also the leader for the Norwegian Cervical Cancer Screening program during this time, and head of the Department of screening-based research at the Cancer Registry until 2006.

Mette Kalager led the program from October 2004 to June 2006. Berit Damtjernhaug led the program from January 2007 to May 2013. Solveig Hofvind has been the leader of the program since June 2013.

Steering group

A multidisciplinary Steering Group was established in 2015. The mandate of this group is to provide high-level advice and recommendations to the Cancer Registry and the Directorate of Health. Members are appointed from the regional health authorities, the Norwegian Association of General Practitioners and the Norwegian Cancer Society. The Director of the Cancer Registry is a permanent member of the group. The person in charge of the screening program has an observer role. To ensure that the screening program maintains its high professional quality, the Steering Group reviews aspects related to data sources, early performance measures, diagnostic methods, information outreach, target groups, and ethics, among others. The Steering Group is responsible for ensuring that the screening program has a quality assurance manual. Finally, the Steering Group can recommend the initiation of an external evaluation of the program.

Advisory groups

An advisory group has guided the development of the screening program since its inception. This group provides advice to the secretariat of the program. The group's mandate and structure is currently under revision.

The Cancer Registry currently has informal working groups in the disciplines of radiology, pathology and medical physics that have provided guidance to the secretariat on subjects relevant to their professional development and the screening program.



Figure 2.8: Radiographers from around the country recently participated in “ambassador week”, an initiative in preparation for a new mammography specialisation program in radiography (Oslo, August 2017). Photo by Gunhild Mangerud, Cancer Registry of Norway

3. Start-up and noteworthy developments

Following years of discussion about the merits of organised mammographic breast cancer screening in Norway, the Norwegian Breast Cancer Screening Program started as a pilot project in Rogaland in November 1995. Hordaland, Akershus, and Oslo joined the project during the first quarter of 1996. The pilot was initially intended to be a four year project, however, in 1998, after the first screening round, the government made a decision to offer mammographic screening for breast cancer nationwide. The screening program became nationwide in 2005 following a staggered implementation. This chapter describes the start-up of the program. It also presents important developments that have affected the program such as changes in legislation and organisation, as well as the transition to full field digital mammography.

Start-up of the national program

Discussions about screening, 1980-1992

A national discussion about organised mammographic screening for breast cancer started in the 1980s following the publication of results from Swedish randomised controlled trials that suggested mammographic screening reduced breast cancer mortality (31). These results were confirmed by other international trials and in 1985 the Directorate of Health established a working group to evaluate the potential benefits, harms, and costs of implementing mammographic screening in Norway (32–35).

No randomised controlled trials for mammographic screening were performed in Norway, but based on results from trials conducted in other countries, the working group published the Official Norwegian Report NOU 1987:7 *Mammografiscreening i Norge* (“Mammographic screening in Norway”) (36). This report recommended biennial screening for women aged 50-74 and suggested that there may be some evidence to recommend annual screening for women aged 40-49.

In 1989, a multidisciplinary national consensus meeting was held to discuss organised screening in Norway. The outcome of this meeting was a recommendation against organised screening until the latest results on screening from the Swedish trials were published (37–39). Following the consensus meeting, the original NOU 1987:7 working group revised their report and an update was released in 1990. The updated recommendations were largely the same as those in the original report but instead recommended screening for women aged 50-69.

During this time, individual municipalities had also been discussing the merits of organised breast cancer screening. In 1986, the municipality of Oslo recommended screening for women aged 50-74 and the neighbouring municipality of Akershus recommended screening for women aged 40-70 in 1990. The municipality of Oslo updated their report in 1994 to recommend screening for women aged 50-69.

Although the debate about organised screening by now had been active for years, no concrete plans for an organised screening program had been put in place. However, it was estimated that approximately 220,000 mammograms were acquired in Norway in 1993, and about 70% of these were acquired outside of the public health system (40). At this time, many countries in Europe had either implemented or decided to implement an organised screening program (41). In the Nordic countries, organised screening was available to varying degrees in Sweden, Finland, Iceland, and Denmark (41).

In 1991, the Norwegian Cancer Society provided 5 million NOK to the Directorate of Health for the planning and initiation of publicly available mammographic screening. A year later the Ministry of Labour and Social Affairs (now the Ministry of Health and Care Services) asked the Directorate of Health to draw up a concrete plan for organised screening in one or more counties. This plan was delivered in the fall of 1992 and an appendix report was provided by the National Health Screening Service (now a part of the Norwegian Institute of Public Health).

Pilot project, 1993-1997

Despite the plans provided in 1992, the Ministry of Labour and Social Affairs required additional investigation related to organisational, technical, and financial resources associated with organised screening. A reference group was formed in 1993 to investigate and plan a pilot project for organised mammographic screening for breast cancer in Norway. The following year, the reference group delivered their report. Their plan was approved and approximately 25 million NOK was allocated from the state budget to implement a four-year pilot project.

The primary objective of the pilot project was to identify methods to implement screening that could reasonably be expected to reduce breast cancer mortality. The secondary objective was to assess the organisational, technical, and financial needs associated with breast cancer screening in the pilot counties and to determine the needs of a nationwide program (42).

The counties of Rogaland, Hordaland, and Akershus were initially selected for the pilot project. A short time later, Oslo was also included. The plan was to invite about 160,000 women, roughly 40% of women aged 50-69 in Norway, to two screening rounds during the pilot project (42, 43). All four counties received national financing to support biennial mammographic screening, as recommended in the 1994 project plan. The first county, Rogaland, started screening in November 1995. Hordaland and Oslo started screening in January 1996, and Akershus started screening in February 1996. The first screening round in all four counties took place during 1996-1997.

Nationwide expansion, 1998-2005

In the spring of 1998, Parliament passed a motion to implement a nationwide program as soon as the necessary personnel were available. To this end, the 1998 state budget increased the funding allocated to mammographic screening by 20 million NOK to extend screening services to an additional four counties.

New counties joined the program through an application process to the Cancer Registry, which worked in close collaboration with the Ministry of Health and Care Services. The birth cohorts targeted for screening, planned organisation, competence and access to qualified professionals, treatment capacity, and investment needs (primarily in terms of medical equipment) were assessed as part of this process. Financing for equipment, renovations, mobile screening units, professional training, and operating expenses was obtained through grants from the Ministry of Health and Care Services. Expansion of the program continued gradually in this way until becoming nationwide in 2004/05.

Noteworthy developments

Organisational changes

Several institutions have been involved in the planning of invitations and letter dispatch throughout the program's history. From 1995 to 2001, the National Health Screening Service was responsible for invitation planning in collaboration with the breast centres, and for dispatching invitation and result letters. On January 1, 2002, *Statens Institutt for Folkehelse* and the National Health Screening Service joined to form the Norwegian Institute of Public Health. The Norwegian Institute of Public Health was then responsible for invitation planning and letter dispatch on behalf of the screening program.

After mid-2003, the Norwegian Institute of Public Health was responsible only for the dispatch of letters as the Cancer Registry took over the function of planning invitations. The Norwegian Institute of Public Health's official role in the screening program formally ended on January 1, 2016, when the screening program joined the national program for secure digital mail. Since then, letter dispatch has taken place under this agreement with other service providers.

The National Health Screening Service, and later the Norwegian Institute of Public Health, were responsible for the procurement and operation of the mobile screening units until 2004. This has since been the responsibility of the "department for electro-medical services" (*avdeling for mobile elektromedisinske tjenester*, Vestre Viken Health Trust). More information on the mobile units can be found on page S12.

Multidisciplinary breast centres

The introduction of organised screening in Norway was strongly associated with optimised diagnostics, treatment and improved survival through multidisciplinary medical management and care (44). During the expansion period until the screening program became nationwide, 17 multidisciplinary breast centres were established across Norway, and the number of hospitals performing breast cancer surgery was reduced from over 50 to about 20. This development was closely tied to the implementation of the organised screening program.

Another driving force in this development was the publication of national recommendations for breast cancer diagnosis and treatment, which have been published regularly since 1981 (29, 45). These guidelines, in combination with the specialised, multidisciplinary breast centres, have been critical in ensuring women, regardless of where they are live in Norway, in principle are offered the same diagnostics and treatment for breast cancer. This development has served as a model for other areas of cancer diagnosis and treatment in Norway.



Figure 3.1: Radiologists Stanimir Yanakiev (L) and Hanna Bjerke (R) at work, Oslo breast centre (2017). Photo by Gunhild Mangerud, Cancer Registry of Norway

Technical quality assurance

During the pilot project, and later in the national program until 2017, the Norwegian Radiation Protection Authority was responsible for technical quality assurance. As a result, the Radiation Protection Authority has been central in the development of quality assurance procedures in the screening program to ensure an optimal balance between image quality and exposure to ionising radiation. Also, in preparation for the pilot project, the Radiation Protection Authority developed two technical quality control manuals for the quality assurance of equipment used for patient exposure and film development in mammography. One of these manuals addressed comprehensive acceptance and status controls, while the other addressed frequently conducted quality control activities.

A survey group at the Radiation Protection Authority has been responsible for all acceptance and status control testing of the equipment used for screening or diagnostic mammography during most of the programs' history. Acceptance and status control activities were typically performed by medical physicists from this survey group following the installation of new equipment and then at annual intervals thereafter (Figure 3.2). When analogue images were in use, acceptance testing also included the evaluation of film developers.

The breast centres were initially responsible for frequent quality control activities on screening and diagnostic equipment. Each breast centre named a quality control radiographer who was in contact with the Radiation Protection Authority and who reported quality control results biennially. The Radiation Protection Authority was also actively involved in training radiographers in the screening program.

Transition to digital mammography

The arrival of full-field digital mammography systems (digital mammography) on the market coincided with the gradual implementation of organised screening in Norway. This sparked a debate over whether counties joining the screening program should invest in screen-film mammography (analogue mammography), or the newer digital systems. At the time, there were no established procedures for technical quality control or functionality evaluation for digital mammography.

When a GE Senographe 2000D full-field digital mammography machine was installed at Galleri Oslo in 1999, not only was it the first full-field digital mammography unit in Norway, but also the first intended for screening. By the time a second machine was installed at Ullevål University Hospital about four months later, a project plan had been developed to compare full-field digital mammography to analogue mammography in screening. This project would become known as the Oslo I study (26, 46). Later on, the Oslo II study was conducted (27, 47). When Oslo I started in early 2000, 12 counties had yet to join the screening program. Four years later in 2004, Vestfold was the last county to join the screening program, the second to offer full-field digital mammography, and the first to screen exclusively with full-field digital mammography (48). Table 3.1 summarises when digital mammo-

graphy was implemented at each screening unit in the program. More information on the Oslo I and II studies can be found on page S57.

The implementation of digital mammography presented a broad range of challenges, from purely technical, to knowledge-based and procedural. In addition to the requirements for equipment training and the time needed to gain interpretative experience with digital images, there was a need to develop a new framework for storing, transferring, retrieving and presenting studies and images. Furthermore, workplace routines needed to be adapted to suit and take advantage of this new technology. Some of these topics were addressed early on by two working groups, which published their opinions on challenges and solutions in two reports (49, 50).

In 2009, a protocol for routine quality control, developed in close cooperation with radiographers, was published (24, 51). A year later a national protocol for acceptance and status control testing was published, based both on European guidelines and acquired experience in quality control of digital mammography systems (23). The transition from analogue to full-field digital mammography in the screening program was completed when Møre og Romsdal implemented full-field digital mammography in the fall of 2011.



Figure 3.4: Radiographer Sonja Stormo hanging analogue mammograms, UNN Tromsø breast centre (2003). Photo by Kristin Pedersen, UNN



Figure 3.5: Radiologist Jan Ole Frantzen reading digital mammograms, UNN Tromsø breast centre (2003). Photo by Kristin Pedersen, UNN

Table 3.1: Installation of full-field digital mammography equipment at stationary and mobile screening units by screening area

Screening area	Stationary screening units	FFDM start
Rogaland	Gamle Stavangersykehus	01.2007
	Haugesund sykehus	05.2007
Hordaland	Danmarks plass, Bergen	09.2014
	Haukeland universitetssjukehus ¹	08.2007
Oslo	Aker sykehus	08.2013
	Galleri Oslo ^{1,2}	01.2000-01.2005
	Majorstuen ¹	-
Akershus ³	Akershus Universitetssykehus	-
	Galleri Oslo ^{1,2}	01.2000-01.2005
	Løkketangen, Sandvika	-
	Lillestrøm sykehus	08.2007
Telemark	Sykehuset Telemark Porsgrunn	08.2008
	Downtown kjøpesenter ¹	-
	Rjukan ¹	-
Agder	Arendal sykehus	08.2010
	Flekkefjord sykehus	02.2011
	Kristiansand sykehus	09.2010
	Røntgensenteret AS, Kristiansand	-
Troms og Finnmark	UNN ⁴ Tromsø	09.2004
	UNN ⁴ Narvik	01.2011
	UNN ⁴ Harstad	02.2013
Østfold	Sykehuset Østfold Kalnes	-
	Fredrikstad sykehus ¹	08.2008
Nordland	Nordlandssykehuset Bodø	09.2009
Buskerud ⁵	Drammen sykehus ⁵	04.2009
Trøndelag	St. Olavs Hospital, Trondheim	11.2008
	Levanger sykehus	09.2009
	Namsos sykehus	09.2009
	Kjøpmannsgata 17, Trondheim ¹	-
Oppland	Sykehuset Innlandet Lillehammer	01.2010
Møre og Romsdal	Ålesund sjukehus	08.2011
	Molde sjukehus	08.2011
Sogn og Fjordane	Førde Sentralsjukehus	08.2006
Vestfold	Sykehuset i Vestfold, Tønsberg	02.2004
Hedmark	Sykehuset Innland Hamar	10.2009
Akershus Øst ³	Ski sykehus	01.2009
	Lillestrøm sykehus	08.2007
	Romerike Helsebygg ¹	08.2012
Akershus Vest ^{3,5}	Sandvika storsenter ¹	-
Vestre Viken ⁵	Drammen sykehus ⁵	04.2009
	Bærum sykehus	08.2011
	Mobile screening units	FFDM start
	Emma	08.2008
	Frøya	04.2010
	James	04.2008
	Kaiia	05.2009

¹ No longer a screening location² The Oslo I and II trials were performed from 2000-2001 (see page S57 for more information). Women were randomly allocated to screening with digital mammography between 2002 and 2005.³ The Akershus breast screening region was split into Akershus Øst and Akershus Vest in August 2007⁴ Universitetssykehuset Nord-Norge⁵ Buskerud and Akershus Vest were merged to form a new screening area, Vestre Viken, in August 2011

4. Early performance measures, 1996-2016

This chapter presents the results of early performance measures for the Norwegian Breast Cancer Screening Program. The following early performance measures are reported: attendance, recall, and cancer detection rates, positive predictive values, histopathologic tumour characteristics, and surgery rates. A number of these are considered to be important for program surveillance in order to reduce future breast cancer mortality.

Data considerations

Data used for this report were extracted from the Cancer Registry during June 2017. Results are presented for all of Norway and for each screening area. Although all analyses were population-based, some screening areas serve rural populations and some results are therefore based on small cell counts. This can also be the case in years when individual screening areas joined the screening program or were merged with other areas (Table 4.1). The number of women invited to screening and diagnosed with breast cancer in each screening area can give an idea of the magnitude of this issue (see Tables 4.4, 4.8 and 4.11).

Results pertaining to invitations, attendance, recalls, and screen-detected breast cancers are presented for the period 1996-2016. Results pertaining to interval breast cancers are presented for women screened between 1996-2014 and diagnosed between 1996-

2016, as a two-year period is required to diagnose all interval breast cancers following a screening examination. Information about needle biopsies with malignant outcomes is presented for 1996-2016, while information about benign outcomes is presented for 1996-2015. While figures may present data on a yearly basis, tables present this data using the following categories: 1996-2000, 2001-2005, 2006-2010, 2011-2015, and 2016.

The transition from screen-film to digital mammography took place between 2000 and 2011. Table 3.1 outlines when each screening unit began screening with digital mammography.

The screening program targets women aged 50-69. However, women aged 48-71 are invited due to the staggered implementation of the screening program (Table 4.1). Age at diagnosis can range from 48-73 years because women are followed for interval breast cancer for two years after their last screening examination.

Since the screening program rolled out nationwide, the majority of prevalently screened women have been 50-51 years old and the subsequently screened women have been 52 years or older. Age-stratified results are presented based on either age at invitation, screening, or diagnosis.

Lastly, the screening program's databases are continuously updated and corrected. Results presented in this report may therefore deviate slightly from those in previous publications.



Table 4.1: The Norwegian Breast Cancer Screening Program was implemented gradually on a per-county basis between 1995 and 2005. Different birth cohorts are screened in different years depending on the screening area. Women are generally sent invitations to attend ten screening rounds between the ages of 50 and 69

Screening area	Screening start	1	2	3	4	5	6	7	8	9	10	11	
Rogaland	11.1995	Screening years Birth cohorts	1996-1997 1927-1946	1998-1999 1927-1948	2000-2001 1931-1950	2002-2003 1933-1952	2004-2005 1935-1954	2006-2007 1937-1956	2008-2009 1939-1958	2010-2011 1941-1960	2012-2013 1943-1962	2014-2015 1945-1964	2016-2017 1947-1966
Hordaland	01.1996	Screening years Birth cohorts	1996-1997 1927-1946	1998-1999 1927-1948	2000-2001 1931-1950	2002-2003 1933-1952	2004-2005 1935-1954	2006-2007 1937-1956	2008-2009 1939-1958	2010-2011 1941-1960	2012-2013 1943-1962	2014-2015 1945-1964	2016-2017 1947-1966
Oslo	01.1996	Screening years Birth cohorts	1996-1997 1927-1946	1998-1999 1927-1948	2000-2001 1931-1950	2002-2003 1933-1952	2004-2005 1935-1954	2006-2007 1937-1956	2008-2009 1939-1958	2010-2011 1941-1960	2012-2013 1943-1962	2014-2015 1945-1964	2016-2017 1947-1966
Akershus ¹	02.1996	Screening years Birth cohorts	1996-1997 1927-1946	1998-1999 1927-1948	2000-2001 1931-1950	2002-2003 1933-1952	2004-2005 1935-1954	2006-2007 1937-1956	2008-2009 1939-1958	2010-2011 1941-1960	2012-2013 1943-1962	2014-2015 1945-1964	2016-2017 1947-1966
Telemark	09.1999	Screening years Birth cohorts	1999-2001 1931-1950	2001-2003 1933-1952	2003-2005 1935-1954	2005-2007 1937-1956	2007-2009 1939-1958	2009-2011 1941-1960	2011-2013 1943-1962	2013-2015 1945-1964	2015-2017 1947-1966		
Agder	11.1999	Screening years Birth cohorts	1999-2001 1931-1950	2002-2003 1933-1952	2004-2005 1935-1954	2006-2007 1937-1956	2008-2009 1939-1958	2010-2011 1941-1960	2012-2013 1943-1962	2014-2015 1945-1964	2016-2017 1947-1966		
Troms og Finnmark	05.2000	Screening years Birth cohorts	2000-2002 1931-1950	2002-2004 1933-1952	2004-2006 1935-1954	2006-2008 1937-1956	2008-2010 1939-1958	2010-2012 1941-1960	2012-2014 1943-1962	2014-2016 1945-1964	2016-2018 1947-1966		
Østfold	04.2001	Screening years Birth cohorts	2001-2003 1933-1952	2003-2005 1935-1954	2005-2007 1937-1956	2007-2009 1939-1958	2009-2011 1941-1960	2011-2013 1943-1962	2013-2015 1945-1964	2015-2017 1947-1966			
Nordland	05.2001	Screening years Birth cohorts	2001-2003 1933-1952	2003-2005 1935-1954	2005-2007 1937-1956	2007-2009 1939-1958	2009-2011 1941-1960	2011-2013 1943-1962	2013-2015 1945-1964	2015-2017 1947-1966			
Buskerud ²	09.2001	Screening years Birth cohorts	2001-2003 1933-1952	2003-2005 1935-1954	2005-2007 1937-1956	2007-2009 1939-1958	2009-2011 1941-1960						
Trøndelag	09.2001	Screening years Birth cohorts	2001-2003 1933-1952	2003-2005 1935-1954	2005-2007 1937-1956	2007-2009 1939-1958	2009-2011 1941-1960	2011-2013 1943-1962	2013-2015 1945-1964	2015-2017 1947-1966			
Oppland	01.2002	Screening years Birth cohorts	2002-2003 1933-1952	2004-2005 1935-1954	2006-2007 1937-1956	2008-2009 1939-1958	2010-2011 1941-1960	2012-2013 1943-1962	2014-2015 1945-1964	2016-2017 1947-1967			
Møre og Romsdal	04.2002	Screening years Birth cohorts	2002-2004 1933-1952	2004-2006 1935-1954	2006-2008 1937-1956	2008-2010 1939-1958	2010-2012 1941-1960	2012-2014 1943-1962	2014-2016 1945-1964	2016-2018 1947-1966			
Sogn og Fjordane	01.2003	Screening years Birth cohorts	2003-2004 1935-1954	2005-2006 1937-1956	2007-2008 1939-1958	2009-2010 1941-1960	2011-2012 1943-1962	2013-2014 1945-1964	2015-2016 1947-1966				
Hedmark	08.2003	Screening years Birth cohorts	2003-2005 1935-1954	2005-2007 1937-1956	2007-2009 1939-1958	2009-2011 1941-1960	2011-2013 1943-1962	2013-2015 1945-1964	2015-2017 1947-1966				
Vestfold	02.2004	Screening years Birth cohorts	2004-2005 1935-1954	2006-2007 1937-1957	2008-2009 1939-1959	2010-2011 1941-1961	2012-2013 1943-1963	2014-2015 1945-1965	2016-2017 1947-1967				
Akershus Øst ¹	01.2006	Screening years Birth cohorts	2006-2007 1937-1956	2008-2009 1939-1958	2010-2011 1941-1960	2012-2013 1943-1962	2014-2015 1945-1964	2016-2017 1947-1966					
Akershus Vest ¹	01.2006	Screening years Birth cohorts	2006-2007 1937-1956	2008-2009 1939-1958	2010-2011 1941-1960/61								
Vestre Viken ²	08.2011	Screening years Birth cohorts	2011 1941-1961	2012-2013 1943-1962	2014-2015 1945-1964	2016-2017 1947-1966							

¹ The Akershus breast screening region split into Akershus Øst and Akershus Vest in 2006 ² Buskerud and Akershus Vest were merged to form a new screening area, Vestre Viken, in August 2011

The right to withdraw from data storage

Women with a negative screening result have the right to request that data relating to their identity be erased from the screening database after the quality of the data has been assured. As of December 31, 2016, roughly 15,385 women had made such a request. These women represent approximately 1.6% of all invited women and 1.9% of all participating women (Table 4.2). Information about these women is excluded from this report.

The right to opt out from being invited

Women invited to the screening program may opt out of receiving future invitations. As of December 31, 2016, roughly 3.8% of women invited to the program had opted out (Table 4.2). Although it is voluntary to cite a reason for requesting an invitation stop, over 40% of women cited a diagnosis of breast cancer as the reason for

their request. These women are typically followed up with mammography outside of the screening program. It is also expected that some women opt out of receiving invitations to the screening program because they attend screening at private clinics, or because they consider the potential harms associated with mammographic screening to outweigh the benefits.

In Hordaland, only 1.1% of invited women had opted out. This is likely associated with the fact that Hordaland has unique follow-up procedures for women diagnosed with breast cancer.

Møre og Romsdal has the highest proportion of invited women who had opted out, 7.3%. It is also well known that women residing in Kristiansund and surrounding areas have an attendance rate below 30% among those invited. This may be due to a higher rate of opportunistic screening at private centres in this area.

Table 4.2: Approximate number (n) and proportion (%) of women who have ever requested that data about their negative screening examinations should be erased or who have opted out from receiving future invitations, as of December 31, 2016

Screening area	Invited	Attended	Requested negative data be erased			Opted out from the program	
			n	% of invited	% of attended	n	% of invited
Rogaland	84,740	73,865	1355	1.6 %	1.8 %	2845	3.4 %
Hordaland	95,590	83,395	2155	2.3 %	2.6 %	1035	1.1 %
Oslo	123,330	87,710	2720	2.2 %	3.1 %	7110	5.8 %
Akershus	73,615	46,760	1850	2.5 %	4.0 %	3030	4.1 %
Telemark	36,540	31,165	515	1.4 %	1.7 %	920	2.5 %
Agder	54,005	47,180	790	1.5 %	1.7 %	1565	2.9 %
Troms og Finnmark	48,725	41,590	965	2.0 %	2.3 %	1670	3.4 %
Østfold	54,945	45,525	535	1.0 %	1.2 %	2780	5.1 %
Nordland	43,055	39,690	545	1.3 %	1.4 %	1445	3.4 %
Buskerud	41,500	27,030	640	1.5 %	2.4 %	1955	4.7 %
Trøndelag	79,085	69,035	945	1.2 %	1.4 %	2175	2.8 %
Oppland	38,255	32,050	500	1.3 %	1.6 %	1285	3.4 %
Møre og Romsdal	45,725	37,000	630	1.4 %	1.7 %	3370	7.4 %
Sogn og Fjordane	18,900	17,245	195	1.0 %	1.1 %	375	2.0 %
Vestfold	41,955	36,175	395	0.9 %	1.1 %	1885	4.5 %
Hedmark	37,160	31,375	465	1.3 %	1.5 %	1430	3.8 %
Akershus Øst	24,765	34,070	85	0.3 %	0.2 %	710	2.9 %
Akershus Vest	5605	5465	55	1.0 %	1.0 %	280	5.0 %
Vestre Viken	17,095	28,525	40	0.2 %	0.1 %	405	2.4 %
Total	964,590	814,850	15,380	1.6 %	1.9 %	36,270	3.8 %

Screening intervals

The program's screening interval is two years. That is, appointments are scheduled every 2 years $\pm$ 6 months (730 days $\pm$ 180 days). Practically, individual screening intervals are determined based on the date of a woman's last screening examination. From 1996 to 2016, the average (mean) time between two screening invitations was 741 days (median 731 days, Table 4.3).

Women who do not respond to their ordinary invitation are sent a reminder. Women who attend screening as a result of the reminder are invited to screening two years following the date of

their screening examination. This increases the average screening interval for those women and the program. Those who do not attend following the reminder are sent a new invitation two years after the original appointment date.

The use of mobile screening units can also affect screening intervals. These units are stationed for up to 16 weeks. Opportunities for attending a mobile unit in response to a reminder are dependent on the length of a mobile unit's stay at a given site. Once a mobile unit has moved, women must attend their local stationary unit for screening.

Table 4.3: Mean and median number of calendar days between invitations and screening examinations

Time between	Mean	Median	Interquartile range
Dispatch of two ordinary invitations	741	731	720-746
Two consecutive screening examinations following ordinary invitations	730	730	719-742
Two consecutive screening examinations following an ordinary invitation and a reminder	806	785	769-801
Two screening examinations regardless of attendance pattern	785	733	720-748



Invitations and attendance

From the initiation of the screening program in 1996 through to the end of 2016, over 4.4 million personal invitations were sent to 947,933 women across the country. Approximately 3.3 million screening examinations were taken during this time and, on average, three out of four women (76%) attended the program.

The number of invitations sent to women increased almost every year, from 61,577 in 1996, to 299,040 in 2016 (Figure 4.1). During this time, the yearly number of women attending screening increased from 49,526 to 223,266. Increases between 1996 and 2004 largely reflect the expansion of the screening program, while increases between 2005 and 2016 reflect the growing number of women in the target group.

After becoming a nationwide program in 2005, the attendance rate declined from a high of 77% in 2006 to a low of 73% in 2012. However, it has been stable at 75% in the years since. Over the past 20 years, the average attendance rate following an ordinary invitation was 71%. The average attendance rate among women who received a reminder following an ordinary invitation was 17%, which corresponds to a nearly five percentage-point increase in overall attendance and is an important factor in helping the screening program achieve the desired attendance rate of at least 75% (Figure 4.2).

On average, women of all ages attend screening at a rate that exceeds the target level of 70%. Women receiving a prevalent invitation (primarily younger women) and women aged under 55 receiving a subsequent invitation have the lowest attendance (73%). Women between the ages of 60–64 have the highest attendance rate on average (78%) (Figure 4.3).

Rogaland, Hordaland, Nordland, and Sogn og Fjordane have the highest attendance rates ($\geq 80\%$, Table 4.5). To access the screening program, some women in Rogaland and Sogn og Fjordane must travel to Stavanger/Haugesund and Førde, respectively. Women in Sogn og Fjordane may have to travel as many as three hours to reach the screening unit. This is in stark contrast to Oslo which frequently has the lowest attendance rates, dating back to the inception of the program (64% overall with a high of 71% in 1996 and lows of 60% in 2003, 2007, and 2012). Since 2013, screening in Oslo has taken place at Aker sykehus, which is relatively close to the city centre and accessible by public transport. It is thought that attendance may be low in Oslo because a higher proportion of women may obtain screening through private clinics. Moreover, a higher percentage of immigrant women live in Oslo than elsewhere. Attendance rates have been shown to be lower among immigrants than non-immigrants (52). Mammographic screening taking place outside the screening program is difficult to accurately quantify (13, 53), however such information would be of great interest for estimating the program's effectiveness.

Women who have opted out from receiving invitations to screening have not been included in these analysis. Attendance figures presented here are therefore slightly inflated. Moreover, these results do not include women who have requested that their data related to normal mammography findings not be saved by the screening program. These women collectively make up a small proportion of women targeted for screening (see page S22 for more details).

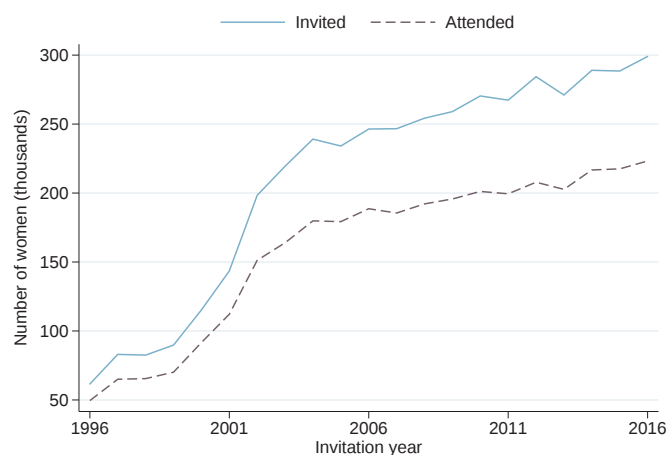


Figure 4.1: Yearly number of women invited to and attending the screening program by invitation year, 1996-2016

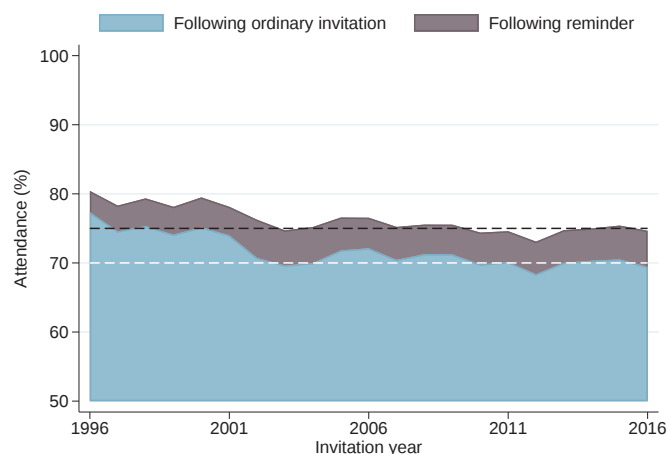


Figure 4.2: Attendance rate (%) following an ordinary invitation and a reminder by invitation year, 1996-2016

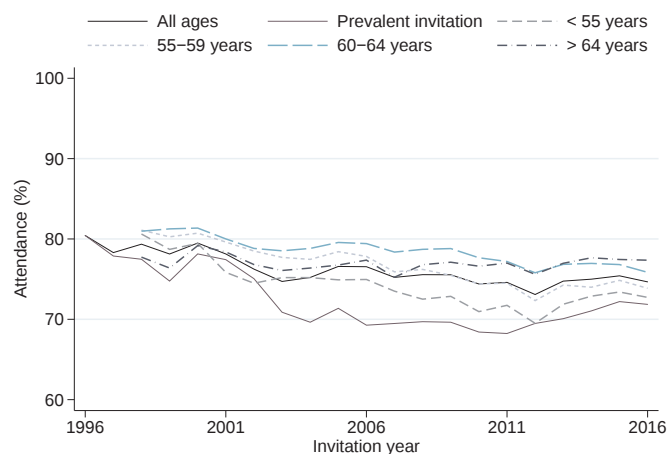


Figure 4.3: Attendance rate (%) among women invited to screening by age group and year of invitation dispatch, 1996-2016

Table 4.4: Number of invitations dispatched by screening area and invitation year, 1996-2016

Screening area	Invitation year					Total
	1996-2000	2001-2005	2006-2010	2011-2015	2016	
Rogaland	78,779	88,271	102,351	114,079	25,033	408,513
Hordaland	95,558	106,048	118,427	128,899	27,308	476,240
Oslo	115,092	110,100	122,992	139,589	29,925	517,698
Akershus	108,727	127,819	53,119			289,665
Telemark	12,958	45,782	51,069	54,105	11,230	175,144
Agder	14,168	65,306	74,415	80,420	18,207	252,516
Troms og Finnmark	6853	55,637	61,178	75,634	14,943	214,245
Østfold		66,639	76,073	84,575	17,858	245,145
Nordland		58,158	65,919	64,887	12,976	201,940
Buskerud		60,241	76,892			137,133
Trøndelag		93,577	114,138	123,315	26,766	357,796
Oppland		42,126	55,501	58,353	13,158	169,138
Møre og Romsdal		43,761	65,055	70,832	14,947	194,595
Sogn og Fjordane		17,241	28,929	31,516	6507	84,193
Vestfold		25,793	66,148	71,439	15,677	179,057
Hedmark		28,020	58,814	63,038	12,599	162,471
Akershus Øst			58,416	109,084	23,342	190,842
Akershus Vest			27,411			27,411
Vestre Viken				130,553	28,564	159,117
Total	432,135	1,034,519	1,276,847	1,400,318	299,040	4,442,859

Table 4.5: Attendance rate (%) at the screening program by screening area and invitation year, 1996-2016

Screening area	Invitation year					Total
	1996-2000	2001-2005	2006-2010	2011-2015	2016	
Rogaland	88 %	86 %	83 %	80 %	79 %	84 %
Hordaland	85 %	83 %	80 %	77 %	74 %	81 %
Oslo	68 %	63 %	62 %	62 %	66 %	64 %
Akershus	79 %	74 %	71 %			75 %
Telemark	81 %	79 %	75 %	73 %	74 %	76 %
Agder	81 %	80 %	79 %	78 %	77 %	79 %
Troms og Finnmark	83 %	82 %	80 %	77 %	77 %	79 %
Østfold		72 %	74 %	74 %	73 %	74 %
Nordland		81 %	81 %	80 %	80 %	81 %
Buskerud		75 %	77 %			76 %
Trøndelag		78 %	78 %	76 %	78 %	78 %
Oppland		69 %	74 %	75 %	75 %	73 %
Møre og Romsdal		72 %	72 %	72 %	74 %	72 %
Sogn og Fjordane		82 %	84 %	81 %	78 %	82 %
Vestfold		73 %	76 %	73 %	74 %	74 %
Hedmark		64 %	69 %	72 %	75 %	70 %
Akershus Øst			72 %	74 %	73 %	73 %
Akershus Vest			72 %			72 %
Vestre Viken				74 %	75 %	74 %
Total	79 %	76 %	75 %	75 %	75 %	76 %

Recall for further assessment

Women can be recalled for further assessment due to abnormal mammographic findings, clinical symptoms, or technically inadequate images (unsatisfactory image quality). The recall rate decreased over 40% during the study period, from a high of 6.1% in 1996 to 3.6% in 2016 (Figure 4.4). Between 1996 and 2016 over 96% of all screening examinations were interpreted as negative. Women with a negative screening result receive a letter telling them that there were no signs of abnormal findings on their screening mammogram.

On average 3.2% of all screening examinations resulted in a recall due to abnormal mammographic findings (Table 4.6). Recall due to clinical symptoms and unsatisfactory image quality were each associated with 0.3% of all screening examinations. Women who are recalled due to clinical symptoms or technically inadequate images have a lower risk of breast cancer than those who were recalled due to abnormal mammographic findings (see page S34 for more details). Although the switch from screen film mammography to digital mammography had limited or no effect on recall rates due to abnormal mammographic findings, a decrease in the proportion of technical recalls has been observed (54). The majority of this decrease is likely attributable to under-reporting since radiographers can preview the digital mammograms at the time of acquisition and decide to retake images without saving or reporting unsatisfactory images.

Recall rates due to abnormal mammographic findings were over twice as high for prevalently versus subsequently screened women (an average of 5.5% versus 2.6% respectively from 1996-2016; Figure 4.5 and Table 4.7). Prevalently screened women typically have a higher recall rate than subsequently screened women because of the unavailability of prior mammograms against which to make a comparison, and because mammographic density is higher in this group of younger women. Recall rates for prevalently screened women were consistently above 6% after 2005. There was little variation in recall rates due to abnormal findings among subsequent screening examinations when stratified by age.

Recall rates varied by county. The lowest recall rate was observed in Troms og Finnmark (2.5%), which also reported the lowest overall rate due to abnormal mammography findings (2.0%) (Figure 4.6).

False positive screening results are screening examinations leading to a recall for assessment that turns out to be negative. False positive screening results are widely considered a harm of mammographic screening and are associated with anxiety while waiting for diagnostic results. Studies have shown that this is temporary and typically diminishes to normal levels after three months (55–57). For women who participate in ten screening rounds between ages 50–69, the cumulative risk of a false positive screening results leading to additional imaging such as diagnostic mammography or ultrasound is roughly 15%, while the cumulative risk of a false positive screening result leading to an invasive procedure is 4% (58).

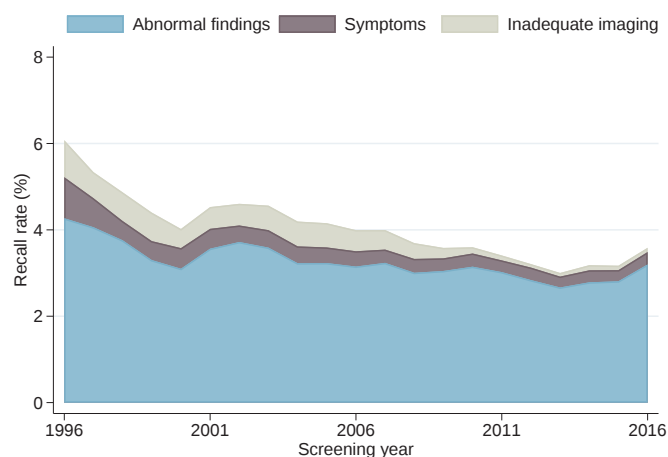


Figure 4.4: Recall rates (%) due to abnormal mammographic findings, symptoms or technical reasons (inadequate imaging), 1996-2016

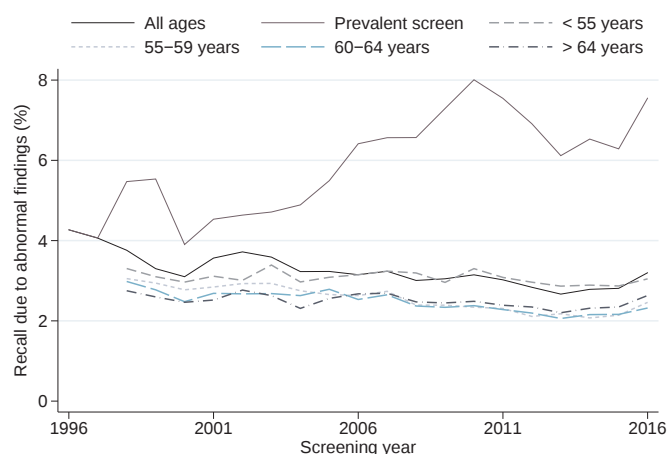


Figure 4.5: Recall rate (%) due to abnormal mammographic findings by age groups, 1996-2016

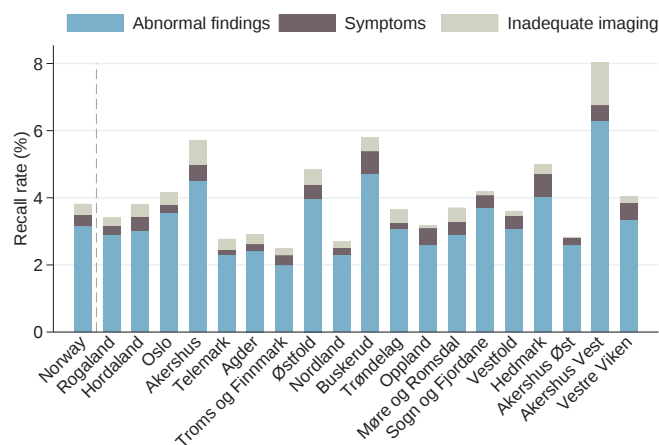


Figure 4.6: Recall rate (%) due to abnormal mammographic findings, clinical symptoms, and inadequate imaging by screening area, 1996-2016

Table 4.6: Number (n) and percent (%) of recall examinations due to abnormal mammographic findings by screening area and year, 1996-2016

Screening area	Screening year										Total (n) (%)	
	1996-2000 (n) (%)		2001-2005 (n) (%)		2006-2010 (n) (%)		2011-2015 (n) (%)		2016 (n) (%)			
Rogaland	2697	4.0 %	1965	2.6 %	2369	2.8 %	2367	2.6 %	446	2.3 %	9844	2.9 %
Hordaland	2627	3.3 %	2037	2.3 %	2593	2.7 %	3441	3.4 %	810	4.2 %	11,508	3.0 %
Oslo	2407	3.2 %	2311	3.3 %	3303	4.3 %	2906	3.4 %	765	3.9 %	11,692	3.6 %
Akershus	3396	4.1 %	4462	4.7 %	1897	5.0 %					9755	4.5 %
Telemark	358	3.7 %	1114	3.1 %	842	2.2 %	629	1.6 %	125	1.5 %	3068	2.3 %
Agder	351	3.3 %	1400	2.7 %	1237	2.1 %	1452	2.3 %	326	2.4 %	4766	2.4 %
Troms og Finnmark	121	2.5 %	1231	2.7 %	836	1.7 %	894	1.5 %	278	2.5 %	3360	2.0 %
Østfold			2759	5.9 %	1817	3.2 %	2233	3.6 %	295	2.3 %	7104	4.0 %
Nordland			852	1.9 %	1503	2.8 %	1114	2.1 %	256	2.4 %	3725	2.3 %
Buskerud			2565	5.8 %	2330	3.9 %					4895	4.7 %
Trøndelag			2332	3.3 %	2745	3.1 %	2861	3.0 %	560	2.7 %	8498	3.1 %
Oppland			824	2.9 %	996	2.4 %	1103	2.5 %	247	2.6 %	3170	2.6 %
Møre og Romsdal			839	2.8 %	1182	2.5 %	1651	3.2 %	364	3.3 %	4036	2.9 %
Sogn og Fjordane			469	3.5 %	662	2.7 %	1112	4.4 %	275	5.5 %	2518	3.7 %
Vestfold			741	4.1 %	1393	2.8 %	1568	3.0 %	350	3.1 %	4052	3.1 %
Hedmark			864	5.0 %	1751	4.3 %	1551	3.4 %	396	4.1 %	4562	4.0 %
Akershus Øst					1353	3.2 %	1616	2.0 %	585	3.5 %	3554	2.6 %
Akershus Vest					1247	6.3 %					1247	6.3 %
Vestre Viken							2942	3.0 %	948	4.5 %	3890	3.3 %
Total	11,957	3.6 %	26,765	3.4 %	30,056	3.1 %	29,440	2.8 %	7026	3.2 %	105,244	3.2 %

Table 4.7: Percent (%) of recall examinations due to abnormal mammographic findings at prevalent and subsequent screening examinations by screening area and year, 1996-2016

Screening area	Screening year											
	1996-2000		2001-2005		2006-2010		2011-2015		2016		Total	
	Prev	Sub	Prev	Sub	Prev	Sub	Prev	Sub	Prev	Sub	Prev	Sub
Rogaland	5.3 %	2.9 %	5.1 %	2.2 %	5.6 %	2.4 %	6.4 %	2.1 %	4.9 %	1.9 %	5.5 %	2.3 %
Hordaland	4.5 %	2.3 %	4.4 %	2.0 %	6.4 %	2.3 %	7.0 %	3.0 %	8.0 %	3.6 %	5.2 %	2.5 %
Oslo	3.7 %	2.7 %	4.5 %	3.1 %	7.5 %	3.9 %	6.9 %	2.8 %	9.9 %	2.9 %	5.1 %	3.2 %
Akershus	4.8 %	3.3 %	9.0 %	4.2 %	9.7 %	4.4 %					6.0 %	4.0 %
Telemark	3.7 %	<0.1 %	4.9 %	2.5 %	4.8 %	1.9 %	3.5 %	1.4 %	2.3 %	1.5 %	4.2 %	1.8 %
Agder	3.3 %	1.9 %	4.2 %	2.1 %	5.4 %	1.7 %	5.5 %	1.9 %	4.5 %	2.1 %	4.4 %	1.9 %
Troms og Finnmark	2.5 %	8.3 %	3.8 %	2.1 %	3.7 %	1.5 %	2.9 %	1.3 %	5.4 %	2.1 %	3.5 %	1.6 %
Østfold			8.3 %	3.6 %	6.2 %	2.8 %	8.1 %	3.0 %	5.1 %	1.8 %	7.8 %	3.0 %
Nordland			2.4 %	1.3 %	7.5 %	2.2 %	5.6 %	1.7 %	6.1 %	2.0 %	3.9 %	1.9 %
Buskerud			6.9 %	4.7 %	11.4 %	3.0 %					8.0 %	3.5 %
Trøndelag			4.0 %	2.5 %	8.0 %	2.4 %	7.3 %	2.5 %	6.7 %	2.2 %	5.4 %	2.5 %
Oppland			3.3 %	2.5 %	4.3 %	2.2 %	5.6 %	2.1 %	6.3 %	1.9 %	4.1 %	2.2 %
Møre og Romsdal			3.2 %	2.2 %	5.5 %	2.1 %	8.0 %	2.6 %	7.3 %	2.9 %	4.6 %	2.4 %
Sogn og Fjordane			4.2 %	1.7 %	7.8 %	2.1 %	12.6 %	3.4 %	17.1 %	4.3 %	6.7 %	2.8 %
Vestfold			4.1 %	5.3 %	6.4 %	2.2 %	7.3 %	2.5 %	8.5 %	2.4 %	5.3 %	2.4 %
Hedmark			5.2 %	4.1 %	8.6 %	3.7 %	7.4 %	3.0 %	10.8 %	3.4 %	6.5 %	3.4 %
Akershus Øst					8.1 %	2.6 %	6.1 %	1.4 %	8.5 %	2.6 %	7.0 %	1.9 %
Akershus Vest					11.4 %	5.3 %					11.4 %	5.3 %
Vestre Viken							7.9 %	2.5 %	10.8 %	3.5 %	8.5 %	2.6 %
Total	4.4 %	2.8 %	4.8 %	2.8 %	7.0 %	2.6 %	6.7 %	2.3 %	7.6 %	2.6 %	5.5 %	2.6 %

Breast cancer detection

Screen-detected breast cancer was defined as a ductal carcinoma *in situ* (DCIS) or an invasive breast cancer diagnosed as a result of a recall assessment diagnosed within 182 days (6 months) following a screening examination.

Interval breast cancer was defined as breast cancer diagnosed after a negative screening result or more than 6 months after a false-positive screening result and within 2.5 years after screening.

Over 18,600 screen-detected breast cancers were diagnosed among women attending the screening program between 1996 and 2016 (Table 4.8), of which approximately 3200 (17%) were DCIS. Roughly 5100 interval breast cancers were diagnosed between 1996 and 2014 (Table 4.11).

Screen-detected breast cancer

Between 1996 and 2016, 5.6 screen-detected breast cancers were detected per 1000 screening examinations (Table 4.8). The rates were relatively stable within each age group, and increased with increasing age among subsequently screened women (Figure 4.7).

Detection rates varied by screening area. In 2016 the rate was highest in Vestfold (6.9/1000 screening examinations) and lowest in Troms and Finnmark (4.1/1000 screening examinations, Table 4.8). The highest rate of screen-detected cancer was observed in Oslo between 2011–2015 (8.4/1000 screening examinations, Table 4.8). This period includes both the Oslo Tomosynthesis Trial and the Oslo, Vestfold, and Vestre Viken study. Both studies used digital breast tomosynthesis which can increase the rate of screen-detected breast cancer (59, 60). For more information about these studies see page S57.

Detection rates were higher for prevalent (6.4/1000) than subsequent screening examinations (5.3/1000, Tables 4.9 and 4.10). Among prevalently screened women, the highest detection rate (9.4/1000 screening examinations) was observed in Vestfold in 2016, while the lowest rate was observed in Telemark (1.1/1000 screening examinations) during the same year. The numbers of prevalent screen-detected cancers were small and these results should be interpreted with caution. There was less variation in detection rates among subsequently screened women.

The majority of screen-detected cancers are detected following a recall examination due to abnormal findings. On average, only 1.7% of screen-detected breast cancers were diagnosed following clinical symptoms at time of screening mammography, while 0.3% were diagnosed following a recall examination due to technically inadequate images (Figure 4.8).

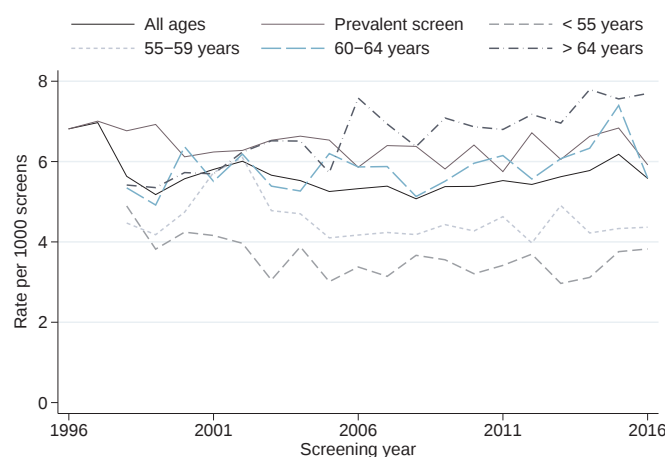


Figure 4.7: Rate of screen-detected breast cancer per 1000 screening examinations (%), 1996–2016

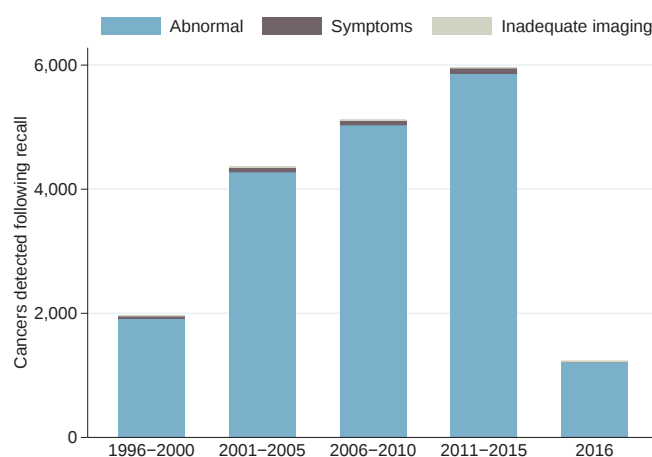


Figure 4.8: Number of screen-detected breast cancers based on reason for recall, 1996–2016

“The rate of screen-detected breast cancers was stable between 5 and 6 per 1000 screening examinations between 1996 and 2016”

Table 4.8: Number (n) and rate per 1000 screening examinations (‰) of screen-detected breast cancers by screening area and year, 1996-2016

Screening area	Screening year										Total	
	1996-2000		2001-2005		2006-2010		2011-2015		2016			
	(n)	(‰)	(n)	(‰)	(n)	(‰)	(n)	(‰)	(n)	(‰)	(n)	(‰)
Rogaland	478	7.0	444	5.9	476	5.6	554	6.0	112	5.7	2064	6.1
Hordaland	445	5.6	450	5.1	536	5.7	597	6.0	116	6.0	2144	5.6
Oslo	457	6.0	456	6.5	475	6.2	725	8.4	100	5.1	2213	6.7
Akershus	438	5.2	557	5.9	237	6.2					1232	5.7
Telemark	64	6.6	204	5.6	163	4.2	202	5.1	46	5.6	679	5.1
Agder	56	5.3	248	4.8	254	4.4	333	5.3	78	5.8	969	4.9
Troms og Finnmark	27	5.5	211	4.7	180	3.7	294	5.0	46	4.1	758	4.5
Østfold			242	5.2	310	5.5	346	5.5	73	5.6	971	5.4
Nordland			214	4.7	266	4.9	255	4.9	53	5.1	788	4.9
Buskerud			336	7.6	328	5.5					664	6.4
Trøndelag			365	5.1	492	5.5	558	5.9	109	5.3	1524	5.5
Oppland			156	5.5	206	5.1	252	5.7	46	4.8	660	5.4
Møre og Romsdal			150	5.0	229	4.9	280	5.5	65	5.9	724	5.2
Sogn og Fjordane			70	5.2	108	4.4	104	4.1	27	5.4	309	4.5
Vestfold			142	7.9	304	6.1	312	5.9	78	6.9	836	6.3
Hedmark			123	7.1	220	5.4	235	5.2	57	5.9	635	5.6
Akershus Øst					206	4.9	312	3.9	96	5.7	614	4.4
Akershus Vest					130	6.6					130	6.6
Vestre Viken							602	6.2	124	5.9	726	6.2
Total	1965	5.9	4368	5.6	5120	5.3	5961	5.7	1226	5.6	18,640	5.6



Table 4.9: Number (n) and rate per 1000 prevalent screening examinations (‰) of screen-detected breast cancers by screening area and year, 1996-2016

Screening area	Screening year										Total	
	1996-2000 (n)	(‰)	2001-2005 (n)	(‰)	2006-2010 (n)	(‰)	2011-2015 (n)	(‰)	2016 (n)	(‰)		
Rogaland	264	8.4	79	7.2	83	6.8	114	9.1	12	3.9	552	7.9
Hordaland	277	7.1	74	5.8	88	7.1	85	6.3	21	6.9	545	6.7
Oslo	254	6.5	75	6.5	101	7.9	138	8.9	24	6.1	592	7.1
Akershus	261	6.0	87	6.1	44	7.9					392	6.2
Telemark	64	6.6	67	7.1	10	2.0	29	5.5	1	1.1	171	5.6
Agder	56	5.3	84	5.0	33	4.3	47	5.3	9	4.5	229	5.0
Troms og Finnmark	27	5.5	109	5.9	38	5.8	36	4.6	7	4.9	217	5.5
Østfold			146	5.8	60	7.1	58	6.6	17	7.9	281	6.3
Nordland			142	5.8	52	7.0	43	6.1	5	3.7	242	6.0
Buskerud			226	9.2	58	6.6					284	8.5
Trøndelag			248	6.3	64	5.2	73	5.7	16	5.4	401	5.9
Oppland			100	5.9	30	5.0	48	7.8	10	5.4	188	6.1
Møre og Romsdal			109	5.5	34	4.6	46	6.3	9	5.6	198	5.5
Sogn og Fjordane			55	5.6	16	4.6	11	3.4	2	3.6	84	4.9
Vestfold			138	7.8	66	6.8	38	5.5	15	9.4	257	7.2
Hedmark			106	7.3	38	4.8	40	5.9	7	5.5	191	6.3
Akershus Øst					40	6.2	57	4.6	19	6.4	116	5.3
Akershus Vest					33	8.3					33	8.3
Vestre Viken							90	6.7	30	8.3	120	7.0
Total	1203	6.8	1845	6.4	888	6.2	953	6.4	204	5.9	5093	6.4

**Figure 4.9:** Radiographer Nina Vårdal in action in Røros, Trøndelag (2015).
Photo by Signe Blix, Trøndelag breast centre

Table 4.10: Number (n) and rate per 1000 subsequent screening examinations (‰) of screen-detected breast cancers by screening area and year, 1996-2016

Screening area	Screening year										Total	
	1996-2000 (n)	(‰)	2001-2005 (n)	(‰)	2006-2010 (n)	(‰)	2011-2015 (n)	(‰)	2016 (n)	(‰)		
Rogaland	214	5.9	365	5.7	393	5.4	440	5.5	100	6.1	1512	5.6
Hordaland	168	4.2	376	4.9	448	5.5	512	5.9	95	5.8	1599	5.3
Oslo	203	5.5	381	6.5	374	5.9	587	8.3	76	4.8	1621	6.6
Akershus	177	4.4	470	5.9	193	5.9					840	5.5
Telemark	0	0	137	5.1	153	4.6	173	5.1	45	6.2	508	5.0
Agder	0	0	164	4.7	221	4.4	286	5.3	69	6.0	740	4.9
Troms og Finnmark	0	0	102	3.8	142	3.4	258	5.1	39	4.0	541	4.2
Østfold			96	4.4	250	5.2	288	5.4	56	5.1	690	5.1
Nordland			72	3.4	214	4.6	212	4.7	48	5.3	546	4.5
Buskerud			110	5.6	270	5.3					380	5.4
Trøndelag			117	3.7	428	5.5	485	6.0	93	5.3	1123	5.4
Oppland			56	5.0	176	5.1	204	5.4	36	4.7	472	5.2
Møre og Romsdal			41	3.9	195	4.9	234	5.4	56	5.9	526	5.1
Sogn og Fjordane			15	4.1	92	4.4	93	4.2	25	5.6	225	4.4
Vestfold			4	8.7	238	5.9	274	6.0	63	6.5	579	6.0
Hedmark			17	6.0	182	5.5	195	5.1	50	6.0	444	5.4
Akershus Øst					166	4.6	255	3.8	77	5.5	498	4.3
Akershus Vest					97	6.1					97	6.1
Vestre Viken							512	6.2	94	5.5	606	6.0
Total	762	5.0	2523	5.1	4232	5.2	5008	5.6	1022	5.5	13,547	5.3



Interval breast cancer

On average, 1.8 interval breast cancers were diagnosed per 1000 screening examinations (Table 4.11). Detection rates have been relatively stable since the inception of the screening program. Unlike screen-detected cancers, interval breast cancer detection rates were similar across all age groups (Figure 4.10).

Interval breast cancer detection rates varied across screening areas (Table 4.11). However, this variation must be interpreted with caution because the number of cases diagnosed each year in individual screening areas is very small. The highest rate of interval breast cancer was observed in Oslo (2.3/1000 screening examinations). This might be due to the availability and use of private clinics in the time between two screening examinations.

The majority of interval breast cancers (roughly 70%) were detected more than a year following screening (Figure 4.11). This distribution has been relatively stable since the inception of the program (61, 62).

Interval breast cancers accounted for nearly a quarter (24%) of all breast cancers detected in the screening program from 1996 to 2014 (Table 4.12). The lowest proportion of interval breast cancers was observed in Hedmark (20%), while the highest was observed in Akershus Øst (34%).

Interval breast cancer detection rates are important in the evaluation of organised screening programs because a high rate results in low program sensitivity. Regular reviews of screening and diagnostic mammograms from women diagnosed with interval breast cancer is one way to improve radiologist sensitivity and to reduce the rate and their overall proportion. Informed, consensus-based retrospective reviews from Norway have demonstrated that 20-25% of interval breast cancers showed abnormalities on the screening mammograms prior to the diagnosis (63, 64). In these reviews both screening and diagnostic images, and histopathological results were available. An informed review strategy makes it easier for radiologists to detect abnormalities on the screening mammograms. This result therefore does not represent clinical practice, but rather offers an opportunity for learning. Blinded reviews, where only screening mammograms are available and cancer cases are mixed with normal screening mammograms, have demonstrated a lower rate of missed cases (63). Regardless of the review method used, the rate of missed interval breast cancers represented only a small proportion of all breast cancers detected among women attending screening. The review of interval breast cancer cases plays an important role in the education and professional development of breast radiologists and such reviews may help to minimise the overall rate of interval breast cancers.

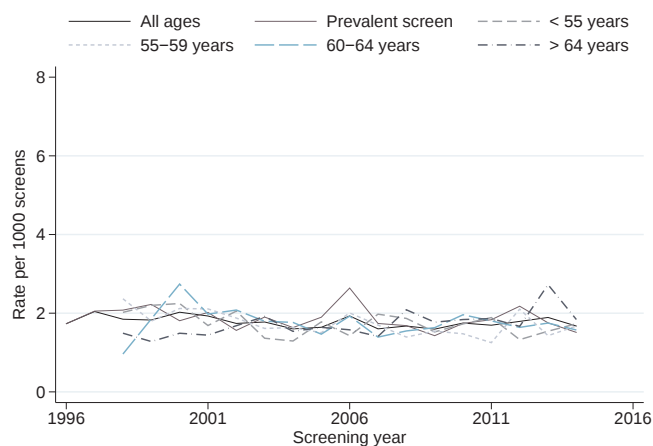


Figure 4.10: Interval breast cancer detection rate per 1000 screening examinations (%), 1996-2014

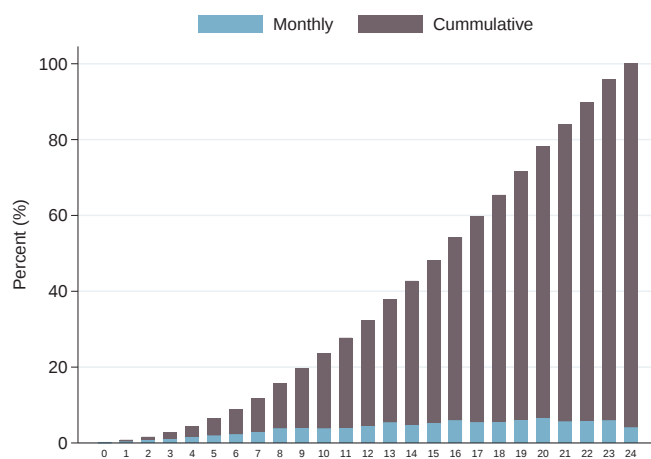


Figure 4.11: Distribution of interval breast cancer from time of screening examination, 1996-2014

“Interval breast cancers constituted 24% of the breast cancers diagnosed among women screened in the Norwegian Breast Cancer Screening Program between 1996 and 2014”

Table 4.11: Number (n) and rate per 1000 screening examinations (‰) of interval breast cancers by screening area and year, 1996-2014

Screening area	1996-2000		2001-2005		Screening year 2006-2010		2011-2014		Total	
	(n)	(‰)	(n)	(‰)	(n)	(‰)	(n)	(‰)	(n)	(‰)
Rogaland	93	1.4	132	1.8	158	1.9	142	2.0	525	1.7
Hordaland	136	1.7	127	1.4	137	1.5	122	1.6	522	1.5
Oslo	181	2.4	173	2.5	157	2.1	147	2.2	658	2.3
Akershus	175	2.1	159	1.7	65	1.7			399	1.8
Telemark	22	2.3	59	1.6	66	1.7	46	1.5	193	1.7
Agder	20	1.9	98	1.9	114	2.0	95	1.9	327	1.9
Troms og Finnmark	7	1.4	77	1.7	61	1.3	92	2.0	237	1.6
Østfold			64	1.4	88	1.6	69	1.4	221	1.4
Nordland			86	1.9	89	1.7	64	1.5	239	1.7
Buskerud			68	1.5	117	2.0			185	1.8
Trøndelag			110	1.5	132	1.5	102	1.4	344	1.5
Oppland			36	1.3	67	1.6	59	1.7	162	1.6
Møre og Romsdal			61	2.0	92	2.0	82	2.0	235	2.0
Sogn og Fjordane			15	1.1	31	1.3	32	1.6	78	1.3
Vestfold			41	2.3	96	1.9	76	1.8	213	1.9
Hedmark			30	1.7	59	1.4	45	1.3	134	1.4
Akershus Øst					78	1.8	149	2.4	227	2.1
Akershus Vest					42	2.1			42	2.1
Vestre Viken							130	1.7	130	1.7
Total	634	1.9	1336	1.7	1649	1.7	1452	1.8	5071	1.8

Table 4.12: Proportion of interval breast cancers among all breast cancers detected in the screening program by screening area and year, 1996-2014

Screening area	1996-2000		Screening year		Total
	1996-2000	2001-2005	2006-2010	2011-2014	
Rogaland	16 %	23 %	25 %	25 %	22 %
Hordaland	23 %	22 %	20 %	20 %	22 %
Oslo	28 %	28 %	25 %	22 %	26 %
Akershus	29 %	22 %	22 %		25 %
Telemark	26 %	22 %	29 %	23 %	25 %
Agder	26 %	28 %	31 %	28 %	29 %
Troms og Finnmark	21 %	27 %	25 %	30 %	27 %
Østfold		21 %	22 %	20 %	21 %
Nordland		29 %	25 %	24 %	26 %
Buskerud		17 %	26 %		22 %
Trøndelag		23 %	21 %	18 %	21 %
Oppland		19 %	25 %	23 %	23 %
Møre og Romsdal		29 %	29 %	28 %	29 %
Sogn og Fjordane		18 %	22 %	27 %	23 %
Vestfold		22 %	24 %	24 %	24 %
Hedmark		20 %	21 %	20 %	20 %
Akershus Øst			28 %	38 %	34 %
Akershus Vest			24 %		24 %
Vestre Viken				22 %	22 %
Total	24 %	23 %	24 %	24 %	24 %

Positive predictive values

The positive predictive value (PPV) of a test is the probability that a positive screening result indicates the presence of breast cancer (65). PPV is important in mammographic screening because it is directly related to false positive mammographic findings: a high PPV indicates a low rate of false positive screening results and vice versa.

In mammographic screening, PPV-1 refers to the percentage of breast cancers detected among women recalled due to abnormal mammographic findings. A high PPV-1 indicates that many women recalled for further assessment have breast cancer. PPV-2 refers to the percentage of breast cancers detected among recalled women who had an invasive procedure (needle biopsy). A high PPV-2 indicates that many women who undergo an invasive procedure have breast cancer.

PPV-1

Since the inception of the screening program, 18% of women recalled due to abnormal mammographic findings were diagnosed with breast cancer (PPV-1 = 18%, Table 4.13). PPV-1 increased from 15% in 1996 to 17% in 2016 (Figure 4.12). There was substantial variation in PPV-1, both over time and between screening areas. In Troms og Finnmark, PPV-1 varied from 33% during 2011-2015 to 16% in 2016. While across the screening areas, PPV-1 ranged from 10% in Akershus Vest to 22% in Troms og Finnmark for all years combined (Table 4.13).

PPV-1 was lower for prevalent screening examinations (11%) than for subsequent screening examinations (22%) (Table 4.14). Among subsequent screening examinations, PPV-1 increased with age from 13% for women younger than 55 to 29% for women older than 64 (Figure 4.13).

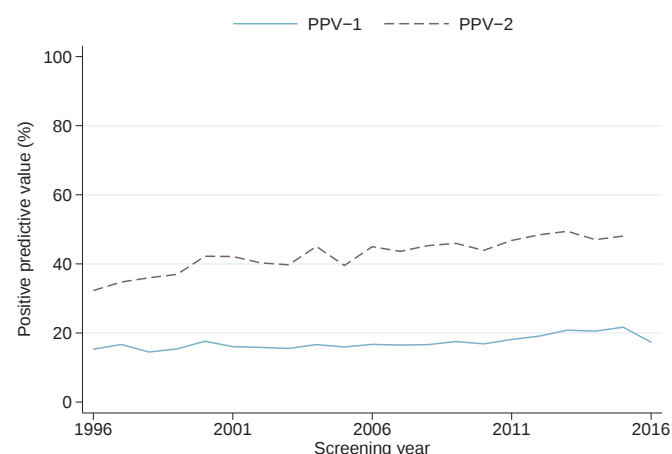


Figure 4.12: Proportion of breast cancer cases diagnosed as a result of a recall due to abnormal mammographic findings (PPV-1; 1996-2016) and as a result of an invasive procedure (PPV-2; 1996-2015)

Results for PPV-1 are presented for women recalled due to abnormal mammographic findings. Including women recalled due to clinical symptoms or technically inadequate images lowered the PPV-1 to 15% overall. This is because the overwhelming majority of women diagnosed with screen-detected breast cancer had abnormal findings on their screening mammogram (Figure 4.8). The overall PPV-1 among women recalled due to clinical symptoms was 2.8%, and for women with technically inadequate images 0.5%. It should be noted that in the past 20 years of organised screening, 315 women had symptoms of breast cancer that were mammographically occult. Moreover, 51 women with screen-detected breast cancer were diagnosed following a recall examination due to technically inadequate screening images. Most of these women were diagnosed during the transition period from analogue to digital mammography.

PPV-2

Results for PPV-2 are presented until 2015, as the coding for invasive procedures that took place in 2016 was not complete at the time of data extraction for this report.

Between 1996 and 2015, 44% of screened women who underwent an invasive procedure were diagnosed with breast cancer (PPV-2 = 43%). PPV-2 also varied over time and between screening areas. PPV-2 increased from 32.3% in 1996 to 48.1% in 2015 (Figure 4.12). The overall highest PPV-2 during the past 20 years was observed in Oppland (58%) and the lowest in Akershus Vest (25%) (Table 4.16). The highest PPV-2 during 2011-2015 was observed in Telemark (68%), while the lowest was observed in Akershus Øst (32%).

Like PPV-1, PPV-2 was lowest for prevalently screened women (29%) and increased with age for subsequently screened women, from 40% for women younger than 55, to 62% for women older than 64 (Table 4.17 and Figure 4.13).

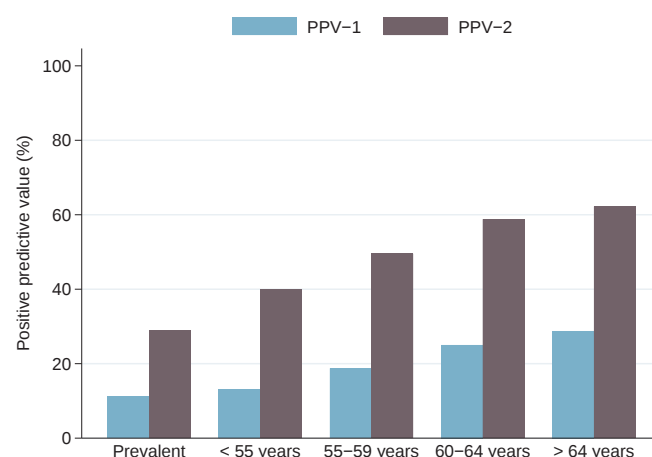


Figure 4.13: Proportion of breast cancer cases diagnosed as a result of a recall due to abnormal mammographic findings (PPV-1; 1996-2016) and as a result of an invasive procedure (PPV-2; 1996-2015), by age group

Table 4.13: Proportion of breast cancers among women recalled due to abnormal mammographic findings (PPV-1) by screening area and year, 1996-2016

Screening area	Screening year					Total
	1996-2000	2001-2005	2006-2010	2011-2015	2016	
Rogaland	18 %	22 %	20 %	23 %	25 %	21 %
Hordaland	16 %	21 %	21 %	17 %	14 %	19 %
Oslo	18 %	20 %	14 %	25 %	13 %	19 %
Akershus	13 %	12 %	12 %			12 %
Telemark	18 %	18 %	19 %	32 %	38 %	22 %
Agder	15 %	18 %	20 %	23 %	24 %	20 %
Troms og Finnmark	21 %	17 %	21 %	33 %	16 %	22 %
Østfold		8 %	17 %	16 %	25 %	13 %
Nordland		24 %	18 %	23 %	21 %	21 %
Buskerud		13 %	14 %			13 %
Trøndelag		15 %	18 %	19 %	19 %	18 %
Oppland		19 %	20 %	22 %	19 %	21 %
Møre og Romsdal		18 %	19 %	17 %	18 %	18 %
Sogn og Fjordane		15 %	16 %	9 %	10 %	12 %
Vestfold		19 %	21 %	19 %	22 %	20 %
Hedmark		14 %	12 %	15 %	14 %	14 %
Akershus Øst			15 %	19 %	16 %	17 %
Akershus Vest			10 %			10 %
Vestre Viken				20 %	13 %	18 %
Total	16 %	16 %	17 %	20 %	17 %	18 %

Table 4.14: Proportion of breast cancer cases among women recalled due to abnormal mammographic findings (PPV-1) for prevalent and subsequent screening by screening area and year, 1996-2016

Screening area	Screening year										Total	
	1996-2000		2001-2005		2006-2010		2011-2015		2016		Prev	Sub
	Prev	Sub	Prev	Sub	Prev	Sub	Prev	Sub	Prev	Sub	Prev	Sub
Rogaland	15 %	21 %	14 %	26 %	12 %	23 %	14 %	29 %	8 %	34 %	14 %	25 %
Hordaland	15 %	19 %	13 %	25 %	11 %	25 %	9 %	21 %	8 %	17 %	12 %	22 %
Oslo	17 %	22 %	12 %	22 %	10 %	16 %	13 %	32 %	7 %	19 %	13 %	23 %
Akershus	12 %	14 %	7 %	15 %	8 %	14 %					10 %	14 %
Telemark	18 %		14 %	21 %	4 %	24 %	14 %	39 %	5 %	45 %	13 %	28 %
Agder	15 %		12 %	23 %	7 %	26 %	10 %	30 %	11 %	29 %	11 %	27 %
Troms og Finnmark	21 %		15 %	20 %	15 %	24 %	16 %	39 %	9 %	19 %	15 %	27 %
Østfold			7 %	13 %	11 %	19 %	8 %	19 %	15 %	31 %	8 %	18 %
Nordland			24 %	27 %	10 %	22 %	10 %	30 %	6 %	28 %	15 %	26 %
Buskerud			13 %	13 %	6 %	19 %					10 %	17 %
Trøndelag			15 %	16 %	7 %	24 %	8 %	24 %	7 %	25 %	11 %	23 %
Oppland			18 %	20 %	12 %	23 %	14 %	26 %	9 %	28 %	15 %	24 %
Møre og Romsdal			17 %	20 %	9 %	24 %	8 %	22 %	8 %	22 %	11 %	22 %
Sogn og Fjordane			13 %	26 %	6 %	22 %	3 %	13 %	2 %	14 %	7 %	16 %
Vestfold			19 %	18 %	11 %	29 %	7 %	26 %	11 %	28 %	13 %	27 %
Hedmark			13 %	16 %	6 %	15 %	8 %	18 %	6 %	18 %	9 %	17 %
Akershus Øst					8 %	21 %	7 %	30 %	8 %	23 %	7 %	25 %
Akershus Vest					7 %	12 %					7 %	12 %
Vestre Viken							8 %	27 %	8 %	16 %	8 %	24 %
Total	15 %	19 %	13 %	19 %	9 %	21 %	9 %	26 %	8 %	23 %	11 %	22 %

Table 4.15: Proportion of breast cancers among women recalled for any reason (PPV-1) by screening area and year, 1996-2016

Screening area	Screening year					Total
	1996-2000	2001-2005	2006-2010	2011-2015	2016	
Rogaland	14 %	18 %	18 %	22 %	24 %	18 %
Hordaland	12 %	15 %	18 %	16 %	13 %	15 %
Oslo	14 %	17 %	13 %	22 %	12 %	16 %
Akershus	11 %	10 %	10 %			10 %
Telemark	14 %	15 %	16 %	29 %	34 %	19 %
Agder	12 %	15 %	16 %	21 %	22 %	17 %
Troms og Finnmark	12 %	12 %	19 %	31 %	14 %	18 %
Østfold		7 %	14 %	14 %	22 %	11 %
Nordland		21 %	14 %	21 %	20 %	18 %
Buskerud		11 %	11 %			11 %
Trøndelag		13 %	14 %	18 %	18 %	15 %
Oppland		16 %	16 %	19 %	16 %	17 %
Møre og Romsdal		12 %	14 %	15 %	16 %	14 %
Sogn og Fjordane		12 %	14 %	9 %	9 %	11 %
Vestfold		16 %	19 %	17 %	20 %	18 %
Hedmark		11 %	10 %	13 %	13 %	11 %
Akershus Øst			15 %	18 %	15 %	16 %
Akershus Vest			8 %			8 %
Vestre Viken				17 %	11 %	16 %
Total	12 %	13 %	14 %	18 %	16 %	15 %

“One in five women recalled due to abnormal mammographic findings were diagnosed with breast cancer. One in two women who underwent a needle biopsy were diagnosed with breast cancer”

Table 4.16: Proportion of breast cancer cases diagnosed as a result of an invasive procedure (PPV-2) by screening area and year, 1996-2015

Screening area	Screening year				Total
	1996-2000	2001-2005	2006-2010	2011-2015	
Rogaland	43 %	53 %	53 %	56 %	51 %
Hordaland	43 %	52 %	43 %	40 %	43 %
Oslo	47 %	52 %	47 %	57 %	51 %
Akershus	23 %	29 %	29 %		26 %
Telemark	50 %	43 %	42 %	68 %	49 %
Agder	39 %	52 %	55 %	58 %	54 %
Troms og Finnmark	81 %	36 %	47 %	61 %	48 %
Østfold		26 %	44 %	49 %	38 %
Nordland		57 %	50 %	54 %	53 %
Buskerud		37 %	42 %		40 %
Trøndelag		50 %	58 %	45 %	50 %
Oppland		55 %	60 %	59 %	58 %
Møre og Romsdal		39 %	40 %	39 %	39 %
Sogn og Fjordane		35 %	45 %	37 %	39 %
Vestfold		39 %	53 %	47 %	47 %
Hedmark		33 %	38 %	40 %	38 %
Akershus Øst			37 %	32 %	34 %
Akershus Vest			25 %		25 %
Vestre Viken				49 %	49 %
Total	37 %	41 %	45 %	48 %	44 %

Table 4.17: Proportion of breast cancer cases diagnosed as a result of an invasive procedure (PPV-2) for prevalent and subsequent screening by screening area and year, 1996-2015

Screening area	1996-2000		2001-2005		Screening year		2011-2015		Total	
	Prev	Sub	Prev	Sub	2006-2010	2006-2010	Prev	Sub	Prev	Sub
Rogaland	37 %	55 %	37 %	58 %	34 %	60 %	34 %	66 %	36 %	61 %
Hordaland	37 %	60 %	33 %	58 %	21 %	53 %	17 %	50 %	28 %	54 %
Oslo	42 %	54 %	34 %	58 %	36 %	52 %	34 %	68 %	38 %	59 %
Akershus	20 %	27 %	15 %	35 %	17 %	35 %			18 %	33 %
Telemark	50 %		36 %	48 %	10 %	54 %	37 %	79 %	34 %	59 %
Agder	39 %		35 %	69 %	23 %	69 %	29 %	69 %	32 %	69 %
Troms og Finnmark	81 %		32 %	41 %	36 %	51 %	30 %	71 %	35 %	56 %
Østfold			21 %	41 %	31 %	50 %	25 %	61 %	23 %	52 %
Nordland			50 %	76 %	28 %	61 %	29 %	66 %	38 %	65 %
Buskerud			35 %	44 %	20 %	55 %			30 %	51 %
Trøndelag			46 %	59 %	28 %	70 %	20 %	56 %	34 %	61 %
Oppland			52 %	64 %	33 %	69 %	39 %	67 %	44 %	67 %
Møre og Romsdal			37 %	46 %	18 %	49 %	16 %	52 %	25 %	50 %
Sogn og Fjordane			32 %	54 %	21 %	56 %	13 %	48 %	25 %	52 %
Vestfold			39 %	50 %	30 %	66 %	18 %	59 %	31 %	62 %
Hedmark			31 %	50 %	20 %	48 %	20 %	50 %	25 %	49 %
Akershus Øst					19 %	49 %	12 %	49 %	14 %	49 %
Akershus Vest					17 %	29 %			17 %	29 %
Vestre Viken							23 %	61 %	23 %	61 %
Total	33 %	45 %	33 %	50 %	25 %	54 %	23 %	60 %	29 %	55 %

Tumour histopathology

This report includes only women's first screen-detected or interval breast cancer diagnosed as a result of participating in the screening program. Women diagnosed with breast cancer before their first invitation, metastatic breast cancer, breast cancer recurrence, or other types of cancer localised in the breast were excluded. This section presents results about tumour histologic type, size, grade, lymph node involvement, and hormone receptor status, and focuses on invasive breast cancers.

Histologic type

Of all screen-detected breast cancers, 17% were DCIS, 70% were invasive carcinoma of no special type (previously called invasive ductal carcinoma), and 8% were invasive lobular carcinoma (Figure 4.14). The remaining 5% were "other invasive breast cancer". The proportions of DCIS and invasive lobular carcinoma among interval breast cancers were 6% and 12%, respectively.

Histopathologic type varied between screening areas. The proportion of DCIS varied from 12% to 21% for screen-detected and

from 3% to 12% for interval breast cancers (Tables 4.18 and 4.19). The proportion of DCIS was generally higher among the youngest women. However, there was variation between age groups over time (Figure 4.15). The overall rate of DCIS has been relatively stable over time, however, the number of DCIS cases in each age group is small and the results should be interpreted with caution. Additionally, the lower percentage of DCIS in some screening areas compared to earlier years may be due to incomplete reporting, coding, or data extraction (see page S48).

DCIS accounted for 5% of all breast cancer cases registered before the start of organised screening in 1996 (66). There was no systematic registration of DCIS before the screening program started, and the rate of DCIS increased after the start of the organised screening program (66). It is expected that DCIS makes up a lower proportion of interval than screen-detected breast cancers as studies show that less than 5% of DCIS cases are symptomatic (67). However, this study was performed 40 years ago and the incidence of DCIS has likely increased the past decades due to increased awareness of this disease, and more precise histopathologic diagnostic methods.

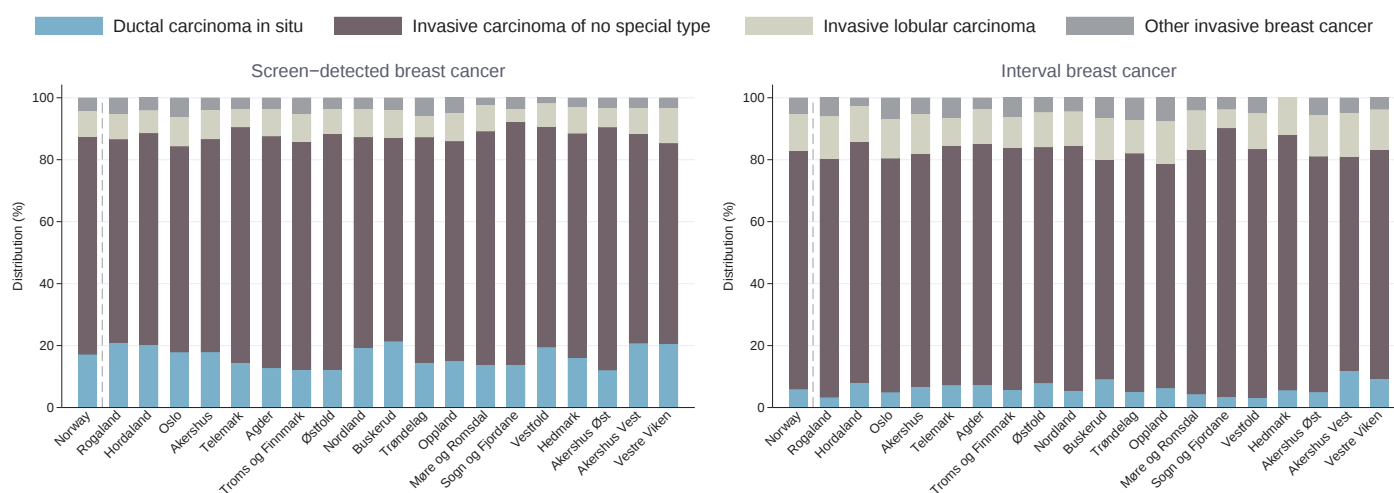


Figure 4.14: Histopathologic type of screen-detected (left, 1996-2016) and interval (right, 1996-2014) breast cancer by screening area

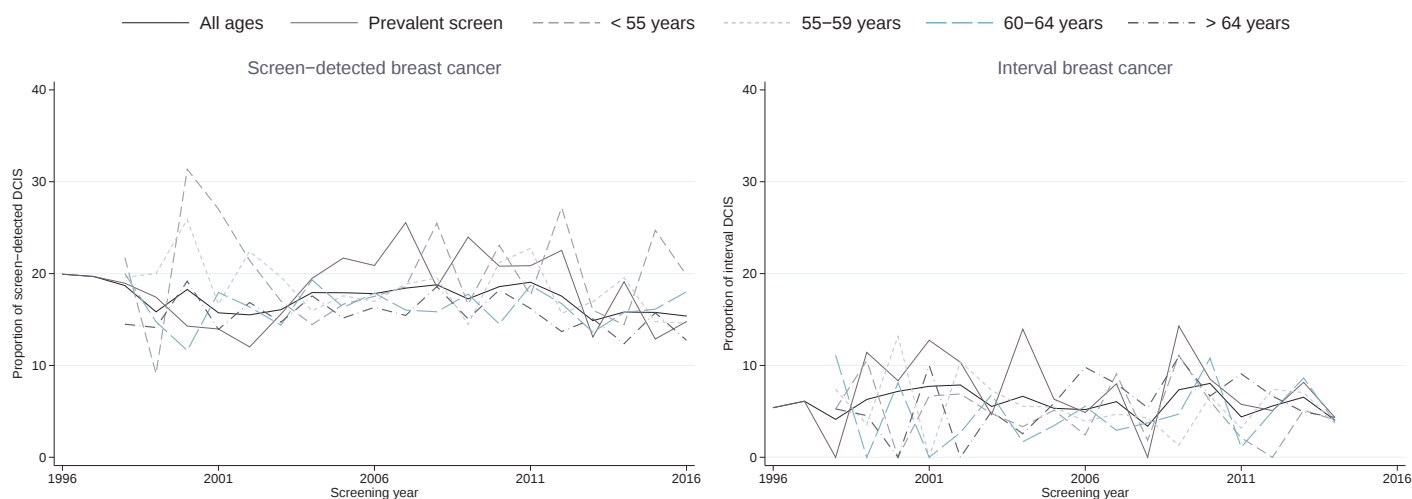


Figure 4.15: Percent of Ductal carcinoma *in situ* (DCIS) cases among all screen-detected (left, 1996-2016) and interval (right, 1996-2014) breast cancers by screening area

Table 4.18: Proportion (%) of DCIS among screen-detected breast cancers by screening area and year, 1996-2016

Screening area	Screening year					Total
	1996-2000	2001-2005	2006-2010	2011-2015	2016	
Rogaland	23.2 %	18.2 %	22.7 %	20.0 %	19.8 %	21.0 %
Hordaland	22.0 %	18.2 %	24.3 %	19.2 %	12.3 %	20.5 %
Oslo	14.7 %	20.6 %	21.3 %	16.5 %	14.6 %	17.9 %
Akershus	15.5 %	19.2 %	19.4 %			17.9 %
Telemark	15.6 %	16.7 %	14.7 %	14.0 %	6.5 %	14.6 %
Agder	12.5 %	14.5 %	9.8 %	13.8 %	12.8 %	12.8 %
Troms og Finnmark	7.4 %	8.5 %	12.2 %	14.7 %	15.6 %	12.2 %
Østfold		11.2 %	13.5 %	12.2 %	9.6 %	12.2 %
Nordland		15.9 %	18.8 %	22.0 %	24.5 %	19.4 %
Buskerud		20.5 %	22.3 %			21.4 %
Trøndelag		12.6 %	16.1 %	15.0 %	11.9 %	14.5 %
Oppland		9.6 %	18.4 %	15.2 %	19.6 %	15.2 %
Møre og Romsdal		12.7 %	11.8 %	16.5 %	12.5 %	13.9 %
Sogn og Fjordane		18.6 %	12.0 %	11.7 %	18.5 %	14.0 %
Vestfold		24.6 %	18.4 %	18.6 %	17.9 %	19.5 %
Hedmark		17.1 %	16.4 %	14.9 %	17.5 %	16.1 %
Akershus Øst			16.0 %	10.0 %	10.5 %	12.1 %
Akershus Vest			20.8 %			20.8 %
Vestre Viken				20.1 %	22.6 %	20.6 %
Total	18.5 %	16.7 %	18.2 %	16.6 %	15.4 %	17.2 %

Table 4.19: Proportion (%) of DCIS among interval breast cancers by screening area and year, 1996-2014

Screening area	Screening year				Total
	1996-2000	2001-2005	2006-2010	2011-2014	
Rogaland	3.2 %	5.3 %	1.9 %	3.6 %	3.4 %
Hordaland	8.1 %	7.9 %	8.8 %	8.3 %	8.3 %
Oslo	4.4 %	4.0 %	6.4 %	5.5 %	5.0 %
Akershus	7.4 %	6.9 %	4.6 %		6.8 %
Telemark	9.1 %	8.5 %	7.6 %	4.4 %	7.3 %
Agder	5.0 %	12.2 %	4.4 %	6.5 %	7.4 %
Troms og Finnmark	<0.1 %	3.9 %	1.6 %	9.8 %	5.5 %
Østfold		7.8 %	11.4 %	1.5 %	7.3 %
Nordland		5.8 %	5.6 %	1.6 %	4.6 %
Buskerud		10.3 %	8.5 %		9.2 %
Trøndelag		5.5 %	5.3 %	4.1 %	5.0 %
Oppland		8.3 %	4.5 %	5.1 %	5.6 %
Møre og Romsdal		6.6 %	5.4 %	2.5 %	4.7 %
Sogn og Fjordane		< 0.1 %	6.5 %	3.3 %	3.9 %
Vestfold		4.9 %	4.2 %	<0.1 %	2.8 %
Hedmark		< 0.1 %	8.5 %	4.5 %	5.3 %
Akershus Øst			5.1 %	5.5 %	5.4 %
Akershus Vest			11.9 %		11.9 %
Vestre Viken				9.3 %	9.3 %
Total	6.0 %	6.5 %	6.0 %	5.2 %	5.9 %

Tumour size - invasive breast cancer

Between 1996 and 2016, the mean and median tumour size for invasive screen-detected breast cancers was 15 mm and 13 mm, respectively (Table 4.20). On average, the largest screen-detected tumours were reported in Sogn og Fjordane (mean 18 mm, median 14 mm), and the smallest were reported in Akershus Vest (mean 12 mm, median 10 mm).

Overall, reported tumour size was stable throughout the reporting period, although small variations were detected between and within screening areas over time (Table 4.20). Nearly half of reported screen-detected tumours (45%) were 11-20 mm, while less than 1% of cases were greater than 50 mm (Figure 4.17). Tumour size reports for screen-detected breast cancer decreased with increasing age (Figure 4.16). The mean (median) tumour size was 16 mm (14 mm) for prevalently and 15 mm (12 mm) for subsequently screened women.

For interval breast cancers, the mean and median tumour size was 21 mm and 18 mm, respectively (Table 4.21). On average, the largest interval breast cancers were reported in Rogaland (mean 24 mm, median 21 mm), while the smallest were reported in Møre og Romsdal (mean 19 mm, median 16 mm). Nearly half (42%) of all interval breast cancers were between 11-20 mm. A substantially lower proportion of interval breast cancers were <11 mm (16.9%) compared with screen-detected cancers (36.5%). Tumour size did not differ substantially across age groups, time, or screening areas (Figures 4.16 and 4.17, and Table 4.21). Prior analysis of tumour characteristics have demonstrated that tumour size was the only difference between interval breast cancer detected in the first versus the second year following a screening examination (61).

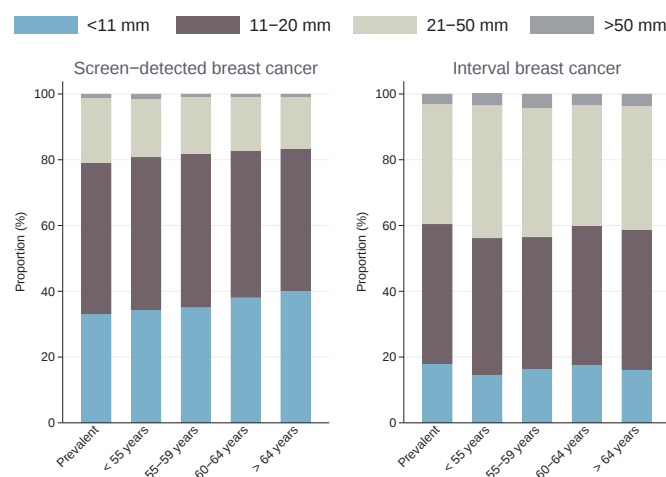


Figure 4.16: Largest reported tumour diameter (<11 mm, 11-20 mm, 21-50 mm, >50 mm) for screen-detected breast cancers (left, 1996-2016) and interval breast cancers (right, 1996-2014), by age group

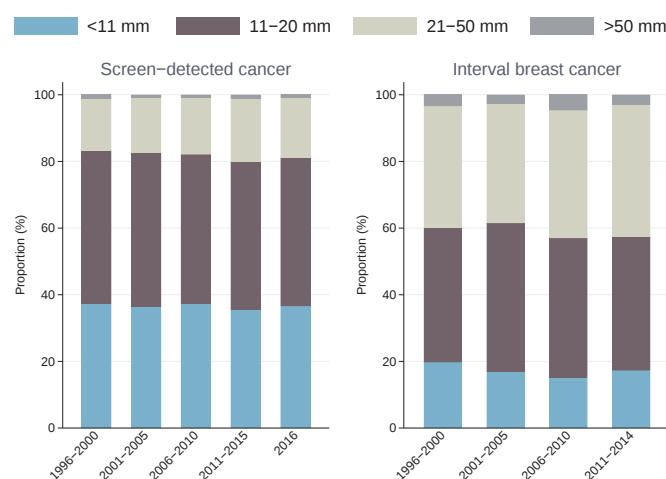


Figure 4.17: Largest reported tumour diameter (<11 mm, 11-20 mm, 21-50 mm, >50 mm) for screen-detected breast cancers (left, 1996-2016) and interval breast cancers (right, 1996-2014), by screening year

Table 4.20: Mean and median reported tumour diameter (mm) of screen-detected breast cancers by screening area, 1996-2016

Screening area	Screening year											
	1996-2000		2001-2005		2006-2010		2011-2015		2016		Total	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Rogaland	14	12	15	13	14	12	16	13	17	15	15	13
Hordaland	16	13	14	12	16	14	16	14	17	15	16	13
Oslo	15	13	15	13	14	12	14	12	12	11	14	12
Akershus	15	13	14	12	14	12					14	12
Telemark	13	12	15	13	15	13	13	12	14	12	14	12
Agder	17	13	15	13	16	13	14	12	13	12	15	13
Troms og Finnmark	17	14	15	12	15	13	15	12	14	15	15	12
Østfold			14	12	13	11	16	12	15	14	15	12
Nordland			15	14	15	13	16	14	17	15	15	14
Buskerud			15	12	14	12					15	12
Trøndelag			14	12	14	12	16	13	14	13	15	13
Oppland			16	13	15	13	15	12	11	10	15	13
Møre og Romsdal			15	14	15	13	14	12	14	12	15	13
Sogn og Fjordane			16	13	19	15	18	15	18	13	18	14
Vestfold			16	14	14	13	15	13	14	12	15	13
Hedmark			16	15	14	13	15	12	13	11	15	12
Akershus Øst					15	13	17	15	15	12	16	13
Akershus Vest					12	10					12	10
Vestre Viken							16	13	15	14	15	13
Total	15	13	15	13	15	12	15	13	15	13	15	13

Table 4.21: Mean and median reported tumour diameter (mm) of interval breast cancers by screening area, 1996-2014

Screening area	Screening year									
	1996-2000		2001-2005		2006-2010		2011-2014		Total	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Rogaland	25	19	23	21	26	21	23	22	24	21
Hordaland	20	20	20	18	23	20	24	21	22	20
Oslo	20	18	19	16	22	18	21	16	20	17
Akershus	21	19	18	17	19	16			19	18
Telemark	18	18	21	20	22	20	21	19	21	19
Agder	24	22	23	20	23	20	18	16	22	20
Troms og Finnmark	20	18	21	18	24	20	20	17	21	18
Østfold			19	15	22	19	22	19	21	18
Nordland			24	20	20	18	21	18	22	19
Buskerud			24	20	20	19			22	20
Trøndelag			18	16	22	18	20	18	20	18
Oppland			20	16	18	17	23	19	20	17
Møre og Romsdal			19	18	19	16	19	16	19	16
Sogn og Fjordane			19	20	23	20	25	20	24	20
Vestfold			15	15	22	18	21	18	21	17
Hedmark			22	20	21	19	18	17	20	18
Akershus Øst					22	18	24	20	23	19
Akershus Vest					21	20			21	20
Vestre Viken							20	20	20	20
Total	21	19	20	18	22	19	21	19	21	18

Histologic grade – invasive breast cancer

Grade was reported for invasive cancers using the Nottingham histologic score system (Elston-Ellis modification of the Scarff-Bloom-Richardson grading system) (68).

Nearly half of invasive screen-detected breast cancer cases were classified as histologic grade II (48%), while 19% were classified as grade III (Table 4.22) during the last 20 years. There were substantial variations in the distribution of histologic grade between screening areas (Table 4.22). The proportion of grade III tumours increased from 9% in 1996 to 24% in 2016 (Figure 4.19).

The proportion of grade III tumours varied between 17% and 23% for both prevalently and subsequently screened women (Figure 4.18). Variations in histologic grade by age-group were not clinically significant.

For interval breast cancer, 46% of invasive breast cancer tumours were diagnosed as grade II, while 37% were classified as grade III (Table 4.23). The proportion of grade I and II tumours increased with age (Figure 4.18).

Similar to screen-detected breast cancers, among interval breast cancers the proportion of grade III tumours increased over time (Table 4.23). Overall, grade II and III tumours made up roughly 80% of interval breast cancer cases in most screening areas, however this proportion varied substantially between some screening areas. Variation in the distribution of tumour grade between and across screening areas could be due to inter- and intra-rater variation among pathologists. The clinical significance of these differences is unclear and needs to be investigated.

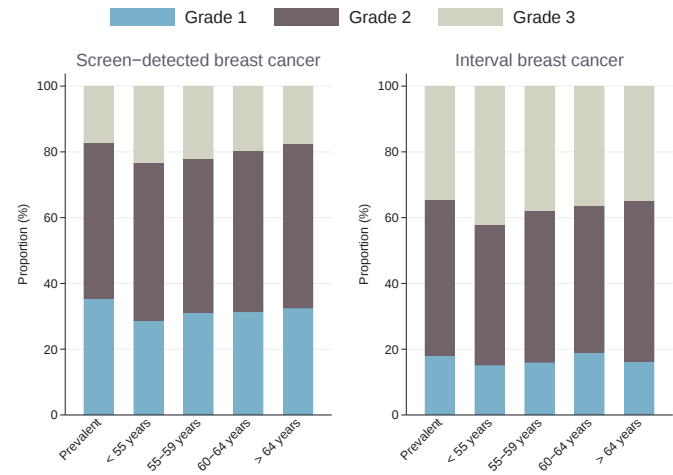


Figure 4.18: Distribution of histologic grade for invasive screen-detected breast cancers (left, 1996-2016) and interval breast cancers (right, 1996-2014) by age group

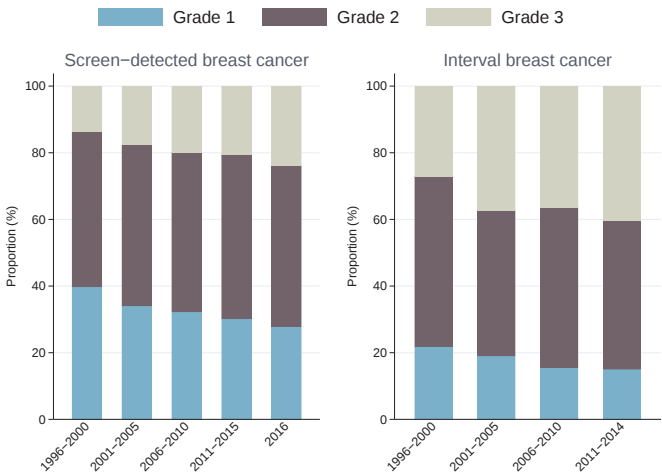


Figure 4.19: Distribution of histologic grade for invasive screen-detected breast cancers (left, 1996-2016) and interval breast cancers (right, 1996-2014) by screening year

“The distribution of histologic grade varied substantially across screening areas. Whether these differences are real or due to individual pathologist variation remains unclear and needs to be investigated”

Table 4.22: Distribution of histologic grade for invasive screen-detected breast cancers by screening year, 1996-2016

Screening area	Screening year															Total		
	1996-2000			2001-2005			2006-2010			2011-2015			2016					
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rogaland	44 %	40 %	16 %	29 %	51 %	20 %	33 %	46 %	21 %	29 %	43 %	28 %	24 %	38 %	39 %	33 %	45 %	23 %
Hordaland	43 %	42 %	15 %	43 %	44 %	13 %	37 %	45 %	19 %	35 %	46 %	19 %	28 %	47 %	26 %	38 %	45 %	17 %
Oslo	36 %	51 %	13 %	34 %	52 %	14 %	35 %	43 %	21 %	36 %	48 %	16 %	21 %	52 %	27 %	35 %	49 %	17 %
Akershus	35 %	54 %	11 %	27 %	56 %	17 %	28 %	58 %	14 %							30 %	56 %	14 %
Telemark	39 %	47 %	14 %	34 %	46 %	20 %	26 %	55 %	20 %	34 %	43 %	23 %	40 %	38 %	21 %	33 %	47 %	20 %
Agder	47 %	47 %	7 %	45 %	40 %	15 %	36 %	49 %	15 %	34 %	55 %	11 %	39 %	48 %	13 %	39 %	48 %	13 %
Troms og Finnmark	46 %	33 %	21 %	35 %	47 %	18 %	38 %	44 %	18 %	44 %	39 %	17 %	30 %	41 %	30 %	39 %	42 %	19 %
Østfold				29 %	48 %	23 %	28 %	58 %	14 %	19 %	62 %	18 %	20 %	60 %	20 %	25 %	57 %	18 %
Nordland				39 %	40 %	22 %	29 %	41 %	30 %	23 %	47 %	30 %	28 %	47 %	25 %	30 %	43 %	27 %
Buskerud				41 %	44 %	15 %	40 %	37 %	23 %							41 %	41 %	19 %
Trøndelag				29 %	50 %	21 %	25 %	51 %	24 %	26 %	49 %	26 %	28 %	50 %	22 %	26 %	50 %	24 %
Oppland				30 %	56 %	14 %	39 %	49 %	12 %	32 %	54 %	14 %	41 %	32 %	27 %	34 %	52 %	14 %
Møre og Romsdal				34 %	43 %	23 %	34 %	41 %	24 %	43 %	38 %	18 %	29 %	45 %	27 %	37 %	41 %	22 %
Sogn og Fjordane				47 %	32 %	21 %	22 %	51 %	27 %	12 %	56 %	31 %	14 %	62 %	24 %	24 %	49 %	27 %
Vestfold				28 %	48 %	24 %	27 %	55 %	19 %	27 %	55 %	18 %	28 %	57 %	15 %	27 %	54 %	19 %
Hedmark				29 %	61 %	10 %	29 %	57 %	14 %	28 %	56 %	17 %	17 %	64 %	19 %	27 %	58 %	15 %
Akershus Øst							31 %	44 %	25 %	21 %	49 %	30 %	31 %	47 %	22 %	26 %	47 %	27 %
Akershus Vest							42 %	44 %	14 %							42 %	44 %	14 %
Vestre Viken										28 %	53 %	20 %	29 %	48 %	22 %	28 %	52 %	20 %
Total	40 %	47 %	14 %	34 %	48 %	18 %	32 %	48 %	20 %	30 %	49 %	21 %	28 %	48 %	24 %	32 %	48 %	19 %

Table 4.23: Distribution of histologic grade for interval breast cancers by screening year, 1996-2014

Screening area	Screening year															Total		
	1996-2000			2001-2005			2006-2010			2011-2014								
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III			
Rogaland	31 %	34 %	35 %	18 %	34 %	48 %	11 %	50 %	39 %	15 %	44 %	41 %	18 %	41 %	41 %			
Hordaland	24 %	50 %	26 %	22 %	42 %	36 %	14 %	45 %	40 %	19 %	30 %	51 %	20 %	42 %	38 %			
Oslo	25 %	52 %	23 %	27 %	42 %	31 %	17 %	44 %	40 %	12 %	51 %	37 %	20 %	47 %	32 %			
Akershus	11 %	61 %	28 %	14 %	53 %	33 %	16 %	49 %	34 %				13 %	56 %	31 %			
Telemark	44 %	44 %	11 %	15 %	48 %	37 %	21 %	34 %	44 %	14 %	52 %	34 %	20 %	44 %	36 %			
Agder	< 1 %	63 %	37 %	23 %	37 %	40 %	17 %	55 %	27 %	24 %	52 %	23 %	20 %	50 %	30 %			
Troms og Finnmark	29 %	43 %	29 %	21 %	49 %	31 %	20 %	44 %	36 %	21 %	36 %	43 %	21 %	43 %	36 %			
Østfold				18 %	50 %	32 %	15 %	55 %	30 %	11 %	55 %	35 %	14 %	54 %	32 %			
Nordland				21 %	43 %	36 %	14 %	46 %	40 %	11 %	43 %	46 %	16 %	44 %	40 %			
Buskerud				9 %	43 %	48 %	20 %	47 %	33 %				16 %	45 %	39 %			
Trøndelag				16 %	44 %	40 %	15 %	43 %	43 %	14 %	44 %	42 %	15 %	43 %	41 %			
Oppland				31 %	41 %	28 %	19 %	53 %	27 %	11 %	59 %	30 %	18 %	53 %	29 %			
Møre og Romsdal				19 %	42 %	39 %	24 %	35 %	41 %	25 %	34 %	41 %	23 %	36 %	40 %			
Sogn og Fjordane				14 %	43 %	43 %	7 %	59 %	33 %	4 %	54 %	42 %	7 %	54 %	39 %			
Vestfold				16 %	34 %	50 %	7 %	62 %	31 %	19 %	49 %	32 %	13 %	52 %	35 %			
Hedmark				7 %	60 %	33 %	15 %	57 %	28 %	16 %	53 %	30 %	13 %	57 %	30 %			
Akershus Øst							15 %	45 %	40 %	11 %	39 %	50 %	12 %	41 %	46 %			
Akershus Vest							8 %	53 %	39 %				8 %	53 %	39 %			
Vestre Viken										10 %	42 %	48 %	10 %	42 %	48 %			
Total	22 %	51 %	27 %	19 %	44 %	37 %	16 %	48 %	36 %	15 %	45 %	40 %	17 %	46 %	37 %			

Lymph node involvement

The rate of lymph node involvement among women with screen-detected breast cancer was relatively stable over time. Rates ranged from 29% in 1998 and 2007 to 18% in 2016 (Figure 4.20). The 2016 rate may be effected by incomplete reporting or data registration/extraction (Figure 4.26) and will be monitored.

Overall, roughly a quarter (23%) of women diagnosed with screen-detected breast cancer between 1996-2016 had lymph node involvement (Table 4.24). This proportion varied between screening areas from 16% (Akershus Vest) to 30% (Møre og Romsdal). As with histologic grade, some of this variability may be due to differences between individual pathologists.

Among women with lymph node positive screen-detected breast cancer, 1-3 lymph nodes were involved in over 78% of cases, while 4-9 lymph nodes were involved in 16% of cases (Figure 4.22). In the remaining 6% of cases, 10 or more lymph nodes were involved. Overall, the proportion of women diagnosed with any lymph node involvement decreased with increasing age (Figure 4.21).

The rate of lymph node involvement among women with interval breast cancer peaked in 2006 (48%) but reached a low in 2014 (31%), Figure 4.20). Overall, 40% of women diagnosed between 1996-2014 had lymph node involvement, ranging from 36% in Vestfold and Trøndelag to 47% in Nordland (Table 4.25). This rate decreased slightly with increasing age (Figure 4.21). 1-3 lymph nodes were involved in the majority (66%) of interval breast cancer cases with lymph node involvement (Figure 4.22). However, 4-9 lymph nodes were involved in a larger proportion (23%) of interval breast cancer cases than screen-detected cases and the proportion with >9 lymph nodes involved was 11%.

Changes in the rates of lymph node positive tumours over time could be due to the introduction of the sentinel node technique in the late 1990s. The sentinel node is the first lymph node into which a breast cancer tumour spreads. If this lymph node contains cancer cells, this indicates spreading to lymph nodes in the axilla (armpit) and that these must be removed. The absence of cancer cells in the sentinel node indicates that cancer has not spread to the lymphatic system and that surgery to remove axillary lymph nodes is not required.

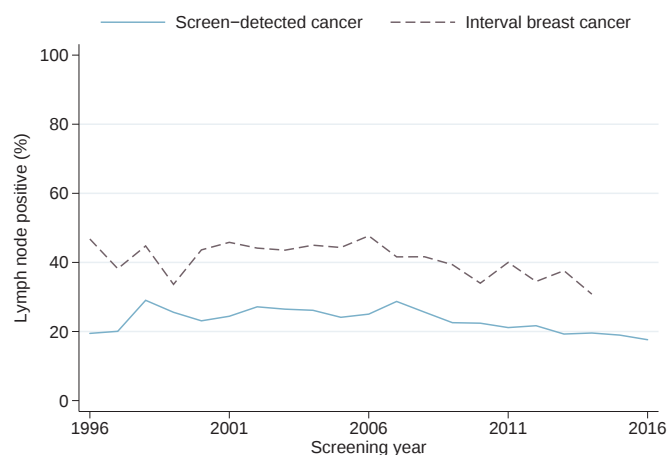


Figure 4.20: Proportion of screen-detected (1996-2016) and interval breast cancers (1996-2014) with lymph node involvement by screening year

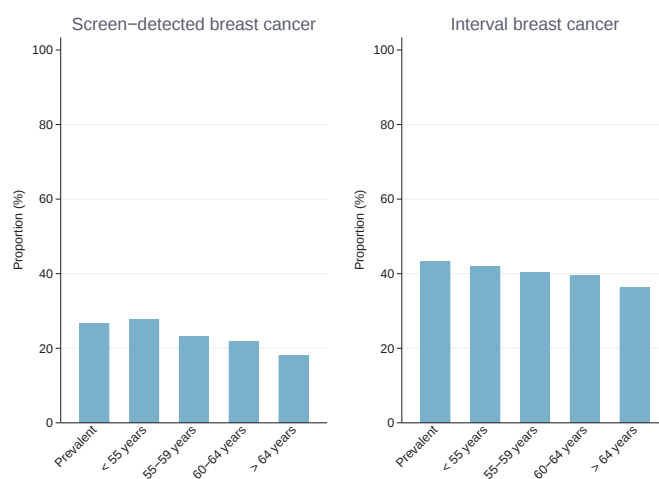


Figure 4.21: Proportion of screen-detected (left, 1996-2016) and interval breast cancers (right, 1996-2014) with lymph node involvement by age group

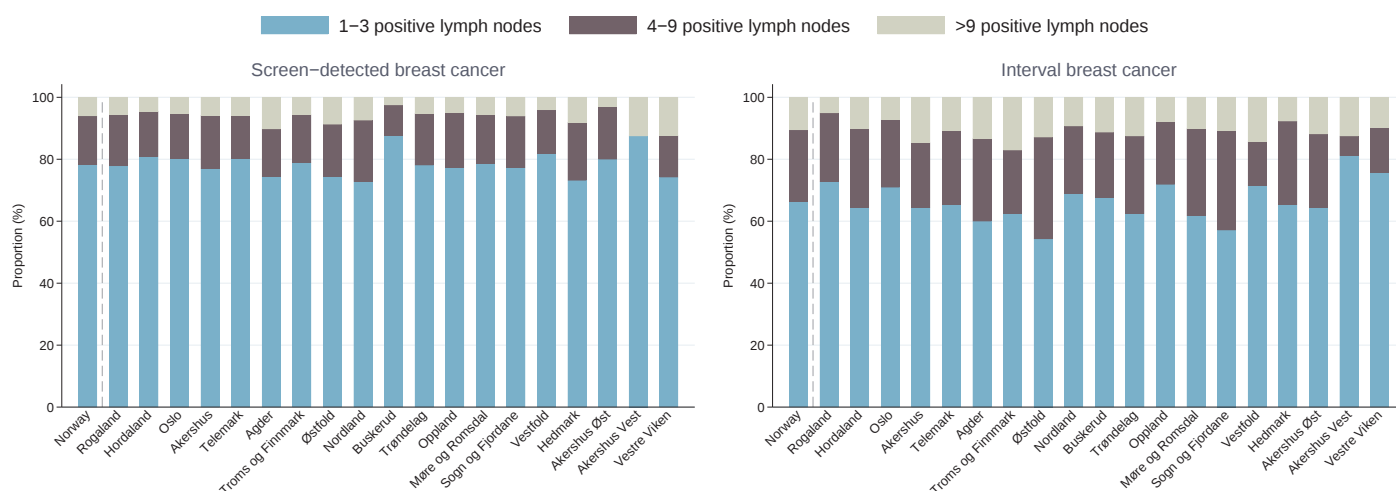


Figure 4.22: Distribution of lymph node involvement among women with positive lymph nodes diagnosed with screen-detected (left, 1996-2016) and interval breast cancers (right, 1996-2014) by screening area

Table 4.24: Proportion screen-detected breast cancers with lymph node involvement by screening area and year, 1996-2016

Screening area	Screening year					Total
	1996-2000	2001-2005	2006-2010	2011-2015	2016	
Rogaland	18 %	28 %	26 %	18 %	26 %	22 %
Hordaland	23 %	26 %	22 %	15 %	11 %	20 %
Oslo	27 %	24 %	21 %	18 %	16 %	21 %
Akershus	24 %	25 %	32 %			26 %
Telemark	28 %	26 %	28 %	17 %	22 %	24 %
Agder	35 %	19 %	21 %	23 %	15 %	21 %
Troms og Finnmark	20 %	23 %	25 %	20 %	16 %	22 %
Østfold		27 %	21 %	24 %	27 %	24 %
Nordland		24 %	31 %	22 %	29 %	26 %
Buskerud		24 %	23 %			24 %
Trøndelag		22 %	28 %	23 %	17 %	24 %
Oppland		35 %	25 %	22 %	16 %	26 %
Møre og Romsdal		36 %	35 %	23 %	17 %	30 %
Sogn og Fjordane		23 %	26 %	31 %	20 %	27 %
Vestfold		35 %	23 %	19 %	12 %	23 %
Hedmark		30 %	24 %	22 %	14 %	23 %
Akershus Øst			21 %	19 %	16 %	19 %
Akershus Vest			16 %			16 %
Vestre Viken				18 %	15 %	17 %
Total	23 %	26 %	25 %	20 %	18 %	23 %

Table 4.25: Proportion interval breast cancers with lymph node involvement by screening area and year, 1996-2014

Screening area	Screening year				Total
	1996-2000	2001-2005	2006-2010	2011-2014	
Rogaland	45 %	46 %	41 %	36 %	42 %
Hordaland	37 %	47 %	50 %	31 %	41 %
Oslo	38 %	40 %	38 %	29 %	37 %
Akershus	45 %	43 %	42 %		44 %
Telemark	35 %	54 %	41 %	43 %	45 %
Agder	50 %	44 %	39 %	25 %	37 %
Troms og Finnmark	43 %	44 %	33 %	44 %	41 %
Østfold		32 %	36 %	42 %	37 %
Nordland		55 %	50 %	33 %	47 %
Buskerud		52 %	41 %		45 %
Trøndelag		42 %	35 %	31 %	36 %
Oppland		42 %	42 %	50 %	45 %
Møre og Romsdal		46 %	37 %	43 %	42 %
Sogn og Fjordane		27 %	46 %	41 %	41 %
Vestfold		40 %	39 %	30 %	36 %
Hedmark		48 %	43 %	39 %	43 %
Akershus Øst			42 %	36 %	38 %
Akershus Vest			46 %		46 %
Vestre Viken				37 %	37 %
Total	41 %	44 %	41 %	36 %	40 %

Hormone receptor status

The Cancer Registry collects information about oestrogen receptor, progesterone receptor, and human epidermal growth factor receptor 2 (Her2) status, as well as Ki-67 expression. Information about oestrogen and progesterone receptor status has been systematically collected and registered since 1996. Information has been collected and registered about Her2 receptor status since 2005, while other tumour characteristics, such as Ki-67 expression, have been registered since 2010.

Oestrogen receptor status

Nearly nine of ten women with screen-detected cancer and seven of ten women with interval breast cancer had oestrogen receptor positive tumours (Figure 4.23). There were small variations in the proportion of women with oestrogen receptor positive tumours over time and across screening areas (Table 4.26).

The proportion of prevalently screened women with oestrogen receptor positive tumours was 90% and was 89% for subsequently screened women. These proportions were lower for women with interval breast cancer. The proportion of oestrogen receptor positive tumours was similar across all age groups for women with screen-detected breast cancer and increased slightly with age among women with interval breast cancer (Figure 4.23).

Progesterone receptor status

Seven of ten women with screen-detected breast cancer and six of ten women with interval breast cancer had progesterone receptor positive tumours (Figure 4.25 and Table 4.27). This proportion ranged from 62% in Østfold to 81% in Vestre Viken for screen-detected cancers, and for interval breast cancers ranged from 46% in Østfold to 55% in Vestre Viken.

The proportion of prevalently screened women with progesterone receptor positive tumours was 73%. For subsequently screened women it was 70%. These proportions were lower for women with interval breast cancer (Figure 4.24). The proportion of progesterone receptor positive tumours increased with age among subsequently screened women with interval breast cancer.

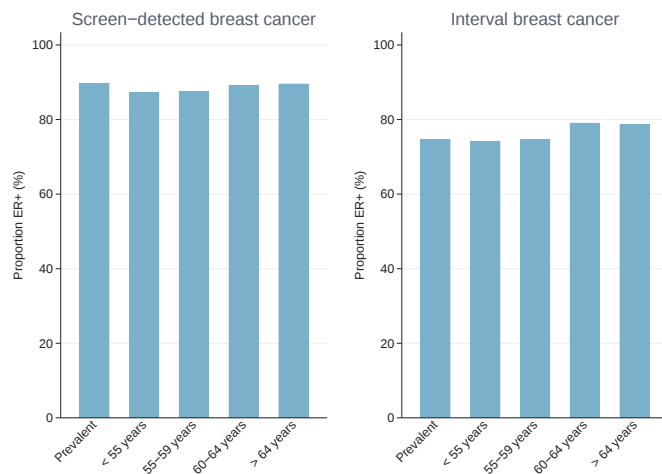


Figure 4.23: Proportion of oestrogen receptor positive (ER+) screen-detected breast cancers (left, 1996-2016) and interval breast cancers (right, 1996-2014) by screening year

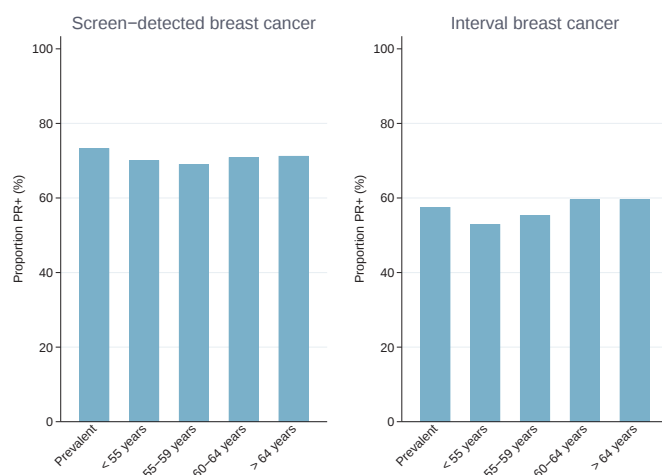


Figure 4.24: Proportion of progesterone receptor positive (PR+) screen-detected breast cancers (left, 1996-2016) and interval breast cancers (right, 1996-2014) by screening year

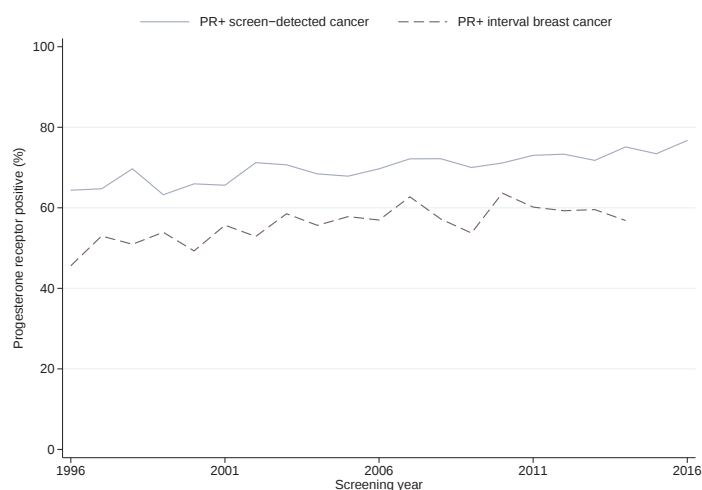
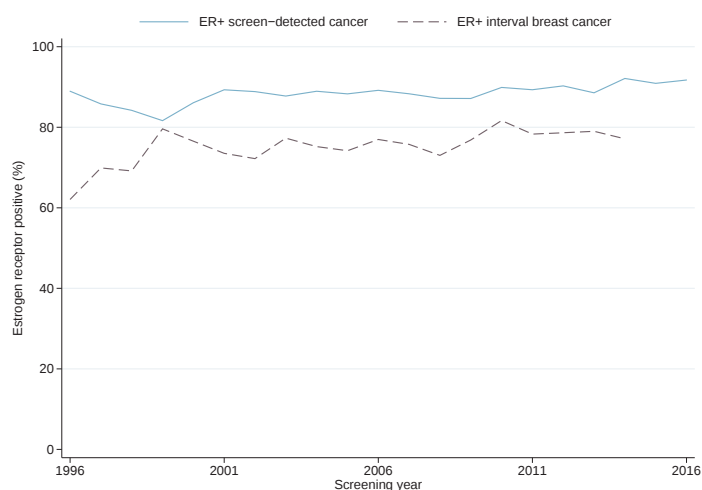


Figure 4.25: Proportion of oestrogen (ER+, left) and progesterone (PR+, right) receptor positive screen-detected breast cancers (1996-2016) and interval breast cancers (1996-2014) by screening year

Table 4.26: Proportion (%) of women with positive oestrogen receptor status (ER+) screen-detected (1996-2016) and interval (1996-2014) breast cancer by screening area and year

Screening area	Screening Year						Interval breast cancer				
	1996-2000	2001-2005	2006-2010	2011-2015	2016	Total	1996-2000	2001-2005	2006-2010	2011-2014	Total
Rogaland	86 %	92 %	90 %	90 %	92 %	90 %	72 %	72 %	71 %	84 %	75 %
Hordaland	91 %	89 %	87 %	89 %	94 %	89 %	72 %	78 %	73 %	76 %	75 %
Oslo	76 %	85 %	89 %	93 %	92 %	87 %	71 %	75 %	76 %	76 %	75 %
Akershus	87 %	88 %	92 %			88 %	76 %	76 %	87 %		78 %
Telemark	88 %	90 %	85 %	89 %	90 %	88 %	72 %	78 %	78 %	75 %	76 %
Agder	89 %	89 %	92 %	91 %	90 %	90 %	64 %	80 %	71 %	77 %	75 %
Troms og Finnmark	92 %	85 %	88 %	90 %	89 %	88 %	71 %	70 %	70 %	74 %	72 %
Østfold		87 %	90 %	90 %	94 %	90 %		83 %	79 %	85 %	82 %
Nordland		84 %	85 %	93 %	88 %	87 %		64 %	73 %	67 %	68 %
Buskerud		91 %	91 %			91 %		75 %	80 %		78 %
Trøndelag		89 %	87 %	88 %	91 %	88 %		74 %	79 %	81 %	78 %
Oppland		94 %	87 %	87 %	95 %	89 %		75 %	77 %	84 %	79 %
Møre og Romsdal		89 %	85 %	90 %	93 %	88 %		75 %	75 %	78 %	76 %
Sogn og Fjordane		91 %	84 %	96 %	86 %	90 %		87 %	73 %	76 %	77 %
Vestfold		91 %	91 %	90 %	94 %	91 %		69 %	86 %	84 %	82 %
Hedmark		89 %	89 %	88 %	91 %	89 %		66 %	81 %	79 %	77 %
Akershus Øst			86 %	87 %	91 %	88 %			88 %	75 %	79 %
Akershus Vest			91 %			91 %			72 %		72 %
Vestre Viken				93 %	93 %	93 %				81 %	81 %
Total	85 %	89 %	88 %	90 %	92 %	89 %	73 %	75 %	77 %	78 %	76 %

Table 4.27: Proportion (%) of women with positive progesterone receptor status (PR+) screen-detected (1996-2016) and interval (1996-2014) breast cancer by screening area and year

Screening area	Screening Year						Interval breast cancer				
	1996-2000	2001-2005	2006-2010	2011-2015	2016	Total	1996-2000	2001-2005	2006-2010	2011-2014	Total
Rogaland	60%	62%	81%	68%	80%	69%	35%	57%	66%	57%	56%
Hordaland	73%	76%	67%	75%	85%	74%	55%	60%	53%	65%	58%
Oslo	59%	66%	72%	75%	71%	70%	48%	56%	58%	59%	55%
Akershus	70%	70%	71%			70%	63%	63%	60%		62%
Telemark	71%	68%	61%	68%	69%	67%	56%	58%	57%	48%	55%
Agder	80%	63%	75%	66%	70%	69%	36%	57%	61%	54%	56%
Troms og Finnmark	42%	60%	73%	77%	73%	69%	14%	37%	66%	59%	52%
Østfold		54%	53%	72%	79%	62%		40%	42%	55%	46%
Nordland		78%	71%	80%	75%	76%		45%	52%	61%	52%
Buskerud		76%	81%			79%		75%	64%		68%
Trøndelag		71%	70%	71%	76%	71%		56%	55%	61%	57%
Oppland		81%	73%	71%	76%	74%		61%	58%	55%	58%
Møre og Romsdal		72%	57%	64%	75%	64%		58%	55%	56%	56%
Sogn og Fjordane		72%	71%	81%	82%	76%		67%	54%	66%	61%
Vestfold		60%	77%	80%	79%	76%		59%	68%	66%	66%
Hedmark		77%	75%	74%	79%	75%		52%	62%	65%	61%
Akershus Øst			71%	70%	76%	71%			67%	53%	57%
Akershus Vest			78%			78%			61%		61%
Vestre Viken				82%	77%	81%				65%	65%
Total	66%	69%	71%	73%	77%	71%	51%	56%	59%	59%	57%

Unavailable tumour characteristic data

The systems and processes for data collection and registration have changed since the start-up of the screening program (see page S8). These changes present challenges to longitudinal interpretation of prognostic and predictive breast tumours characteristics. Moreover, information about tumour size can be unavailable for women with locally advanced disease and for those who undergo neoadjuvant therapy prior to surgery.

Overall, complete histopathology information about screen-detected breast cancer was available for over 95% of cases with respect to tumour size, grade, or lymph node involvement (Table 4.28).

Complete information about oestrogen and progesterone receptor status was available for 95% of screen-detected and interval breast cancer cases (Tables 4.28 and 4.29). Reporting and coding of hormonal status information were implemented as a part of the screening program. Rates of missing hormone receptor status were highest when the screening program started (Figure 4.26). This may be associated with a lack of procedures and reminders for this information to be sent to the Cancer Registry in the ini-

tial years of the program. However, data completeness reached an acceptable level within a short time.

Information for interval breast cancer was generally missing at a higher rate than that for screen-detected breast cancers (Table 4.29). However, with the exception of tumour size, the proportion of not available information for interval breast cancer decreased over time (Figure 4.26). Complete information about tumour size was available for 89% of cases. Because a higher proportion of women undergo neoadjuvant therapy prior to surgery following a diagnosis of interval breast cancer than for screen-detected breast cancer, this was not an unexpected finding. The rate of missing data about tumour size for interval breast cancers generally grew with the screening program and peaked in 2006. It is difficult to determine how much of this increase was attributable to growing pains as various screening areas joined the program, and how much was attributable to a change in database software around this time.

Other reasons that histopathology data were not available for some women are: omissions in reporting, failures to send a reminder upon no receipt of expected histopathology information, failures in coding and registration, and failures in the extraction of data from the databases.

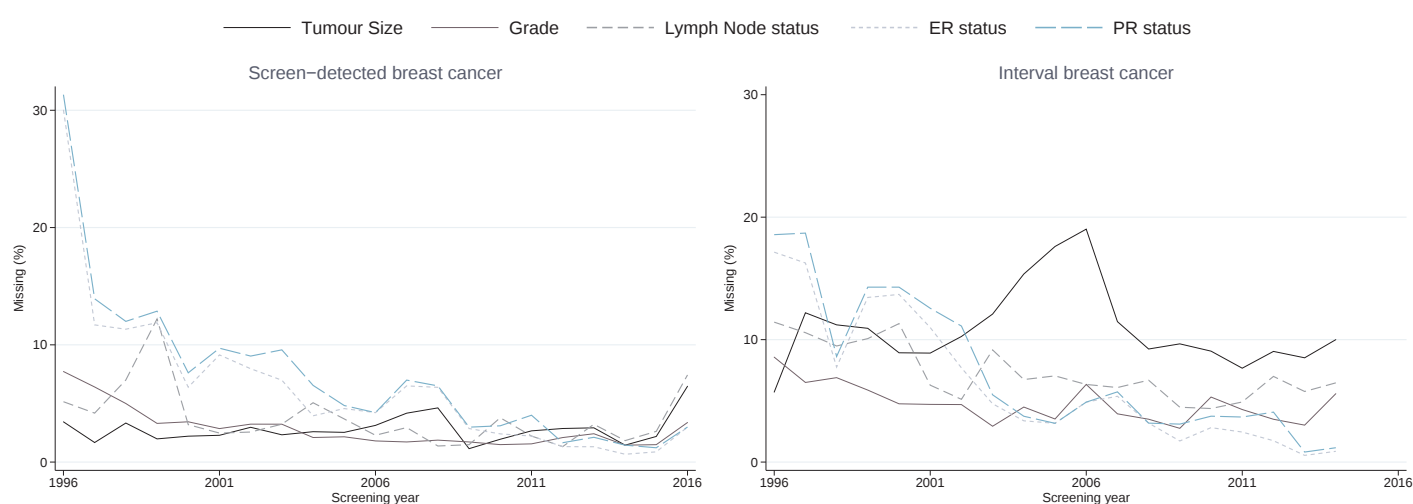


Figure 4.26: Proportion of missing data for histopathologic tumour characteristics of screen-detected (left, 1996-2016) and interval breast cancers (right, 1996-2014)

Table 4.28: Proportion (%) of missing information about histopathologic tumour size (mm), grade, lymph node involvement, and oestrogen receptor (ER) and progesterone receptor (PR) status among women diagnosed with screen-detected breast cancer by screening area, 1996-2016

Screening area	Tumour size	Histologic grade	Lymph node involvement	ER status	PR status
Rogaland	1.5 %	2.3 %	2.6 %	6.3 %	9.2 %
Hordaland	4.0 %	3.6 %	5.6 %	4.4 %	4.5 %
Oslo	2.6 %	2.2 %	5.8 %	5.0 %	5.8 %
Akershus	3.6 %	4.4 %	2.8 %	11.7 %	11.9 %
Telemark	3.1 %	1.0 %	1.4 %	3.1 %	3.1 %
Agder	2.5 %	2.6 %	2.6 %	2.4 %	3.3 %
Troms og Finnmark	2.7 %	1.8 %	2.4 %	6.6 %	12.8 %
Østfold	2.7 %	2.2 %	3.3 %	3.5 %	4.3 %
Nordland	2.7 %	5.0 %	2.5 %	3.0 %	3.0 %
Buskerud	3.6 %	1.7 %	1.9 %	7.7 %	8.1 %
Trøndelag	3.6 %	3.1 %	2.3 %	4.6 %	4.6 %
Oppland	2.9 %	1.3 %	2.7 %	4.5 %	4.6 %
Møre og Romsdal	2.2 %	2.1 %	3.4 %	2.1 %	2.4 %
Sogn og Fjordane	3.0 %	2.6 %	6.8 %	1.5 %	1.5 %
Vestfold	3.0 %	2.2 %	2.7 %	3.0 %	3.1 %
Hedmark	1.3 %	0.2 %	1.5 %	3.8 %	3.8 %
Akershus Øst	3.5 %	0.9 %	3.7 %	1.5 %	1.5 %
Akershus Vest	6.8 %	1.0 %	1.0 %	3.9 %	2.9 %
Vestre Viken	2.1 %	0.4 %	2.1 %	0.5 %	0.5 %
Total	2.9 %	2.4 %	3.3 %	4.6 %	5.5 %

Table 4.29: Proportion (%) of missing information about histopathologic tumour size (mm), grade, lymph node involvement, and oestrogen receptor (ER) and progesterone receptor (PR) status among women diagnosed with interval breast cancer by screening area, 1996-2014

Screening area	Tumour size	Histologic grade	Lymph node involvement	ER status	PR status
Rogaland	9.3 %	5.7 %	6.3 %	5.1 %	8.1 %
Hordaland	12.7 %	5.6 %	10.7 %	2.1 %	1.9 %
Oslo	9.9 %	5.4 %	8.0 %	8.2 %	8.8 %
Akershus	10.8 %	3.8 %	3.5 %	9.4 %	10.2 %
Telemark	11.2 %	1.1 %	6.7 %	5.0 %	5.0 %
Agder	9.9 %	5.3 %	6.3 %	4.6 %	5.6 %
Troms og Finnmark	13.8 %	2.7 %	4.9 %	9.8 %	17.4 %
Østfold	14.6 %	4.4 %	7.3 %	2.4 %	2.0 %
Nordland	13.2 %	7.5 %	9.7 %	1.8 %	1.8 %
Buskerud	17.9 %	3.0 %	6.6 %	2.4 %	2.4 %
Trøndelag	12.0 %	6.8 %	5.2 %	4.3 %	4.9 %
Oppland	15.0 %	3.9 %	6.5 %	5.9 %	5.9 %
Møre og Romsdal	6.7 %	1.8 %	4.9 %	1.3 %	1.3 %
Sogn og Fjordane	9.5 %	9.5 %	8.1 %	5.4 %	5.4 %
Vestfold	10.1 %	2.9 %	5.8 %	1.9 %	1.9 %
Hedmark	7.9 %	<0.1 %	4.7 %	1.6 %	1.6 %
Akershus Øst	7.9 %	1.9 %	6.5 %	2.3 %	2.3 %
Akershus Vest	10.8 %	2.7 %	5.4 %	2.7 %	2.7 %
Vestre Viken	11.1 %	2.6 %	5.1 %	2.6 %	3.4 %
Total	11.1 %	4.5 %	6.7 %	4.7 %	5.6 %

Mobile versus stationary units

Early performance measures typically combine results from stationary and mobile screening units. However, because the mammography equipment on mobile units requires frequent technical adjustments/technical quality controls, and because mobile units service a largely rural population, it might be useful to also evaluate early performance measures for stationary and mobile units separately. Moreover, the picture archiving and communication systems (PACS), and workstations differ between the mobile and stationary units, which might affect the display of images for interpreting radiologists.

Approximately 17% of all screening examinations were performed at mobile units. The majority of these women typically live in rural areas a long distance from stationary units. Mobile units were most commonly used in Nordland, Troms og Finnmark, Hedmark, and Hordaland (Table 4.30). Women invited to screening at a mobile unit had a higher attendance rate than women invited to stationary screening units: 80% and 75%, respectively.

For most of the past 20 years, recall rates due to abnormal mammographic findings at mobile units have been slightly lower than at stationary units (Figure 4.28). Moreover, women screened at mobile units had lower cancer detection rates than women screened at stationary units (Figure 4.29). These differences were seen across all age groups, for prevalently and subsequently screened women, and for screen-detected and interval breast cancer. Differences in urban versus rural lifestyles, and distributions of sociodemographic factors associated with breast cancer may partially explain why recall and cancer detection rates were lower among women screened at mobile versus stationary units.

The positive predictive values of mammography (PPV-1) and of biopsy (PPV-2) were similar for mobile and stationary units. This indicates that the quality of care offered at mobile units was comparable to that offered at stationary units (Figure 4.30).



Figure 4.27: Radiographers Astri Brown and Berit Moen on mobile screening unit Frøya, stationed in Jevnaker (2016). Photo by Grete Lier, Oppland breast centre

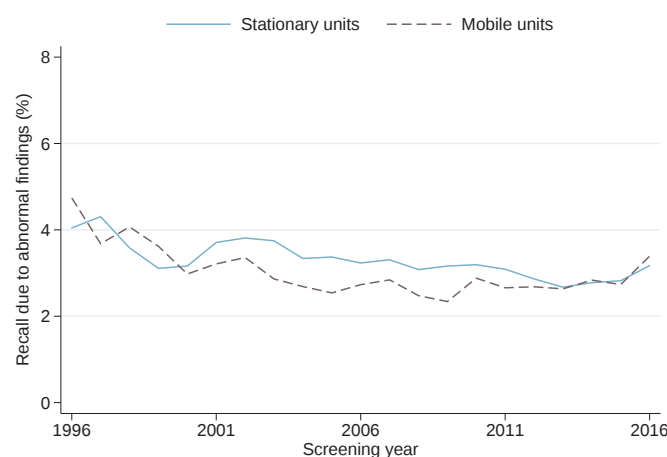


Figure 4.28: Recall rates due to abnormal mammographic findings (%) at stationary and mobile units by screening area and year, 1996-2016

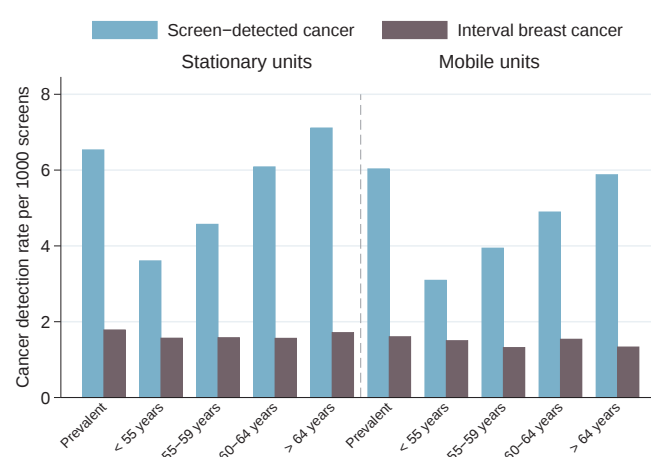


Figure 4.29: Screen-detected and interval breast cancer detection rates at stationary and mobile units per 1000 screening examinations by screening area and year, 1996-2016

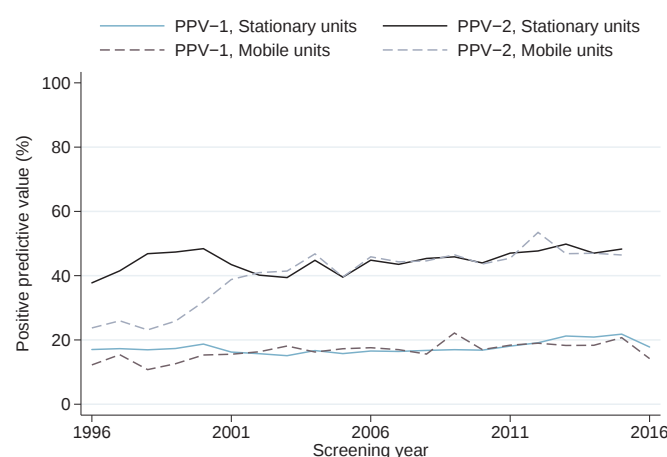


Figure 4.30: Positive predictive values of mammography (PPV-1) and biopsy (PPV-2) at stationary and mobile units by screening area and year, 1996-2016

Table 4.30: Percent (%) screening examinations performed at a mobile unit by screening area and year, 1996-2014

Screening area	Screening year					Total
	1996-2000	2001-2005	2006-2010	2011-2016	2016	
Rogaland	0 %	0 %	0 %	0 %	0 %	0 %
Hordaland	41 %	41 %	37 %	34 %	15 %	37 %
Oslo	0 %	0 %	0 %	0 %	0 %	0 %
Akershus	99 %	23 %	1 %			51 %
Telemark	0 %	0 %	0 %	0 %	0 %	0 %
Agder	4 %	2 %	1 %	2 %	0 %	2 %
Troms og Finnmark	83 %	70 %	68 %	49 %	63 %	62 %
Østfold		0 %	0 %	0 %	0 %	0 %
Nordland		72 %	69 %	65 %	63 %	68 %
Buskerud		28 %	18 %	43 %		24 %
Trøndelag		4 %	3 %	4 %	4 %	4 %
Oppland		6 %	9 %	17 %	16 %	12 %
Møre og Romsdal		3 %	5 %	7 %	6 %	5 %
Sogn og Fjordane		0 %	0 %	0 %	0 %	0 %
Vestfold		0 %	0 %	0 %	0 %	0 %
Hedmark		55 %	33 %	43 %	47 %	42 %
Akershus Øst			0 %	0 %	0 %	0 %
Akershus Vest			0 %	0 %		0 %
Vestre Viken				13 %	12 %	13 %
Total	36 %	19 %	14 %	14 %	12 %	17 %

“The attendance rate among women invited to mobile units is 5 percentage points higher than at stationary units: 80% versus 75% on average”

Surgical treatment

Roughly 62% of women diagnosed with screen-detected or interval breast cancer were treated with breast conserving surgery between 1996 and 2016. The proportion of women who received this treatment increased from 27% in 1996 to 79% in 2016 (Figure 4.31). The proportion of women in 2016 who received breast conserving surgery following a diagnosis of screen-detected DCIS

was 80%, screen-detected invasive breast cancer was 80%, and of invasive interval breast cancer was 59%.

The proportion of women who underwent breast conserving surgery varied between screening areas (Figure 4.32). Of those areas that are currently active, the highest proportion of breast conserving surgery was performed in Telemark and the lowest in Hordaland, for both screen-detected and interval breast cancers. This variation has been observed in prior reports as well (62, 69, 70).

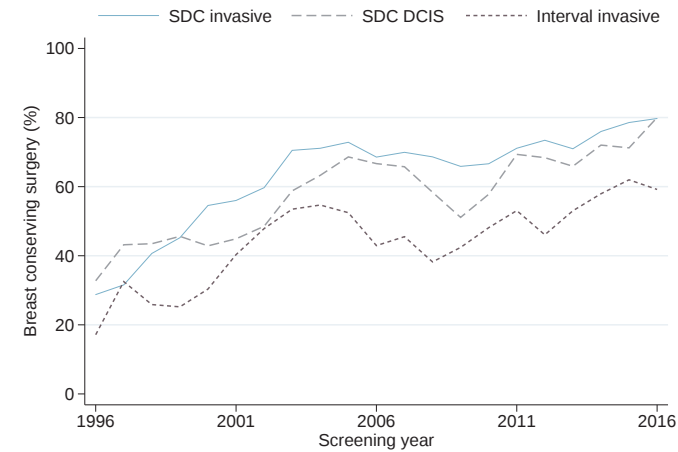


Figure 4.31: Proportion of women with invasive screen-detected breast cancer (SDC) or ductal carcinoma *in situ* (DCIS) (1996-2016) and with invasive interval breast cancer (1996-2014) who had breast conserving surgery by screening year

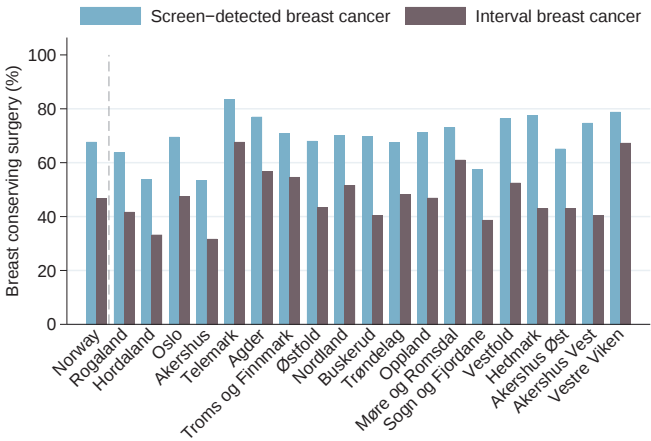


Figure 4.32: Proportion of women with screen-detected (1996-2016) or interval invasive breast cancer (1996-2014) who had breast conserving surgery by screening area

“Eight in ten women with screen-detected DCIS or invasive breast cancer received breast conserving surgery in 2016”

Summary

The evaluation of early performance measures helps to ensure that women are offered high quality health care. This section summarises a number of such measures over the past 20 years.

Roughly 75% of women attended screening following a personal invitation or reminder. Attendance rates varied by age: older women had higher attendance rates than younger women. Moreover, women who were subsequently invited to screening had higher attendance rates than prevalently invited women.

The overall recall rate decreased from 6.1% to 3.6% from 1996 to 2016. Recalls due to abnormal mammographic findings were 5.5% for prevalent screening examinations and 2.6% for subsequent examinations. Recall rates varied across screening areas.

Rates of screen-detected and interval breast cancer have been relatively stable since the start of the program (5.3-5.9/1000 screening examinations, and 1.7-1.9/1000 screening examinations, respectively). Interval breast cancers accounted for approximately 24% of all breast cancers detected among screened women, and the majority were diagnosed over a year after screening.

PPV-1 increased by roughly two percentage points from 1996 to 2016. Among screening examinations resulting in assessment because of abnormal mammographic findings, approximately 1 in 10 resulted in a diagnosis of screen-detected breast cancer among prevalently screened women. This rate was roughly twice as high for subsequently screened women (2 in 10). PPV-2 increased by roughly 15 percentage points from 1996 to 2016. Among those who underwent an invasive procedure, nearly 30% of prevalently screened women and over 50% of subsequently screened were diagnosed with screen-detected breast cancer.

Invasive carcinoma of no special type (previously referred to as invasive ductal carcinoma) was the most common breast cancer diagnosis for both screen-detected and interval breast cancers (70% and 77%, respectively). Moreover, approximately 17% of screen-detected and 6% of interval breast cancers were DCIS.

The size of interval breast cancers was slightly larger than screen-detected breast cancers (mean 21 mm, median 18 mm versus mean 15 mm, median 13 mm, respectively). Tumour size decreased with increasing age among women diagnosed with screen-detected breast cancer, but no such relationship was observed among women with interval breast cancer.

The increase in grade III tumours over time is striking (14% from 1996-2000 to 24% in 2016 among screen-detected cancers and 27% from 1996-2000 to 40% from 2011-2014 for interval breast cancers.) However, there are local variations in the distribution of

grade, which may have clinical implications. This issue requires further investigation.

Roughly 25% of screen-detected breast cancers were lymph node positive, while this rate was about 40% for interval breast cancer. The increase in lymph node positive cancers over time may be associated with the introduction of the sentinel node technique. Differences in rates across screening areas is likely due to differences in local procedures and individual pathologists. The clinical implications of this variability need to be investigated.

The majority of women diagnosed with screen-detected breast cancer had oestrogen or progesterone receptor positive tumours (89% and 71%, respectively). Roughly 76% and 57% of women diagnosed with interval breast cancer had oestrogen or progesterone receptor positive tumours. There were small variations in hormone receptor status over time and between screening areas. It is difficult to determine how much variability in hormone receptor status is due to true geographical variation of breast cancer across screening areas, and how much is due to local pathologists.

Mobile screening is typically offered in more rural areas. Recall rates due to abnormal mammographic findings were higher at stationary versus mobile units from 2000 to 2013, as were screen-detected breast cancer rates. However, PPV-1 and PPV-2 did not differ for stationary and mobile units.

Nearly 70% of women with screen-detected invasive breast cancer had breast conserving surgery. A lower proportion of women diagnosed with DCIS or invasive interval breast cancer had this type of surgery. The proportion of breast conserving surgery varied between screening areas, with the lowest rate in Hordaland and the highest in Telemark.



Figure 4.33: Radiographers Gunvor Waade and Line Camilla Westermann evaluate the image quality of mammograms during "amabasador week" (2017). Photo by Anne Kathrin Ertzaas, Cancer Registry of Norway

5. Breast cancer mortality and early detection

Breast cancer mortality

The main aim of the Norwegian Breast Cancer Screening Program is to reduce breast cancer mortality by detecting cancer in an early stage. Substantial follow-up time and the availability of individual data are prerequisites to estimate this effect. Mortality reductions can be calculated among those invited (intention to treat) or among those who have ever attended the program (per protocol) (71). Not screened women are a heterogeneous group that includes both those who do not want to participate and those who undergo mammography at private clinics. Reductions in mortality are expected to be lower among invited women than screened women due to the inclusion of both screened and not screened women in the invited group.

The first study using data from the Norwegian Breast Cancer Screening Program to estimate breast cancer mortality was published in the New England Journal of Medicine in 2010 (72). Kalaager et al. concluded that the screening program resulted in a 10% reduction in breast cancer mortality among invited women. This publication received a lot of attention and is frequently cited. However, the results have been discussed due to short follow-up time. Further, the inclusion of the first years of screening in the nominally exposed and non-exposed groups has been questioned because it counteracts the effect of prevalently screened women who have a higher incidence of breast cancer.

Two studies on breast cancer mortality were part of the external evaluation of the program (see page S56 for more details). Comparing breast cancer mortality among invited versus not invited women, Olsen et al. estimated that the screening program reduced mortality by roughly 10%, while Weedon-Fekjær et al. estimated the reduction to be 28% (73, 74). The latter study had substantially longer follow-up time, and studied the effect on the entire Norwegian population, not only those in the pilot project.

In 2013, Hofvind et al. estimated that breast cancer mortality was 43% lower among screened versus not screened women (75). This study had 15 years of follow up, the longest of any Norwegian study so far. The decision to estimate the mortality reduction among screened women (per protocol) was discussed due to the

potential for selection bias in favour of participation. However, the fact that the study was based on ever versus never screened might have underestimated the true effect of participation.

Information about screening outside the program has not been available for any of the aforementioned studies. This may have affected the observed effect in reducing breast cancer mortality. For this report we present the cumulative risk of breast cancer mortality among screened versus not screened women in the program since its start-up (Figure 5.1). The cumulative risk of breast cancer death among never screened women increased slowly from that of ever screened women after the start-up of the program in 1996. By the time the program was nationwide in 2005, the cumulative mortality was substantially higher among women who had never been screened. This difference increased over time and confirms that the reduction in breast cancer mortality among women screened in the program continues. However, more studies using both an intention to treat and per protocol design are needed to ensure the program continues to achieve its main goal.

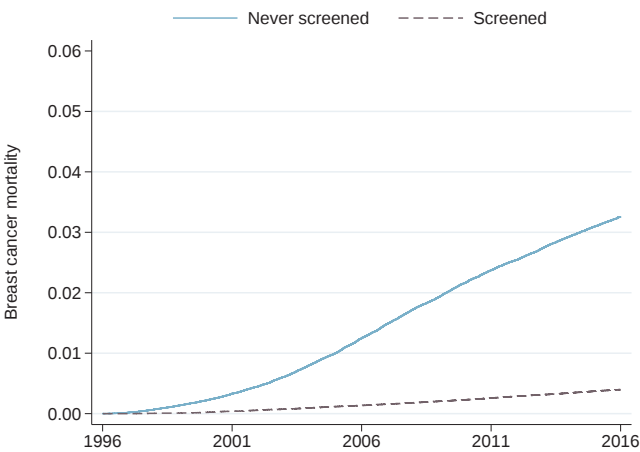


Figure 5.1: Cumulative breast cancer mortality among never screened and screened women in the Norwegian Breast Cancer Screening Program, 1996-2016

Table 5.1: Studies performed on breast cancer mortality among women invited to the Norwegian Breast Cancer Screening Program

Study	Study groups	Effect measure	Estimated effect
Kalager et al. 2010 (72)	Invited vs non-invited	Rate ratio difference	10 (95% CI -4 to 24)
Olsen et al. 2013 (73)	Invited vs non-invited	Rate ratio	0.93 (95% CI 0.77 to 1.12)
Weedon-Fekjær et al. 2014 (74)	Invited vs non-invited	Rate ratio	0.72 (95% CI 0.64 to 0.79)
Hofvind et al. 2013 (75)	Screened vs non-screened	Rate ratio	0.57 (95% CI 0.51 to 0.64)

Early detection and overdiagnosis

Detecting breast cancer in an early, asymptomatic stage is essential for successful screening and to reduce breast cancer mortality. However, during the past decades, the benefit of detecting early stage breast cancer has been questioned. Currently there is no method to identify which breast cancers will develop into aggressive disease, and which will never become life-threatening. All women diagnosed with *in situ* or invasive breast cancer are therefore offered treatment.

Detection of cancers that would have never been found were it not for screening is referred to as overdetected or overdiagnosis (76). Overdiagnosis occurs because some early stage breast cancers might be dormant or so slow growing that they never progress to become symptomatic in the absence of screening. Some women with breast cancer might therefore be overtreated or die from another cause before their cancer becomes evident (symptomatic). Overdiagnosis is only an epidemiologic term because whether a particular woman has an overdiagnosed cancer cannot be clinically verified.

The period between detecting an asymptomatic breast cancer at screening and its symptomatic stage, lead-time, is an inevitable part of screening. Due to the adoption of improved, digital screening tools, lead-time is assumed to be longer than it was using analogue mammography. This may have influenced the risk of detecting dormant or slow growing breast cancers.

Several papers show favourable tumour characteristics and prognoses among women with screen-detected versus interval breast cancer or breast cancer detected outside the screening program (4, 77, 78). In the first years following the start-up of the screening program in Norway, the majority of advanced breast cancer cases (stage ≥ 2) were detected at screening. However, the cumulative incidence of advanced breast cancer among women aged 50-69 diverged substantially between those who were and were not screened after the program became nationwide in 2005 (Figure 5.2).

Similar to estimating changes in breast cancer mortality as a result of organised breast cancer screening, estimation of overdiagnosis requires individual data, and substantial follow up time (79). The

Independent UK Panel on Breast Cancer Screening presented four different measures of overdiagnosis based on whether estimates were based on invited or screened women, and follow up time (12). It is critical to be aware of the different approaches when communicating and comparing results from different studies (80).

There are several studies estimating overdiagnosis in the Norwegian Breast Cancer Screening Program. A summary of the results from four studies based on individual data and from three studies using ecologic data are presented in Table 5.2. These studies represent a mix of the four measures described by the Independent UK Panel and investigated invasive breast cancer alone and in combination with DCIS. The results highlight the inherent challenges in estimating overdiagnosis.

Because of the lack of consensus on optimal methods and resulting variability in methods used in the studies published to date, it is difficult to determine an accurate rate of overdiagnosis in the Norwegian screening program. The Research Council of Norway also underlined the large uncertainty in the estimation of overdiagnosis in their report (13).

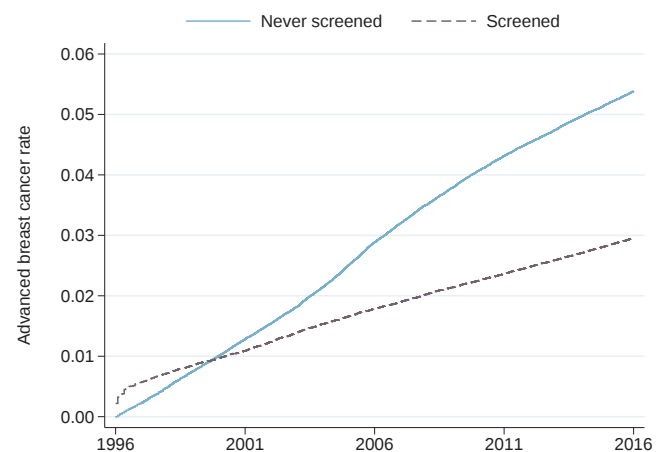


Figure 5.2: Cumulative rate of advanced breast cancer (stage ≥ 2) among women screened and never screened in the Norwegian Breast Cancer Screening Program, 1996-2016

Table 5.2: Studies evaluating overdiagnosis in the Norwegian Breast Cancer Screening Program. Note that various methods were used to calculate overdiagnosis and estimated rates may therefore not be directly comparable

Study	Data	Comparison groups	Estimated rate of overdiagnosis
Zahl et al. 2004 (81)	Ecologic	Target vs non-target group	50%
Jorgensen et al. 2009 (82)	Ecologic	Target vs non-target group	37 to 52 %
Kalager et al. 2012 (83)	Ecologic	Target vs non-target group	18 to 25 %
Falk et al. 2013 (84)	Individual	Invited vs not invited	11 to 16 %
		Screened vs not screened	13 to 19 %
Lund et al. 2013 (85)	Individual	Screened vs not screened	7 to 18 %
Michalopoulos and Duffy 2016 (86)	Individual	Screened vs not screened	0 to 17%
van Luijt et al. 2016 (87)	Simulated (Individual)	Invited vs not invited	2 to 11%

6. Program evaluation and research

Ongoing quality assurance, program evaluation, and research activities contribute to the high quality of the Norwegian Breast Cancer Screening Program. Because of the personal identification number assigned to all residents in Norway and nationwide implementation, the screening program is in a unique position to perform truly population-based analyses. This section summarises the external evaluation performed by the Research Council of Norway in 2015 and describes what is known about the cost-effectiveness of the program. Further, past and present research conducted within the screening program is summarised. A full list of publications associated with the program is included at the end of this report (page S66).

External evaluation

From 2007 to 2015, the Research Council of Norway spearheaded an independent external evaluation of the Norwegian Breast Cancer Screening Program on behalf of the Ministry of Health and Care Services. The evaluation was conducted to determine whether the screening program had “fulfilled its intentions and purpose, and to establish a scientific basis for potential expansion of the screening program to include other age groups” (13). A particular focus of the evaluation was to determine whether the screening program had achieved a 30% reduction in breast cancer specific mortality among invited women.

To this end, an international call for research proposals was put forward in 2008. Projects were to evaluate the impact of the screening program on incidence (i.e. overdiagnosis), stage at diagnosis, interval breast cancer rates, breast cancer mortality, women’s perspectives on the program, or costs associated with screening. Eight Norwegian and three international project proposals were submitted. Seven projects were funded: five lead by Norwegian investigators and two lead by international investigators.

The steering committee for the external evaluation stated that individual level data from a single database should be used for all projects. This way, any variation between study results could be attributed to differences in methodology. One set of quality assured data from the Cancer Registry was used to conduct all evaluation activities. However, the database at the Cancer Registry is designed for administrative purposes. Therefore, before the research teams could access any data, a research-friendly project database had to be established. This was completed in 2009.

Due to challenges related to changes in the informed consent model (see page S17), updated data from the Cancer Registry were available to research teams in 2012. Linked data from other registries were available in 2014.

The funded projects were completed by 2015 and results from observational studies suggested that the screening program reduced breast cancer mortality by approximately 20-30%. However, the effect of the screening program could not be completely disentangled from that associated with advances in diagnosis and

treatment. Overall, the evaluation concluded that the program was cost effective on a societal level but that individual women need to make an informed decision whether to attend screening based on their own values. A recommendation was made for future research as well as for continued evaluation and monitoring of the screening program. The final report is available online (13).

Cost effectiveness

From a societal perspective, the balance between the benefits and costs associated with a national screening program must be within the accepted limits for health care services.

The cost-effectiveness of the program’s first screening round was published in 2001 (88). The cost of screening was estimated to be 29,475 NOK per life-year gained, and 676,314 NOK per life saved. In 2015, the external evaluation published results about the economic effectiveness of the program. The direct and indirect costs associated with the organisation and operation of the program, including screening, recall examinations, treatments, and expenses incurred by women were assessed, and a cost-benefit analysis of the program was performed (13).

It was estimated that, in 2012, the cost per screening round was roughly 1400 NOK per woman screened (574 million NOK in total). This included costs associated with recall examinations, and women’s time and travel expenses, but excluded costs associated with program administration. The average cost per screening round excluding recall examinations was 1300 NOK per woman screened: 64% of this was health service costs, 15% travel-related expenses, and the remaining 21% was associated with loss of productivity. The average cost of screening per recalled woman was estimated to be roughly 3700 NOK (89).

For women aged 50-69 diagnosed with breast cancer, the estimated cost of 10 years of treatment and follow up for breast cancer at a hospital was 356,000 NOK (based on 2008/09 data) (90). The costs of breast cancer treatment for women diagnosed within the screening program were roughly 60,000 NOK lower than for women diagnosed outside of the program.

In terms of quality of life, the cost per quality-adjusted life year (QALY) gained through mammographic screening was between 190,000-480,000 NOK, which was within the recommended threshold from the WHO (1.9 million NOK per QALY) (13).

Evaluation of the cost effectiveness of the screening program is dependent on accurate estimates of costs associated with screening. Researchers have indicated that there are a number of uncertainties in their calculations, but that overall the cost of the screening program is within what Norwegian health authorities define as acceptable for health services (13).

Research projects performed as a part of the screening program

The Oslo I and Oslo II studies

The Oslo I and Oslo II studies compared early performance measures and breast cancer detection rates from screen film and full-field digital mammography in the screening program. The principal investigator for both studies was professor emeritus Per Skaane.

In the Oslo I study, all participating women were screened using both screen film and digital mammography during a single visit between January and June 2000 in Oslo (46). Independent double reading with consensus was used. Meetings were held separately for screen film and digital mammograms. Images were interpreted without prior films for comparison. The study included a two-year follow-up to record cases of interval breast cancer and screen-detected cancer in the subsequent screening round. The study found no statistically significant difference in breast cancer detection rates between screen film and digital mammography (26). Moreover, cancer conspicuity was similar for both modalities.

In the Oslo II study, all women attending screening in Oslo between November 2000 and December 2001 were randomised to undergo either screen film or digital mammography (47). The process for image interpretation was the same as in Oslo I except separate consensus meetings were not held for screen film and digital mammograms. The study found that digital mammography was associated with a higher cancer detection rate than screen film mammography, and concluded that digital mammography with soft-copy reading was suitable for population-based mammography screening programs (27).

The Oslo tomosynthesis trial (OTST)

The aim of the Oslo tomosynthesis trial was to investigate early performance measures from full-field digital mammography and digital breast tomosynthesis (including synthetic mammography) combined in the Norwegian Breast Cancer Screening Program. The study was performed in Oslo from 2011 to 2012. Image interpretation was divided into four arms: digital mammography alone, digital mammography with computer aided detection, digital mammography with tomosynthesis, and tomosynthesis with synthetic mammography.

Interim analyses showed that screening with digital mammography and tomosynthesis led to a significantly higher cancer detection rate, increased the detection of invasive breast cancers in screening, and led to a decrease in false-positive recalls (28, 91). Final results, including screen-detected cancer and interval breast cancer rates, are in progress.

The Oslo tomosynthesis trial was headed by professor emeritus Per Skaane. This trial is considered a pioneering study in the field of screening tomosynthesis, and provides a basis for the evaluation of implementing digital breast tomosynthesis in organised mammographic screening.

Ongoing research studies performed as a part of the screening program

The Tomosynthesis trial in Bergen (TOBE)

Digital breast tomosynthesis is claimed to be a better screening tool than the current standard (full-field digital mammography) based on studies showing lower recall rate and a higher rate of screen-detected breast cancer when screening with tomosynthesis compared to digital mammography (59, 60). However, there is insufficient evidence to support the introduction of tomosynthesis as a tool for breast cancer screening in Norway (92). The Bergen tomosynthesis trial titled "Digital breast tomosynthesis – the future screening tool for breast cancer?" is an ongoing randomised controlled trial funded by the Research Council of Norway. The goal is to measure the effect of screening with tomosynthesis versus digital mammography by comparing results of early performance measures including radiation dose, tumour characteristics, and cost-effectiveness. The study started in 2015 and will be run for one screening round with two years' follow up to record cases of interval breast cancer. Professor Solveig Hofvind is the principal investigator for this study.

Oslo, Vestfold, and Vestre Viken study (OVVV)

Most studies investigating the effect of screening with digital breast tomosynthesis have used tomosynthesis in combination with full-field digital mammography. This almost doubles the radiation dose compared with digital mammography alone (93, 94). Vendors now offer synthetic two-dimensional mammography generated from the raw tomosynthesis data in combination with tomosynthesis. The objective of the Oslo, Vestfold, and Vestre Viken study (OVVV) is to evaluate whether tomosynthesis is a modality suitable for screening when used independently of digital mammography. Women screened with synthetic mammography and tomosynthesis in Oslo will be compared to women screened with digital mammography in Vestfold and Vestre Viken, with a focus on early performance measures (recall rate, cancer detection rate, positive predictive values, and tumour characteristics). Women will be followed up until January 2018 to record cases of interval breast cancer. This study is considered a quality improvement study as part of the Norwegian Breast Cancer Screening Program.

Reviewing screening mammograms

During 2016 and 2017, radiologists from the screening program conducted an informed review of screening mammograms from 75 screen-detected and 75 interval breast cancer cases that were randomly selected from each breast centre in Norway. Consensus assessments from a panel of five radiologists were used to classify cases into one of five radiological classifications (missed, minimal sign actionable, minimal sign not actionable, true, or occult) based on the prior screening and diagnostic mammograms. A consensus assessment was also assigned for mammographic features, including mammographic density. This study will assess the mammographic features and histopathology associated with differing radiological classifications, stratified by mode of detection. This is a quality assurance/quality improvement study headed by the Cancer Registry of Norway. Funding for a PhD student has been applied for.



Figure 6.1: (L-R) Kaitlyn Tsuruda, Marie Lilleborge, Gunvor G. Wåde, Solveig Hofvind, Tone Hovda, Åsne S. Holen, Nataliia Moshina, and Sameer Bhargava, all presenters at the European Congress of Radiology, Vienna, Austria (March 2017)

Screening among immigrants

Mammographic screening and breast cancer among immigrant women has been investigated in many countries with organised screening, but never in Norway. The purpose of this study is to gain knowledge about immigrants and mammographic screening in Norway. This project will compare attendance rates among immigrant and non-immigrant women and study how attendance is associated with sociodemographic circumstances. Immigrant women's rationales for attendance and non-attendance in the screening program will be investigated. Lastly, this project will explore the relationships between screening parameters, tumour histopathology, and survival among immigrant and non-immigrant women diagnosed with breast cancer. This project is part of a PhD project performed by Sameer Bhargava. The primary investigator of the project is professor Solveig Hofvind.

Compression in mammography

Compression force is used in mammography to reduce breast thickness and thereby improve image quality and lower the radiation dose. The screening program's quality assurance manual states that the compression force for images acquired using digital mammography should be within 11 to 18 kg; however, there are no evidence-based recommendations for optimal compression force. The purpose of this study is to analyse breast compression parameters (such as compression force, pressure, and compressed breast thickness) and radiation dose in the screening program, as a first step toward establishing evidence-based recommendations for optimal breast compression. This study is a part of Gunvor Wåde's PhD project performed at Oslo and Akershus University College of Applied Sciences. Her main supervisor is Solveig Hofvind.

Pain and discomfort during screening

Compression during mammography may cause some women to experience pain or discomfort. Because of this, some women choose to not participate in organised mammographic screening. The purpose of this study is to examine the association between breast compression and women's expected and experienced pain and discomfort during mammography. This study started in 2017 and is a quality improvement study in the Norwegian Breast Cancer Screening Program.

Mammographic density

High mammographic density may result in delayed breast cancer diagnosis or missed cancers due to masking, and is independently associated with an increased risk of breast cancer. However, there is a lack of evidence about how mammographic density affects the performance of organised mammographic screening. The objective of this study was to investigate the association between mammographic density and early performance measures in organised screening. Early performance measures of interest were positive predictive values of recall and needle biopsy, and the number of women needed to be recalled or undergo a biopsy to detect breast cancer. Results from this study demonstrated that high mammographic density was lower positive predictive values, and the number of women needed to be recalled or biopsied increased with increasing density (95). Another study concluded that high mammographic density is associated with less favourable histopathologic tumour characteristics in organised screening (96). This study was performed as a part of Nataliia Moshina's PhD project and is headed by professor Solveig Hofvind. Further studies will be performed on this topic.

Progression of premalignant lesions

A small proportion of women attending the screening program undergo a needle biopsy and are diagnosed not with invasive

breast cancer but a benign finding. Such findings can range from normal cells to atypical cells of an *in situ* (pre-malignant) lesion. Women diagnosed with a pre-malignant lesion are at an increased risk for developing invasive breast cancer in the future. In this project, women's screening histories are being used to estimate their long term risk of invasive breast cancer. Further goals are to identify epidemiological risk factors and mammographic features that can predict the progression of pre-malignant lesions. This is a part of a post doc project conducted by Marie Lilleborge. The study is a part of a larger ongoing multidisciplinary study about tumour progression.

PhD projects

The following PhD projects have been conducted using data from the screening program:

- Moshina, N. Understanding the role of mammographic density in a population based breast cancer screening program: a step towards stratified screening for breast cancer in Norway? Oslo: Faculty of Medicine, University of Oslo, 2017.
- Suhrke, P. The incidence and treatment of breast cancer in Norway over three decades. The relationship between mammography, hormone therapy use and overdiagnosis. Oslo: Faculty of Medicine, University of Oslo, 2017.
- Hoff, SR. Radiological and epidemiological aspects of mammographic screening. Trondheim: Faculty of Medicine, Norwegian University of Science and Technology, 2013.
- Falk, RS. Epidemiological studies of early-stage breast cancer in the Norwegian breast cancer screening program. Oslo: Faculty of Medicine, University of Oslo, 2013.
- Kalager, M. The Norwegian Breast Cancer Screening Program: effects on incidence, prognosis and mortality of breast cancer. Oslo: Faculty of Medicine, University of Oslo, 2012.
- Solbjør, M. Women's experiences of mammography screening: decision making, participation and recall. Trondheim: Faculty of Social and Educational Sciences, Norwegian University of Science and Technology, 2008.
- Weedon-Fekjær, H. Modelling breast cancer incidence, progression and screening test sensitivity using screening data. Oslo: Faculty of Medicine, University of Oslo, 2008.
- Hofvind, S. The Norwegian Breast Cancer Screening Program: selected process indicators and their utilization in epidemiological research. Oslo: Faculty of Medicine, University of Oslo, 2005.
- Wang, H. Epidemiological studies of breast cancer in Norway: with focus on implementation of organized mammography screening. Oslo: Faculty of Medicine, University of Oslo, 2002.



7. The future of breast cancer screening

Medical imaging has developed substantially since the first mammographic screening trial in 1963. The ever earlier detection of breast cancers is controversial because of the potential for the detection of dormant and slow growing tumours and subsequent overtreatment. There is a continuous need to generate new evidence about factors influencing breast cancer progression and detection, and how to use this information to improve organised screening and thus increase its benefits for individual women and society. Due to the complexity, uncertainty, and rapid changes in knowledge, the task of conveying information represents a continual challenge.

The use of personalised letters stating a time and place for screening examination was a major factor contributing to the success of the Norwegian Breast Cancer Screening Program when it started in 1995. Over twenty years later it is still just as important to the program's continued success. However, today an increasing amount of information is shared digitally with women: roughly 40% of women are invited through a secure digital mailbox. In the future, we aim to offer women online booking services, and make women's screening histories available online to them and their general practitioners. We believe that general practitioners will play an increasingly important role in breast screening and aim to support their role in informing women about breast care and the screening program in particular.

Mammographic imaging technology is steadily improving. Between 2000 and 2011, digital mammography replaced analogue mammography as a screening tool in the Norwegian screening program. Now tomosynthesis is being considered as an additional tool or a replacement for digital mammography (5, 92). Tomosynthesis is commonly used for clinical mammography, but the evidence about the effectiveness of this technique as a screening tool is limited and still being generated. The transition from screen-film to digital mammography required substantial, expensive changes to the infrastructure used to acquire, interpret, and store mammography images. While the infrastructure needed for tomosynthesis is nearly identical to that for digital mammography, tomosynthesis will increase financial costs, mostly due to increased reading time and data storage (5, 92). The financial cost of screening with tomosynthesis is not currently known for programs run based on the current European guidelines.

While mammographic x-ray tube positioning, detectors, positioning (views), and vendor-specific projection angles were tested, evaluated, and improved for digital breast tomosynthesis, contrast enhanced spectral mammography, hand-held and automated breast ultrasound, and MRI were adapted for screening and/or clinical mammography (97–100). Multimodality screening has come knocking on our door.

With all these improvements in imaging technology, women and society should benefit from an increase in program sensitivity. This improvement would ideally maintain the current rate of screen-detected breast cancer, as to not increase overdiagnosis, and reduce the rate of interval breast cancer. We hypothesise that

in the future we will be able to identify dormant or slow growing breast cancers, and treat these cancers accordingly. We also hypothesise that multimodality screening will help us detect “missed” cancers and thereby reduce the rate of interval breast cancer. Reducing this rate will presumably be favourable for future disease specific mortality since interval breast cancers are usually detected in a later stage than screen-detected breast cancers.

Age and a number of other personal traits affect a woman's risk of breast cancer. There is a wide variation in the distribution of risk factors among women and therefore the lifetime risk of breast cancer. The target group of organised screening has been continuously discussed since the start-up of our program. Recently, the European Commission Initiative on Breast Cancer released recommendations for breast cancer screening (5). Their recommendation was based on strong evidence for organised screening of women aged 50–69 while the recommendations for age groups 45–49 and 70–74 were based on conditional evidence. We assume that a future discussion and subsequent investigation about expanding the target group of the Norwegian Breast Cancer Program will take place.

Like women, breast tumours are heterogeneous and can appear differently in different women. Some tumours may be clearly visible in mammographic fatty and dense breasts, while others may hide in dense parenchyma or not be visible on mammograms at all. A “one-size fits all” approach may thus not be ideal for individual women. As a result, risk-factor based stratification has been highly discussed during the past decade as a method to improve the sensitivity of screening programs. A number of strategies have been proposed (101–104). In particular, a survey of women's risk factors has been suggested before individual plans for breast screening schedules are established. This will result in different screening schedules for individual women: some women may receive annual multimodality screening, while others may receive mammographic screening every three years. Regular reviews will be needed due to changes in risk factors over time, such as the use of hormonal treatment and mammographic density. However, the practical aspects of such stratified screening need to be identified and standardised before they can be feasible. There are substantial organisational and practical challenges left to be resolved before organised biennial mammographic screening can change course. Moreover, extensive evidence is needed to guarantee that stratified screening is ethically justifiable, that is, that women are offered similar or better quality screening using a stratified model versus the current “traditional” model.

Many radiologists are involved in the interpretation of screening mammograms in an organised program. Computer aided detection (CAD) has been used as a method to improve the performance of screening mammography for decades (105). CAD is intended to reduce the rate of false negative findings but possibly at the cost of increased false positive findings (106, 107). This might be

a reason why European screening programs generally have used double reading with consensus instead of using CAD.

Although traditional CAD is not widely used in European screening programs, machine learning methods, such as deep learning, offer new opportunities to make screening more effective, and appear to be taking off in this era of digital imaging. Organised mammographic screening generates large data sets due to the massive number of images acquired daily and the amount of information available for each image. Repeated examinations of the same women are performed at regular intervals and the availability of results for each screening examination provide ideal building blocks to develop evidence-based solutions for breast screening based on population-based data. Because of this, medical image analysis groups across the world are now quickly entering the field of radiology, and specifically breast imaging, to apply rapidly improving methodologies to a wide variety of applications. Results to date have been promising in the field of mammographic imaging (108). We think that machine learning methods will be able to reduce the workload of breast radiologists in screening, freeing up time to dedicate to clinical mammography, which will probably include a broader spectrum of diagnostic techniques in the future.

Non-imaging based solutions are also being investigated for their utility in early detection and ability to forecast breast cancer prognosis. Enzymes and proteins expressing abnormal cells might be strong markers for changes in the breast. Saliva and/or blood samples may one day have the potential to replace digital mammography or tomosynthesis as screening tools. Several breast centres have taken and/or take part in studies aimed at investigating blood as a marker to predict or identify cancer cells. Further studies using saliva are in progress. If we and our international colleagues identify this marker, traditional imaging techniques may in turn be offered to women whose biological samples test positive for breast cancer. Similar to current practice, further assess-

ment could include ultrasound, MRI, contrast enhanced spectral mammography or positron emission tomography/computed tomography.

Future developments in “-omics” (for example genomics, proteomics, metabolomics, and epigenomics) will certainly pave the way for understanding more about tumour characteristics, including biology, progression rates, and risk. This knowledge may help us identify more individualised treatments that are unique for specific tumours. The hope is that, as a result, overdiagnosis and over-treatment will be minimised, as will the side effects of treatment that women experience, and that breast cancer mortality will be diminished. However, years of experience tell us that we are a long way from taking these promising results from basic research to making changes in clinical practice. Currently, there are still huge knowledge gaps that need to be filled before this is a reality.

The “-omics” and other aspects of screening are challenging to understand. They are also challenging to communicate. Additionally, there is now an increased focus on personal privacy and data protection, which requires focused attention in order to satisfy the evolving privacy legislation. All these factors present a challenge with respect to providing women with information to make an informed choice about participation.

One of the goals of the Norwegian Breast Cancer Screening Program is to be among the best screening programs in the world. There are currently challenges related to data access and funding for quality improvement and research studies, particularly for a screening program that is administered and run very well. Until the future is here, we have many years ahead of us to work to increase the benefits and decrease the harms associated with breast cancer screening. We are dedicated and hope that the maintenance and further development of the screening program will be given political priority and financing.



Figure 7.1: The future of breast cancer screening is bright. Oslo breast centre, 2017. Photo by Wenche Melby, Cancer Registry of Norway

Reference list

References

1. Cancer Registry of Norway. Cancer in Norway 2015 - cancer incidence, mortality, survival and prevalence in Norway. Oslo, 2016.
2. Ferlay, J, Soerjomataram, I, Dikshit, R et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. *Int J Cancer* 2015;136:E359–86.
3. Sant, M, Allemani, C, Capocaccia, R et al. Stage at diagnosis is a key explanation of differences in breast cancer survival across Europe. *International Journal of Cancer* 2003;106:416–422.
4. Hofvind, S, Holen, Å, Roman, M, Sebuødegård, S, Puig-Vives, M and Akslen, L. Mode of detection: an independent prognostic factor for women with breast cancer. *J Med Screen* 2016;23:89–97.
5. European Commission Initiative on Breast Cancer. Recommendations from European Breast Guidelines. Last updated 24 July 2017. Accessed 4 Oct 2017. URL: <http://ecibc.jrc.ec.europa.eu/recommendations/>.
6. International Agency for Research on Cancer Handbook Working Group. IARC Handbook of Cancer Prevention. Breast Cancer Screening. Volume 15. Lyon, France: IARC Press, 2015.
7. Shapiro, S. Periodic screening for breast cancer: the HIP Randomized Controlled Trial. Health Insurance Plan. *J Natl Cancer Inst Monogr* 1997;27–30.
8. Biller-Andorno, N and Jüni, P. Abolishing Mammography Screening Programs? A View from the Swiss Medical Board. *New England Journal of Medicine* 2014;370:1965–1967.
9. Loberg, M, Lousdal, ML, Bretthauer, M and Kalager, M. Benefits and harms of mammography screening. *Breast Cancer Res* 2015;17:63.
10. Welch, HG, Prorok, PC, O'Malley, AJ and Kramer, BS. Breast-Cancer Tumor Size, Overdiagnosis, and Mammography Screening Effectiveness. *New England Journal of Medicine* 2016;375:1438–1447.
11. Gotzsche, PC and Jørgensen, KJ. Screening for breast cancer with mammography. *Cochrane Database Syst Rev* 2013;CD001877.
12. Independent U. K. Panel on Breast Cancer Screening. The benefits and harms of breast cancer screening: an independent review. *Lancet* 2012;380:1778–86.
13. Research-based evaluation of the Norwegian Breast Cancer Screening Program. Oslo: The Research Council of Norway, 2015.
14. Wilson, JMG and Junger, G. Principles and practice of screening for disease. Geneva: World Health Organization, 1968.
15. Helsedirektoratet. Styringsstruktur og strategi for nasjonale screeningprogrammer. IS-2242. Oslo: Helsedirektoratet (NO), 2014.
16. Lov om helseregistre og behandling av helseopplysninger (helseregisterloven). LOV-2014-06-20-43.
17. Forskrift om innsamling og behandling av helseopplysninger i Kreftregisteret (Kreftregisterforskriften) [Regulations on the collection and processing of personal health data in the Cancer Registry of Norway (Cancer Registry Regulations)]. FOR-2001-12-21-1477.
18. Act of 18 May 2001 No. 24 on Personal Health Data Filing Systems and the Processing of Personal Health Data (Personal Health Data Filing System Act).
19. Lov om behandling av helseopplysninger ved ytelse av helsehjelp (pasientjournalloven). LOV-2014-06-20-42.
20. Lov om helsepersonell m.v. (helsepersonelloven) [Act of 2 July 1999 No. 64 relating to Health Personnel etc. (The Health Personnel Act)]. LOV-1999-07-02-64.
21. Kvalitetsmanualen i Mammografiprogrammet. Oslo: Kreftregisteret (NO), 2003.
22. Perry, N, Broeders, M, Wolf, C de, Törnberg, S, Holland, R and Karsa, L von. European guidelines for quality assurance in breast cancer screening and diagnosis. Fourth edition—summary document. *Ann Oncol* 2008;19:614–622.
23. Pedersen, K, Bredholt, K, Landmark, ID, Istad, TSJ, Almen, A and Hauge, IH. Teknisk kvalitetskontroll – statuskontroller for digitale mammografisystemer. StrålevernRapport 2010:8. Østerås: Statens strålevern (NO), 2010.
24. Pedersen, K, Landmark, ID, Bredholt, K and Hauge, IH. Teknisk kvalitetskontroll – konstanskontroller for digitale mammografisystemer. StrålevernRapport 2009:5. Østerås: Statens strålevern (NO), 2009.
25. Vee, B, Gullien, R, Handberg, E, Hoftvedt, IJ, Iden, K and K., EA. Retningslinjer for radiograffaglig arbeid. Oslo: The Cancer Registry of Norway (NO), 2011.
26. Skaane, P, Skjennald, A, Young, K et al. Follow-up and final results of the Oslo I study comparing screen-film mammography and full-field digital mammography with soft-copy Reading. *Acta Radiol* 2005;46:679–689.
27. Skaane, P, Hofvind, S and Skjennald, A. Randomized trial of screen-film versus full-field digital mammography with soft-copy reading in population-based screening program: follow-up and final results of Oslo II study. *Radiology* 2007;244:708–17.
28. Skaane, P, Bandos, AI, Gullien, R et al. Comparison of digital mammography alone and digital mammography plus tomosynthesis in a population-based screening program. *Radiology* 2013;267:47–56.
29. Norsk Bryst Cancer Gruppe (NBCG). Nasjonalt handlingsprogram med retningslinjer for diagnostikk, behandling og oppfølging av pasienter med brystkreft. IS-2634. Oslo: Helsedirektoratet (NO), 2017.

30. Forskrift om strålevern og bruk av stråling (strålevernforskriften) [Act on Radiation Protection and Use of Radiation]. FOR-2016-12-16-1659.
31. Tabár, L, Gad, A, Holmberg, L et al. Reduction in mortality from breast cancer after mass screening with mammography: randomised trial from the breast cancer screening working group of the Swedish National Board of Health and Welfare. *Lancet* 1985;325:829–32.
32. Shapiro, S, Strax, P and Venet, L. Periodic breast cancer screening in reducing mortality from breast cancer. *JAMA* 1971;215:1777–85.
33. Shapiro, S. Evidence on screening for breast cancer from a randomized trial. *Cancer* 1977;39:2772–82.
34. Shapiro, S, Venet, W, Strax, P, Venet, L and Roeser, R. Ten-to fourteen-year effect of screening on breast cancer mortality. *J Natl Cancer Inst* 1982;69:349–55.
35. Verbeek, A, Holland, R, Sturmans, F, Hendriks, J, Avunac, M and Day, N. Reduction of breast cancer mortality through mass screening with modern mammography: first results of the Nijmegen project, 1975–1981. *Lancet* 1984;323:1222–4.
36. Reitan, JB. Mammografiscreening i Norge: masseundersøkelse for brystkreft [Mammography screening in Norway]. Oslo: Universitetsforlaget, 1987:88.
37. Norwegian Consensus Conference on Mammography. *Int J of Technol Assess in Health Care* 1991;7:84–90.
38. [Mammography screening. A statement from the consensus conference on mammography screening, Soria Moria, Oslo, February 8–10, 1989]. *Tidsskr Nor Laegeforen* 1989;109:1079–82.
39. Backe, B, ed. Konsensuskonferansen om mammografiscreening. Trondheim: Norsk institutt for sykehusforskning, 1989.
40. Widmark A, OJ. Mammografivirkosmhet i Norge. Strålevern Rapport 1995:5. Østerås: Statens strålevern, 1995.
41. Shapiro, S, Coleman, EA, Broeders, M et al. Breast cancer screening programmes in 22 countries: current policies, administration and guidelines. *International Journal of Epidemiology* 1998;27:735–742.
42. Ertzaas, AK, Hofvind, S and Thoresen, S. Mammografiprogrammet i Norge: Evaluering av prøveprosjektet 1996–2000. Forskningsrapport nr. 2–2000. Kreftregisteret (NO), 2000.
43. Ottestad, L and Wang, H. Prøveprosjekt med masseundersøkelse for brystkreft ved mammografi. Forskningsrapport nr. 2. Oslo: Kreftregisteret (NO), 1999.
44. Kalager, M, Haldorsen, T, Bretthauer, M, Hoff, G, Thoresen, SO and Adami, HO. Improved breast cancer survival following introduction of an organized mammography screening program among both screened and unscreened women: a population-based cohort study. *Br Ca Res* 2009;11.
45. Norwegian Breast Cancer Group. Tidligere versjoner av Blåboka. Accessed 15 Sept 2017. URL: <https://nbcg.no/arkivlenker/tidligere-versjoner-av-blaboka/>.
46. Skaane, P, Young, K and Skjennald, A. Population-based mammography screening: comparison of screen-film and full-field digital mammography with soft-copy reading – Oslo I study. *Radiology* 2003;229:877–84.
47. Skaane, P and Skjennald, A. Screen-film mammography versus full-field digital mammography with soft-copy reading: randomized trial in a population-based screening program—the Oslo II Study. *Radiology* 2004;232:197–204.
48. Vigeland, E, Klaasen, H, Klinge, TA, Hofvind, S and Skaane, P. Full-field digital mammography compared to screen film mammography in the prevalent round of a population-based screening programme: the Vestfold County Study. *Eur Radiol* 2008;18:183–91.
49. Pedersen, K, Vee, B, Fevang, E and Iversen, B. Digital mammografiscreening. Opplæring og kompetansebygging i Mammografi-programmet. Oslo: Kreftregisteret (NO), 2005.
50. Digital mammografiscreening. Utfordringer og løsningsforslag i Mammografiprogrammet. Oslo: Kreftregisteret (NO), 2005.
51. Pedersen, K and Landmark, ID. Trial of a proposed protocol for constancy control of digital mammography systems. *Medical Physics* 2009;36:5537–5546.
52. Bhargava, S, Tsuruda, K, Moen, K, I, B and Hofvind, S. Immigrant women have lower attendance rates than non-immigrants in the Norwegian Breast Cancer Screening Programme. *J Med Screen* 2017. [In press].
53. Hofvind, S and Sanderud, A. Bruk av mammografi i Norge i 2005 og 2008. Oslo: Høgskolen i Oslo (NO), 2010.
54. Hofvind, S, Skaane, P, Elmore, JG, Sebuødegård, S, Hoff, SR and Lee, CI. Mammographic performance in a population-based screening program: before, during, and after the transition from screen-film to full-field digital mammography. *Radiology* 2014;272:52–62.
55. Brewer, N, Salz, T and Lillie, S. Systematic review: The long-term effects of false-positive mammograms. *Annals of Internal Medicine* 2007;146:502–510.
56. Hafslund, B, Espehaug, B and Nortvedt, MW. Effects of false-positive results in a breast screening program on anxiety, depression and health-related quality of life. *Cancer Nurs* 2012;35:E26–34.
57. Bond, M, Pavey, T, Welch, K et al. Systematic review of the psychological consequences of false-positive screening mammograms. *Health Technol Assess* 2013;17:1–170, v–vi.
58. Roman, M, Hubbard, RA, Sebuødegård, S, Miglioretti, DL, Castells, X and Hofvind, S. The cumulative risk of false-positive results in the Norwegian Breast Cancer Screening Program: updated results. *Cancer* 2013;119:3952–8.
59. Hodgson, R, Heywang-Köbrunner, SH, Harvey, SC et al. Systematic review of 3D mammography for breast cancer screening. *The Breast* 2016;27:52–61.
60. Houssami, N and Skaane, P. Overview of the evidence on digital breast tomosynthesis in breast cancer detection. *The Breast* 2013;22:101–108.

61. Hofvind, S, Bjurstam, N, Sorum, R, Bjorndal, H, Thoresen, S and Skaane, P. Number and characteristics of breast cancer cases diagnosed in four periods in the screening interval of a biennial population-based screening programme. *J Med Screen* 2006;13:192–6.
62. Mammografiprogrammet - resultater fra prosessindikatorer 2006-2013/4. Report. Oslo: Kreftregisteret (NO), 2015.
63. Hofvind, S, Skaane, P, Vitak, B et al. Influence of review design on percentages of missed interval breast cancers: retrospective study of interval cancers in a population-based screening program. *Radiology* 2005;237:437–43.
64. Hoff, SR, Abrahamsen, AL, Samset, JH, Vigeland, E, Klepp, O and Hofvind, S. Breast cancer: missed interval and screening-detected cancer at full-field digital mammography and screen-film mammography – results from a retrospective review. *Radiology* 2012;264:378–86.
65. Porta, M. *A Dictionary of Epidemiology*. New York: Oxford University Press, USA, 2008.
66. Sorum, R, Hofvind, S, Skaane, P and Haldorsen, T. Trends in incidence of ductal carcinoma in situ: the effect of a population-based screening programme. *The Breast* 2010;19:499–505.
67. Smart, CR, Myers, MH and Gloeckler, LA. Implications from seer data on breast cancer management. *Cancer* 1978;41:787–9.
68. Elston, CW and Ellis, IO. Pathological prognostic factors in breast cancer. I. The value of histological grade in breast cancer: experience from a large study with long-term follow-up. *Histopathology* 1991;19:403–10.
69. Årsrapport 2013-2014 – Nasjonalt kvalitetsregister for brystkreft. Oslo: The Cancer Registry of Norway (NO), 2015.
70. Årsrapport 2015 – Nasjonalt kvalitetsregister for brystkreft. Oslo: The Cancer Registry of Norway (NO), 2016.
71. Sedgwick, P. Intention to treat analysis versus per protocol analysis of trial data. *BMJ* 2015;350:h681.
72. Kalager, M, Zelen, M, Langmark, F and Adami, HO. Effect of screening mammography on breast-cancer mortality in Norway. *N Engl J Med* 2010;363:1203–10.
73. Olsen, AH, Lynge, E, Njor, SH et al. Breast cancer mortality in Norway after the introduction of mammography screening. *International Journal of Cancer* 2013;132:208–214.
74. Weedon-Fekjaer, H, Romundstad, PR and Vatten, LJ. Modern mammography screening and breast cancer mortality: population study. *BMJ* 2014;348:g3701.
75. Hofvind, S, Ursin, G, Tretli, S, Sebuødegård, S and Moller, B. Breast cancer mortality in participants of the Norwegian Breast Cancer Screening Program. *Cancer* 2013;119:3106–12.
76. Welch, HG and Black, WC. Overdiagnosis in cancer. *J Natl Cancer Inst* 2010;102:605–13.
77. Hofvind, S, Lee, CI and Elmore, JG. Stage-specific breast cancer incidence rates among participants and non-participants of a population-based mammographic screening program. *Breast Cancer Res Treat* 2012;135:291–9.
78. Houssami, N and Hunter, K. The epidemiology, radiology and biological characteristics of interval breast cancers in population mammography screening. *NPJ Breast Cancer* 2017;3:12.
79. Falk, RS. Hvorfor er resultater fra organisert mammografiscreening så vanskelig å tolke? = Why are results of organised mammography screening so difficult to interpret? *Tidsskr Nor Laegeforen* 2014;134:1124–6.
80. Duffy, SW, Michalopoulos, D, Sebuødegård, S and Hofvind, S. Trends in aggregate cancer incidence rates in relation to screening and possible overdiagnosis: a word of caution. *J Med Screen* 2014;21:24–9.
81. Zahl, PH, Strand, BH and Mæhlen, J. Incidence of breast cancer in Norway and Sweden during introduction of nationwide screening: prospective cohort study. *BMJ* 2004;328:921.
82. Jørgensen, KJ and Gøtzsche, PC. Overdiagnosis in publicly organised mammography screening programmes: systematic review of incidence trends. *BMJ* 2009;339:b2587.
83. Kalager, M, Adami, HO, Bretthauer, M and Tamimi, RM. Overdiagnosis of invasive breast cancer due to mammography screening: results from the Norwegian screening program. *Ann Intern Med* 2012;156:491–9.
84. Falk, RS, Hofvind, S, Skaane, P and Haldorsen, T. Overdiagnosis among women attending a population-based mammography screening program. *Int J Cancer* 2013;133:705–12.
85. Lund, E, Mode, N, Waaseth, M and Thalabard, JC. Overdiagnosis of breast cancer in the Norwegian Breast Cancer Screening Program estimated by the Norwegian Women and Cancer cohort study. *BMC Cancer* 2013;13:614.
86. Michalopoulos, D and Duffy, SW. Estimation of overdiagnosis using short-term trends and lead time estimates uncontaminated by overdiagnosed cases: Results from the Norwegian Breast Screening Programme. *J Med Screen* 2016;23:192–202.
87. Luijt, PA van, Heijnsdijk, EA, Ravestein, NT van, Hofvind, S and Koning, HJ de. Breast cancer incidence trends in Norway and estimates of overdiagnosis. *J Med Screen* 2017;24:83–91.
88. Wang, H, Karesen, R, Hervik, A and Thoresen, SO. Mammography screening in Norway: results from the first screening round in four counties and cost-effectiveness of a modeled nationwide screening. *Cancer Causes Control* 2001;12:39–45.
89. Moger, T and Kristiansen, IS. Direct and indirect costs of the Norwegian Breast Cancer Screening Program. Working paper 2012:3. Oslo: University of Oslo, 2012.
90. Moger, TA, Bjørnelv, GM and Aas, E. Expected 10-year treatment cost of breast cancer detected within and outside a public screening program in Norway. *Eur J Health Econ* 2016;17:745–54.
91. Skaane, P, Bandos, AI, Gullien, R et al. Prospective trial comparing full-field digital mammography (FFDM) versus combined FFDM and tomosynthesis in a population-based screening programme using independent double reading with arbitration. *Eur Radiol* 2013;23:2061–71.
92. Movik, E, Dalsbø, T, Fagerlund, B, Friberg, E, Håheim, L and Skår, Å. Digital Breast Tomosynthesis with Hologic 3D mammography Selenia Dimensions System for use in breast cancer screening. Single technology assessment (Hurtig metodevurdering). Oslo: Norwegian Institute of Public Health, 2017.

93. Skaane, P, Bandos, AI, Eben, EB et al. Two-view digital breast tomosynthesis screening with synthetically reconstructed projection images: comparison with digital breast tomosynthesis with full-field digital mammographic images. *Radiology* 2014;271:655–63.
94. Svahn, TM, Houssami, N, Sechopoulos, I and Mattsson, S. Review of radiation dose estimates in digital breast tomosynthesis relative to those in two-view full-field digital mammography. *Breast* 2015;24:93–9.
95. Moshina, N, Ursin, G, Roman, M, Sebuødegård, S and Hofvind, S. Positive predictive values by mammographic density and screening mode in the Norwegian Breast Cancer Screening Program. *Eur J Radiol* 2016;85:248–54.
96. Moshina, N, Ursin, G, Hoff, SR et al. Mammographic density and histopathologic characteristics of screen-detected tumors in the Norwegian Breast Cancer Screening Program. *Acta Radiol Open* 2015;4:2058460115604340.
97. Berg, WA, Bandos, AI, Mendelson, EB, Lehrer, D, Jong, RA and Pisano, ED. Ultrasound as the Primary Screening Test for Breast Cancer: Analysis From ACRIN 6666. *J Natl Cancer Inst* 2016;108:djv367.
98. Skaane, P, Gullien, R, Eben, EB, Sandhaug, M, Schulz-Wendtland, R and Stoeblen, F. Interpretation of automated breast ultrasound (ABUS) with and without knowledge of mammography: a reader performance study. *Acta Radiol* 2015;56:404–12.
99. Tagliafico, AS, Bignotti, B, Rossi, F et al. Diagnostic performance of contrast-enhanced spectral mammography: Systematic review and meta-analysis. *The Breast* 2016;28:13–19.
100. Kuhl, CK. Abbreviated breast MRI for screening women with dense breast: The EA1141 Trial. *Br J Radiol*. [Epub ahead of print]:20170441.
101. Schousboe, JT, Kerlikowske, K, Loh, A and Cummings, SR. Personalizing mammography by breast density and other risk factors for breast cancer: analysis of health benefits and cost-effectiveness. *Ann Intern Med* 2011;155:10–20.
102. Shieh, Y, Eklund, M, Madlensky, L et al. Breast Cancer Screening in the Precision Medicine Era: Risk-Based Screening in a Population-Based Trial. *J Natl Cancer Inst* 2017;109:djw290–djw290.
103. Esserman, LJ, Study, W and Athena, I. The WISDOM Study: breaking the deadlock in the breast cancer screening debate. *NPJ Breast Cancer* 2017;3:34.
104. Lee, CI, Chen, LE and Elmore, JG. Risk-based Breast Cancer Screening: Implications of Breast Density. *Med Clin North Am* 2017;101:725–741.
105. Giger, ML, Chan, HP and Boone, J. Anniversary Paper: History and status of CAD and quantitative image analysis: The role of Medical Physics and AAPM. *Medical Physics* 2008;35:5799–5820.
106. Lehman, C, Wellman, R, Buist, D et al. Diagnostic accuracy of digital screening mammography with and without computer-aided detection. *JAMA Internal Medicine* 2015;175:1828–1837.
107. Azavedo, E, Zackrisson, S, Mejåre, I and Heibert Arnlin, M. Is single reading with computer-aided detection (CAD) as good as double reading in mammography screening? A systematic review. *BMC Medical Imaging* 2012;12:22.
108. Giger, ML, Karssemeijer, N and Schnabel, JA. Breast Image Analysis for Risk Assessment, Detection, Diagnosis, and Treatment of Cancer. *Annual Review of Biomedical Engineering* 2013;15:327–357.

Publication list, 1996-2017

Peer-reviewed articles

1. Thoresen, SØ. Prøveprosjekt med mammografiscreening i fire fylker; organisering og gjennomføring. *Norsk epidemiologi* 1997;7:179–82.
2. Wang, H, Thoresen, SO and Tretli, S. Breast cancer in Norway 1970-1993: a population-based study on incidence, mortality and survival. *Br J Cancer* 1998;77:1519–24.
3. Karesen, R, Bo, JK, Haustveit, S, Hervik, A and Thoresen, SO. [Cost-effectiveness of mammography screening in Norway]. *Tidsskr Nor Laegeforen* 1999;119:3553–9.
4. Thoresen, SO. [Mammography screening of women aged 40 plus–how long must the Norwegian women wait this time?] *Tidsskr Nor Laegeforen* 1999;119:3636.
5. Wang, H, Hofvind, SS and Thoresen, SO. [A pilot project with mammography–results from the first screening round]. *Tidsskr Nor Laegeforen* 2000;120:3237–40.
6. Ekeberg, Ø, Skjauff, H and Kåresen, R. Screening for breast cancer is associated with a low degree of psychological distress. *The Breast* 2001;10:20–24.
7. Hofvind, SS and Thoresen, SO. [Physical activity and breast cancer]. *Tidsskr Nor Laegeforen* 2001;121:1892–5.
8. Klabunde, CN, Sancho-Garnier, H, Broeders, M, Thoresen, S, Rodrigues, VJ and Ballard-Barbash, R. Quality assurance for screening mammography data collection systems in 22 countries. *Int J Technol Assess Health Care* 2001;17:528–41.
9. Wang, H, Bjurstam, N, Bjørndal, H et al. Interval cancers in the Norwegian breast cancer screening program: frequency, characteristics and use of HRT. *Int J Cancer* 2001;94:594–8.
10. Wang, H, Karesen, R, Hervik, A and Thoresen, SO. Mammography screening in Norway: results from the first screening round in four counties and cost-effectiveness of a modeled nationwide screening. *Cancer Causes Control* 2001;12:39–45.
11. Klabunde, CN, Sancho-Garnier, H, Taplin, S et al. Quality assurance in follow-up and initial treatment for screening mammography programs in 22 countries. *Int J Qual Health Care* 2002;14:449–61.
12. Pedersen, K and Nordanger, J. Quality control of the physical and technical aspects of mammography in the Norwegian breast-screening programme. *Eur Radiol* 2002;12:463–70.
13. Sauer, T, Young, K and Thoresen, SO. Fine needle aspiration cytology in the work-up of mammographic and ultrasonographic findings in breast cancer screening: an attempt at differentiating in situ and invasive carcinoma. *Cytopathology* 2002;13:101–10.
14. Hofvind, SS, Wang, H and Thoresen, S. The Norwegian Breast Cancer Screening Program: re-attendance related to the women's experiences, intentions and previous screening result. *Cancer Causes Control* 2003;14:391–8.
15. Obenaus, S, Hermann, KP, Marten, K et al. Soft Copy versus Hard Copy Reading in Digital Mammography. *Journal of Digital Imaging* 2003;16:341–344.
16. Sauer, T, Myrvold, K, Lomo, J, Anderssen, KY and Skaane, P. Fine-needle aspiration cytology in nonpalpable mammographic abnormalities in breast cancer screening: results from the breast cancer screening programme in Oslo 1996-2001. *Breast* 2003;12:314–9.
17. Skaane, P, Young, K and Skjennald, A. Population-based mammography screening: comparison of screen-film and full-field digital mammography with soft-copy reading–Oslo I study. *Radiology* 2003;229:877–84.
18. Hofvind, S, Thoresen, S and Tretli, S. The cumulative risk of a false-positive recall in the Norwegian Breast Cancer Screening Program. *Cancer* 2004;101:1501–7.
19. Hofvind, S, Wang, H and Thoresen, S. Do the results of the process indicators in the Norwegian breast cancer screening program predict future mortality reduction from breast cancer? *Acta Oncol* 2004;43:467–473.
20. Skaane, P and Skjennald, A. Screen-film mammography versus full-field digital mammography with soft-copy reading: randomized trial in a population-based screening program–the Oslo II Study. *Radiology* 2004;232:197–204.
21. Collett, K, Stefansson, IM, Eide, J et al. A basal epithelial phenotype is more frequent in interval breast cancers compared with screen detected tumors. *Cancer Epidemiol Biomarkers Prev* 2005;14:1108–12.
22. Gram, IT, Bremnes, Y, Ursin, G, Maskarinec, G, Bjurstam, N and Lund, E. Percentage density, Wolfe's and Tabar's mammographic patterns: agreement and association with risk factors for breast cancer. *Breast Cancer Res* 2005;7:R854–61.
23. Hofvind, S, Skaane, P, Vitak, B et al. Influence of review design on percentages of missed interval breast cancers: retrospective study of interval cancers in a population-based screening program. *Radiology* 2005;237:437–43.
24. Møller, B, Weedon-Fekjaer, H, Hakulinen, T et al. The influence of mammographic screening on national trends in breast cancer incidence. *Eur J Cancer Prev* 2005;14:117–28.
25. Skaane, P, Balleyguier, C, Diekmann, F et al. Breast lesion detection and classification: comparison of screen-film mammography and full-field digital mammography with soft-copy reading–observer performance study. *Radiology* 2005;237:37–44.

26. Skaane, P, Skjennald, A, Young, K et al. Follow-up and Final Results of the Oslo I Study Comparing Screen-Film Mammography and Full-field Digital Mammography with Soft-Copy Reading. *Acta Radiol* 2005;46:679–689.
27. Weedon-Fekjaer, H, Vatten, LJ, Aalen, OO, Lindqvist, B and Tretli, S. Estimating mean sojourn time and screening test sensitivity in breast cancer mammography screening: new results. *J Med Screen* 2005;12:172–8.
28. Bremnes, Y, Ursin, G, Bjurstam, N, Lund, E and Gram, IT. Different types of postmenopausal hormone therapy and mammographic density in Norwegian women. *Int J Cancer* 2006;120:880–4.
29. Hofvind, S, Bjurstam, N, Sorum, R, Bjorndal, H, Thoresen, S and Skaane, P. Number and characteristics of breast cancer cases diagnosed in four periods in the screening interval of a biennial population-based screening programme. *J Med Screen* 2006;13:192–6.
30. Hofvind, S, Møller, B, Thoresen, S and Ursin, G. Use of hormone therapy and risk of breast cancer detected at screening and between mammographic screens. *Int J Cancer* 2006;118:3112–7.
31. Hofvind, S, Sorum, R, Haldorsen, T and Langmark, F. [Incidence of breast cancer before and after implementation of mammography screening]. *Tidsskr Nor Laegeforen* 2006;126:2935–8.
32. Tornberg, S, Kemetli, L, Lyng, E et al. Breast cancer incidence and mortality in the Nordic capitals, 1970–1998. Trends related to mammography screening programmes. *Acta Oncol* 2006;45:528–35.
33. Bremnes, Y, Ursin, G, Bjurstam, N and Gram, IT. Different measures of smoking exposure and mammographic density in postmenopausal Norwegian women: a cross-sectional study. *Breast Cancer Res* 2007;9:R73.
34. Bremnes, Y, Ursin, G, Bjurstam, N, Rinaldi, S, Kaaks, R and Gram, IT. Endogenous sex hormones, prolactin and mammographic density in postmenopausal Norwegian women. *Int J Cancer* 2007;121:2506–11.
35. Geller, BM, Zapka, J, Hofvind, SSH et al. Communicating with women about mammography. *Journal of Cancer Education* 2007;22:25–31.
36. Hofvind, S. Breast cancer screening—prevalence of disease in women who only respond after an invitation reminder. *J Med Screen* 2007;14:21–2.
37. Hofvind, S, Geller, B, Vacek, PM, Thoresen, S and Skaane, P. Using the European guidelines to evaluate the Norwegian Breast Cancer Screening Program. *Eur J Epidemiol* 2007;22:447–55.
38. Skaane, P, Hofvind, S and Skjennald, A. Randomized trial of screen-film versus full-field digital mammography with soft-copy reading in population-based screening program: follow-up and final results of Oslo II study. *Radiology* 2007;244:708–17.
39. Skaane, P, Kshirsagar, A, Stapleton, S, Young, K and Castellino, RA. Effect of computer-aided detection on independent double reading of paired screen-film and full-field digital screening mammograms. *AJR Am J Roentgenol* 2007;188:377–84.
40. Gram, IT and Lund, E. Breast cancer screening programme as setting for an adjunct research project: effect on programme attendance. *J Med Screen* 2008;15:44–5.
41. Hofvind, S, Geller, B and Skaane, P. Mammographic features and histopathological findings of interval breast cancers. *Acta Radiol* 2008;49:975–81.
42. Hofvind, S, Sorum, R and Thoresen, S. Incidence and tumor characteristics of breast cancer diagnosed before and after implementation of a population-based screening-program. *Acta Oncol* 2008;47:225–31.
43. Hofvind, S, Vacek, PM, Skelly, J, Weaver, DL and Geller, BM. Comparing screening mammography for early breast cancer detection in Vermont and Norway. *J Natl Cancer Inst* 2008;100:1082–91.
44. Østerlie, W, Solbjør, M, Skolbekken, JA, Hofvind, S, Saetnan, AR and Forsmo, S. Challenges of informed choice in organised screening. *J Med Ethics* 2008;34:e5.
45. Sauer, T and Karimzadeh, M. Characteristic cytological features of histological grade one (G1) breast carcinomas in fine needle aspirates. *Cytopathology* 2008;19:287–93.
46. Skaane, P, Diekmann, F, Balleyguier, C et al. Observer variability in screen-film mammography versus full-field digital mammography with soft-copy reading. *Eur Radiol* 2008;18:1134–43.
47. Vigeland, E, Klaasen, H, Klinge, TA, Hofvind, S and Skaane, P. Full-field digital mammography compared to screen film mammography in the prevalent round of a population-based screening programme: the Vestfold County Study. *Eur Radiol* 2008;18:183–91.
48. Weedon-Fekjaer, H, Lindqvist, BH, Vatten, LJ, Aalen, OO and Tretli, S. Breast cancer tumor growth estimated through mammography screening data. *Breast Cancer Res* 2008;10:R41.
49. Weedon-Fekjaer, H, Lindqvist, BH, Vatten, LJ, Aalen, OO and Tretli, S. Estimating mean sojourn time and screening sensitivity using questionnaire data on time since previous screening. *J Med Screen* 2008;15:83–90.
50. Zahl, PH, Maehlen, J and Welch, HG. The natural history of invasive breast cancers detected by screening mammography. *Arch Intern Med* 2008;168:2311–6.
51. Hofvind, S, Geller, BM, Rosenberg, RD and Skaane, P. Screening-detected breast cancers: discordant independent double reading in a population-based screening program. *Radiology* 2009;253:652–60.
52. Hofvind, S, Vee, B, Sorum, R, Hauge, M and Ertzaas, AK. Quality assurance of mammograms in the Norwegian Breast Cancer Screening Program. *Eur J Radiography* 2009;1:22–29.
53. Hofvind, S, Yankaskas, BC, Bulliard, JL, Klabunde, CN and Fracheboud, J. Comparing interval breast cancer rates in Norway and North Carolina: results and challenges. *J Med Screen* 2009;16:131–9.
54. Jørgensen, KJ and Gøtzsche, PC. Overdiagnosis in publicly organised mammography screening programmes: systematic review of incidence trends. *BMJ* 2009;339:62587.

55. Kalager, M, Haldorsen, T, Bretthauer, M, Hoff, G, Thoresen, SO and Adami, HO. Improved breast cancer survival following introduction of an organized mammography screening program among both screened and unscreened women: a population-based cohort study. *Breast Cancer Res* 2009;11:R44.
56. Kalager, M, Karesen, R and Wist, E. [Survival after breast cancer–differences between Norwegian counties]. *Tidsskr Nor Lægeforen* 2009;129:2595–600.
57. Myklebust, A, Seierstad, T, Strandén, E and Lerdal, A. Level of satisfaction during mammography screening in relation to discomfort, service provided, level of pain and breast compression. *Eur J Radiography* 2009;1:66–72.
58. Pedersen, K and Landmark, ID. Trial of a proposed protocol for constancy control of digital mammography systems. *Med Phys* 2009;36:5537–46.
59. Skaane, P. Studies comparing screen-film mammography and full-field digital mammography in breast cancer screening: updated review. *Acta Radiol* 2009;50:3–14.
60. Stuedal, A, Ma, H, Bjørndal, H and Ursin, G. Postmenopausal hormone therapy with estradiol and norethisterone acetate and mammographic density: findings from a cross-sectional study among Norwegian women. *Climacteric* 2009;12:248–58.
61. Wang, H, Jebsen, P, Kåresen, R and Thoresen, S. Ductal Carcinoma In Situ of the Breast: A Review of Diagnosis, Treatment and Outcome in a Hospital-based Norwegian Series. *Acta Oncologica* 2009;39:131–134.
62. Dowling, EC, Klabunde, C, Patnick, J, Ballard-Barbash, R and International Cancer Screening, N. Breast and cervical cancer screening programme implementation in 16 countries. *J Med Screen* 2010;17:139–46.
63. Juel, IM, Skaane, P, Hoff, SR, Johannessen, G and Hofvind, S. Screen-film mammography versus full-field digital mammography in a population-based screening program: The Sogn and Fjordane study. *Acta Radiol* 2010;51:962–8.
64. Kalager, M, Zelen, M, Langmark, F and Adami, HO. Effect of screening mammography on breast-cancer mortality in Norway. *N Engl J Med* 2010;363:1203–10.
65. Sørum, R, Hofvind, S, Skaane, P and Haldorsen, T. Trends in incidence of ductal carcinoma in situ: the effect of a population-based screening programme. *The Breast* 2010;19:499–505.
66. Tornberg, S, Kemetli, L, Ascunce, N et al. A pooled analysis of interval cancer rates in six European countries. *Eur J Cancer Prev* 2010;19:87–93.
67. Weedon-Fekjaer, H, Tretli, S and Aalen, OO. Estimating screening test sensitivity and tumour progression using tumour size and time since previous screening. *Stat Methods Med Res* 2010;19:507–27.
68. Falk, RS, Hofvind, S, Skaane, P and Haldorsen, T. Second events following ductal carcinoma in situ of the breast: a register-based cohort study. *Breast Cancer Res Treat* 2011;129:929–38.
69. Hoff, SR, Samset, JH, Abrahamsen, AL, Vigeland, E, Klepp, O and Hofvind, S. Missed and true interval and screen-detected breast cancers in a population based screening program. *Acad Radiol* 2011;18:454–60.
70. Hofvind, S, Iversen, BF, Eriksen, L, Styr, BM, Kjellefold, K and Kurz, KD. Mammographic morphology and distribution of calcifications in ductal carcinoma in situ diagnosed in organized screening. *Acta Radiol* 2011;52:481–7.
71. Lynge, E, Braaten, T, Njor, SH et al. Mammography activity in Norway 1983 to 2008. *Acta Oncol* 2011;50:1062–7.
72. Qureshi, SA, Couto, E, Hilsen, M, Hofvind, S, Wu, AH and Ursin, G. Mammographic density and intake of selected nutrients and vitamins in Norwegian women. *Nutr Cancer* 2011;63:1011–20.
73. Solbjør, M, Forsmo, S, Skolbekken, JA and Saetnan, AR. Experiences of recall after mammography screening—a qualitative study. *Health Care Women Int* 2011;32:1009–27.
74. Suhrke, P, Maehlen, J, Schlichting, E, Jorgensen, KJ, Gotzsche, PC and Zahl, PH. Effect of mammography screening on surgical treatment for breast cancer in Norway: comparative analysis of cancer registry data. *BMJ* 2011;343:d4692.
75. Broeders, M, Moss, S, Nystrom, L et al. The impact of mammographic screening on breast cancer mortality in Europe: a review of observational studies. *J Med Screen* 2012;19 Suppl 1:14–25.
76. Couto, E, Qureshi, SA, Hofvind, S et al. Hormone therapy use and mammographic density in postmenopausal Norwegian women. *Breast Cancer Res Treat* 2012;132:297–305.
77. Ellingjord-Dale, M, Lee, E, Couto, E et al. Polymorphisms in hormone metabolism and growth factor genes and mammographic density in Norwegian postmenopausal hormone therapy users and non-users. *Breast Cancer Res* 2012;14:R135.
78. Giordano, L, Cogo, C, Patnick, J, Paci, E and Group, EW. Communicating the balance sheet in breast cancer screening. *J Med Screen* 2012;19 Suppl 1:67–71.
79. Giordano, L, Karsa, L von, Tomatis, M et al. Mammographic screening programmes in Europe: organization, coverage and participation. *J Med Screen* 2012;19 Suppl 1:72–82.
80. Hafslund, B, Espehaug, B and Nortvedt, MW. Effects of false-positive results in a breast screening program on anxiety, depression and health-related quality of life. *Cancer Nurs* 2012;35:E26–34.
81. Hafslund, B, Espehaug, B and Nortvedt, MW. Health-related quality of life, anxiety and depression related to mammography screening in Norway. *J Clin Nurs* 2012;21:3223–34.
82. Hansen, BT, Nygard, M, Falk, RS and Hofvind, S. Breast cancer and ductal carcinoma in situ among women with prior squamous or glandular precancer in the cervix: a register-based study. *Br J Cancer* 2012;107:1451–3.
83. Hauge, IH, Pedersen, K, Sanderud, A, Hofvind, S and Olerud, HM. Patient doses from screen-film and full-field digital mammography in a population-based screening programme. *Radiat Prot Dosimetry* 2012;148:65–73.
84. Hoff, SR, Abrahamsen, AL, Samset, JH, Vigeland, E, Klepp, O and Hofvind, S. Breast cancer: missed interval and screening-detected cancer at full-field digital mammography and screen-film mammography—results from a retrospective review. *Radiology* 2012;264:378–86.

85. Hofvind, S, Geller, BM, Skelly, J and Vacek, PM. Sensitivity and specificity of mammographic screening as practised in Vermont and Norway. *Br J Radiol* 2012;85:e1226–32.
86. Hofvind, S, Lee, CI and Elmore, JG. Stage-specific breast cancer incidence rates among participants and non-participants of a population-based mammographic screening program. *Breast Cancer Res Treat* 2012;135:291–9.
87. Hofvind, S, Ponti, A, Patnick, J et al. False-positive results in mammographic screening for breast cancer in Europe: a literature review and survey of service screening programmes. *J Med Screen* 2012;19 Suppl 1:57–66.
88. Hofvind, S, Sakshaug, S, Ursin, G and Graff-Iversen, S. Breast cancer incidence trends in Norway—explained by hormone therapy or mammographic screening? *Int J Cancer* 2012;130:2930–8.
89. Hofvind, S and Skaane, P. Stage distribution of breast cancer diagnosed before and after implementation of population-based mammographic screening. *Rofo* 2012;184:437–42.
90. Kalager, M, Adami, HO, Bretthauer, M and Tamimi, RM. Overdiagnosis of invasive breast cancer due to mammography screening: results from the Norwegian screening program. *Ann Intern Med* 2012;156:491–9.
91. Kalager, M, Tamimi, RM, Bretthauer, M and Adami, HO. Prognosis in women with interval breast cancer: population based observational cohort study. *BMJ* 2012;345:e7536.
92. Moss, SM, Nystrom, L, Jonsson, H et al. The impact of mammographic screening on breast cancer mortality in Europe: a review of trend studies. *J Med Screen* 2012;19 Suppl 1:26–32.
93. Njor, S, Nystrom, L, Moss, S et al. Breast cancer mortality in mammographic screening in Europe: a review of incidence-based mortality studies. *J Med Screen* 2012;19 Suppl 1:33–41.
94. Norum, J, Hofvind, S, Nieder, C, Schnell, EA and Broderstad, AR. Mammographic screening in Sami speaking municipalities and a control group. Are early outcome measures influenced by ethnicity? *Int J Circumpolar Health* 2012;71:1–6.
95. Paci, E and Group, EW. Summary of the evidence of breast cancer service screening outcomes in Europe and first estimate of the benefit and harm balance sheet. *J Med Screen* 2012;19 Suppl 1:5–13.
96. Puliti, D, Duffy, SW, Miccinesi, G et al. Overdiagnosis in mammographic screening for breast cancer in Europe: a literature review. *J Med Screen* 2012;19 Suppl 1:42–56.
97. Qureshi, SA, Couto, E, Hofvind, S, Wu, AH and Ursin, G. Alcohol intake and mammographic density in postmenopausal Norwegian women. *Breast Cancer Res Treat* 2012;131:993–1002.
98. Qureshi, SA, Ellingjord-Dale, M, Hofvind, S, Wu, AH and Ursin, G. Physical activity and mammographic density in a cohort of postmenopausal Norwegian women; a cross-sectional study. *SpringerPlus* 2012;1:75.
99. Skaane, P, Kshirsagar, A, Hofvind, S, Jahr, G and Castellino, RA. Mammography screening using independent double reading with consensus: is there a potential benefit for computer-aided detection? *Acta Radiol* 2012;53:241–8.
100. Solbjør, M, Skolbekken, JA, Saetnan, AR, Hagen, AI and Forsmo, S. Could screening participation bias symptom interpretation? An interview study on women's interpretations of and responses to cancer symptoms between mammography screening rounds. *BMJ Open* 2012;2.
101. Solbjør, M, Skolbekken, JA, Saetnan, AR, Hagen, AI and Forsmo, S. Mammography screening and trust: the case of interval breast cancer. *Soc Sci Med* 2012;75:1746–52.
102. Suhrke, P, Maehlen, J and Zahl, PH. Hormone therapy use and breast cancer incidence by histological subtypes in Sweden and Norway. *Breast J* 2012;18:549–56.
103. Weedon-Fekjaer, H, Bakken, K, Vatten, LJ and Tretli, S. Understanding recent trends in incidence of invasive breast cancer in Norway: age-period-cohort analysis based on registry data on mammography screening and hormone treatment use. *BMJ* 2012;344:e299.
104. Zahl, PH and Maehlen, J. Overdiagnostikk av brystkreft etter 14 år med mammografiscreening = Overdiagnosis of breast cancer after 14 years of mammography screening. *Tidsskr Nor Laegeforen* 2012;132:414–7.
105. Falk, RS, Hofvind, S, Skaane, P and Haldorsen, T. Overdiagnosis among women attending a population-based mammography screening program. *Int J Cancer* 2013;133:705–12.
106. Hauge, IH and Olerud, HM. Uncertainties involved in the estimation of mean glandular dose for women in the Norwegian Breast Cancer Screening Program (NBCSP). *Radiat Prot Dosimetry* 2013;155:81–7.
107. Hoff, SR, Klepp, O and Hofvind, S. Asymptomatic breast cancer in non-participants of the national screening-programme in Norway: a confounding factor in evaluation? *J Med Screen* 2013;19:177–183.
108. Hofvind, S, Schlichting, E, Ursin, G, S, S and Karesen, R. [Breast cancer surgery in Norway 1986–2009]. *Tidsskr Nor Laegeforen* 2013;133:1582–6.
109. Hofvind, S, Ursin, G, Tretli, S, Sebuødegård, S and Moller, B. Breast cancer mortality in participants of the Norwegian Breast Cancer Screening Program. *Cancer* 2013;119:3106–12.
110. Houssami, N and Skaane, P. Overview of the evidence on digital breast tomosynthesis in breast cancer detection. *Breast* 2013;22:101–8.
111. Lund, E, Mode, N, Waaseth, M and Thalabard, JC. Overdiagnosis of breast cancer in the Norwegian Breast Cancer Screening Program estimated by the Norwegian Women and Cancer cohort study. *BMC Cancer* 2013;13:614.
112. Olsen, AH, Lynge, E, Njor, SH et al. Breast cancer mortality in Norway after the introduction of mammography screening. *Int J Cancer* 2013;132:208–14.
113. Roman, M, Hubbard, RA, Sebuødegård, S, Miglioretti, DL, Castells, X and Hofvind, S. The cumulative risk of false-positive results in the Norwegian Breast Cancer Screening Program: updated results. *Cancer* 2013;119:3952–8.
114. Schou Bredal, I, Karesen, R, Skaane, P, Engelstad, KS and Ekeberg, O. Recall mammography and psychological distress. *Eur J Cancer* 2013;49:805–11.

115. Skaane, P, Bandos, AI, Gullien, R et al. Comparison of digital mammography alone and digital mammography plus tomosynthesis in a population-based screening program. *Radiology* 2013;267:47–56.
116. Skaane, P, Bandos, AI, Gullien, R et al. Prospective trial comparing full-field digital mammography (FFDM) versus combined FFDM and tomosynthesis in a population-based screening programme using independent double reading with arbitration. *Eur Radiol* 2013;23:2061–71.
117. Zahl, PH, Jorgensen, KJ and Gotzsche, PC. Overestimated lead times in cancer screening has led to substantial underestimation of overdiagnosis. *Br J Cancer* 2013;109:2014–9.
118. Chen, Y, Klingen, TA, Wik, E et al. Breast cancer stromal elastosis is associated with mammography screening detection, low Ki67 expression and favourable prognosis in a population-based study. *Diagn Pathol* 2014;9:230.
119. Duffy, SW, Michalopoulos, D, Sebuødegård, S and Hofvind, S. Trends in aggregate cancer incidence rates in relation to screening and possible overdiagnosis: a word of caution. *J Med Screen* 2014;21:24–9.
120. Hauge, IH, Pedersen, K, Olerud, HM, Hole, EO and Hofvind, S. The risk of radiation-induced breast cancers due to biennial mammographic screening in women aged 50–69 years is minimal. *Acta Radiol* 2014;55:1174–9.
121. Hofvind, S, Skaane, P, Elmore, JG, Sebuødegård, S, Hoff, SR and Lee, CI. Mammographic performance in a population-based screening program: before, during, and after the transition from screen-film to full-field digital mammography. *Radiology* 2014;272:52–62.
122. Kalager, M, Loberg, M, Bretthauer, M and Adami, HO. Comparative analysis of breast cancer mortality following mammography screening in Denmark and Norway. *Ann Oncol* 2014;25:1137–43.
123. Lousdal, ML, Kristiansen, IS, Moller, B and Stovring, H. Trends in breast cancer stage distribution before, during and after introduction of a screening programme in Norway. *Eur J Public Health* 2014;24:1017–22.
124. Lynge, E, Ponti, A, James, T et al. Variation in detection of ductal carcinoma in situ during screening mammography: a survey within the International Cancer Screening Network. *Eur J Cancer* 2014;50:185–92.
125. Paci, E, Broeders, M, Hofvind, S, Puliti, D, Duffy, SW and Group, EW. European breast cancer service screening outcomes: a first balance sheet of the benefits and harms. *Cancer Epidemiol Biomarkers Prev* 2014;23:1159–63.
126. Ponti, A, Lynge, E, James, T et al. International variation in management of screen-detected ductal carcinoma in situ of the breast. *Eur J Cancer* 2014;50:2695–704.
127. Qureshi, SA, Lund, AC, Veierod, MB et al. Food items contributing most to variation in antioxidant intake; a cross-sectional study among Norwegian women. *BMC Public Health* 2014;14:45.
128. Roman, M, Skaane, P and Hofvind, S. The cumulative risk of false-positive screening results across screening centres in the Norwegian Breast Cancer Screening Program. *Eur J Radiol* 2014;83:1639–44.
129. Skaane, P, Bandos, AI, Eben, EB et al. Two-view digital breast tomosynthesis screening with synthetically reconstructed projection images: comparison with digital breast tomosynthesis with full-field digital mammographic images. *Radiology* 2014;271:655–63.
130. Weedon-Fekjaer, H, Romundstad, PR and Vatten, LJ. Modern mammography screening and breast cancer mortality: population study. *BMJ* 2014;348:g3701.
131. Zahl, PH, Jorgensen, KJ and Gotzsche, PC. Lead-time models should not be used to estimate overdiagnosis in cancer screening. *J Gen Intern Med* 2014;29:1283–6.
132. Boyce, M, Gullien, R, Parashar, D and Taylor, K. Comparing the use and interpretation of PGMI scoring to assess the technical quality of screening mammograms in the UK and Norway. *Radiography* 2015;21:342–347.
133. Ellingjord-Dale, M, dos-Santos-Silva, I, Grotmol, T et al. Vitamin D intake, month the mammogram was taken and mammographic density in Norwegian women aged 50–69. *PLoS One* 2015;10:e0123754.
134. Hofvind, S, Holen, Å, Aas, T, Roman, M, Sebuødegård, S and Akslen, LA. Women treated with breast conserving surgery do better than those with mastectomy independent of detection mode, prognostic and predictive tumor characteristics. *Eur J Surg Oncol* 2015;41:1417–22.
135. Løberg, M, Lousdal, ML, Bretthauer, M and Kalager, M. Benefits and harms of mammography screening. *Breast Cancer Res* 2015;17:63.
136. Moshina, N, Ursin, G, Hoff, SR et al. Mammographic density and histopathologic characteristics of screen-detected tumors in the Norwegian Breast Cancer Screening Program. *Acta Radiol Open* 2015;4:2058460115604340.
137. Skaane, P, Gullien, R, Eben, EB, Sandhaug, M, Schulz-Wendtland, R and Stoeblen, F. Interpretation of automated breast ultrasound (ABUS) with and without knowledge of mammography: a reader performance study. *Acta Radiol* 2015;56:404–12.
138. Solbjør, M, Skolbekken, JA, Østerlie, W and Forsmo, S. Women's experiences with mammography screening through 6 years of participation—a longitudinal qualitative study. *Health Care Women Int* 2015;36:558–77.
139. Suhrke, P and Zahl, PH. Breast cancer incidence and menopausal hormone therapy in Norway from 2004 to 2009: a register-based cohort study. *Cancer Med* 2015;4:1303–8.
140. Zahl, PH and Maehlen, J. Bias in observational studies of the association between menopausal hormone therapy and breast cancer. *PLoS One* 2015;10:e0124076.
141. Deandrea, S, Molina-Barcelo, A, Uluturk, A et al. Presence, characteristics and equity of access to breast cancer screening programmes in 27 European countries in 2010 and 2014. Results from an international survey. *Prev Med* 2016;91:250–263.
142. Domingo, L, Hofvind, S, Hubbard, RA et al. Cross-national comparison of screening mammography accuracy measures in U.S., Norway, and Spain. *Eur Radiol* 2016;26:2520–8.
143. Falk, RS and Hofvind, S. Overdiagnosis in Mammographic Screening because of Competing Risk of Death. *Cancer Epidemiol Biomarkers Prev* 2016;25:759–765.

144. Hofvind, S, Bennett, RL, Brisson, J et al. Audit feedback on reading performance of screening mammograms: An international comparison. *J Med Screen* 2016;23:150–9.
145. Hofvind, S, Holen, Å, Roman, M, Sebuødegård, S, Puig-Vives, M and Akslen, L. Mode of detection: an independent prognostic factor for women with breast cancer. *J Med Screen* 2016;23:89–97.
146. Hofvind, S, Roman, M, Sebuødegård, S and Falk, RS. Balancing the benefits and detriments among women targeted by the Norwegian Breast Cancer Screening Program. *J Med Screen* 2016;23:203–209.
147. Houssami, N, Lang, K, Bernardi, D, Tagliafico, A, Zackrisson, S and Skaane, P. Digital breast tomosynthesis (3D-mammography) screening: A pictorial review of screen-detected cancers and false recalls attributed to tomosynthesis in prospective screening trials. *Breast* 2016;26:119–34.
148. Lesurf, R, Aure, MR, Mork, HH et al. Molecular features of subtype-specific progression from ductal carcinoma in situ to invasive breast cancer. *Cell Rep* 2016;16:1166–79.
149. Michalopoulos, D and Duffy, SW. Estimation of overdiagnosis using short-term trends and lead time estimates uncontaminated by overdiagnosed cases: Results from the Norwegian Breast Screening Programme. *J Med Screen* 2016;23:192–202.
150. Moger, TA, Bjørnelv, GM and Aas, E. Expected 10-year treatment cost of breast cancer detected within and outside a public screening program in Norway. *Eur J Health Econ* 2016;17:745–54.
151. Moshina, N, Ursin, G, Roman, M, Sebuødegård, S and Hofvind, S. Positive predictive values by mammographic density and screening mode in the Norwegian Breast Cancer Screening Program. *Eur J Radiol* 2016;85:248–54.
152. Østerås, BH, Martinsen, AC, Brandal, SH et al. BI-RADS Density Classification From Areometric and Volumetric Automatic Breast Density Measurements. *Acad Radiol* 2016;23:468–78.
153. Østerås, BH, Martinsen, AC, Brandal, SH et al. Classification of fatty and dense breast parenchyma: comparison of automatic volumetric density measurement and radiologists' classification and their inter-observer variation. *Acta Radiol* 2016;57:1178–85.
154. Roman, M, Castells, X, Hofvind, S and Euler-Chelpin, M von. Risk of breast cancer after false-positive results in mammographic screening. *Cancer Med* 2016;5:1298–306.
155. Roman, M, Graff-Iversen, S, Weiderpass, E et al. Postmenopausal Hormone Therapy and Breast Cancer Prognostic Characteristics: A Linkage between Nationwide Registries. *Cancer Epidemiol Biomarkers Prev* 2016;25:1464–1473.
156. Roman, M, Sakshaug, S, Graff-Iversen, S et al. Postmenopausal hormone therapy and the risk of breast cancer in Norway. *Int J Cancer* 2016;138:584–93.
157. Sardanelli, F, Aase, HS, Alvarez, M et al. Position paper on screening for breast cancer by the European Society of Breast Imaging (EUSOBI) and 30 national breast radiology bodies from Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Israel, Lithuania, Moldova, The Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Sweden, Switzerland and Turkey. *Eur Radiol* 2016.
158. Sebuødegård, S, Sagstad, S and Hofvind, S. [Attendance in the Norwegian Breast Cancer Screening Programme]. *Tidsskr Nor Laegeforen* 2016;136:1448–51.
159. Waade, GG, Highnam, R, Hauge, IH et al. Impact of errors in recorded compressed breast thickness measurements on volumetric density classification using volpara v1.5.0 software. *Med Phys* 2016;43:2870.
160. Jørgensen, KJ, Kalager, M, Barratt, A et al. Overview of guidelines on breast screening: Why recommendations differ and what to do about it. *The Breast* 2017;31:261–269.
161. Luijt, PA van, Heijnsdijk, EA and Koning, HJ de. Cost-effectiveness of the Norwegian breast cancer screening program. *Int J Cancer* 2017;140:833–840.
162. Luijt, PA van, Heijnsdijk, EA, Ravestein, NT van, Hofvind, S and Koning, HJ de. Breast cancer incidence trends in Norway and estimates of overdiagnosis. *J Med Screen* 2017;24:83–91.
163. Moshina, N, Roman, M, Sebuødegård, S, Waade, GG, Ursin, G and Hofvind, S. Comparison of subjective and fully automated methods for measuring mammographic density. *Acta Radiol* 2017;284185117712540.
164. Moshina, N, Sebuødegård, S and Hofvind, S. Is breast compression associated with breast cancer detection and other early performance measures in a population-based breast cancer screening program? *Breast Cancer Res Treat* 2017;163:605–613.
165. Waade, GG, Hofvind, S, Thompson, JD, Highnam, R and Hogg, P. Development of a phantom to test fully automated breast density software - A work in progress. *Radiography (Lond)* 2017;23:e14–e19.
166. Waade, GG, Moshina, N, Sebuødegård, S, Hogg, P and Hofvind, S. Compression forces used in the Norwegian Breast Cancer Screening Program. *Br J Radiol* 2017;90:20160770.
167. Waade, GG, Sanderud, A and Hofvind, S. Compression force and radiation dose in the Norwegian Breast Cancer Screening Program. *Eur J Radiol* 2017;88:41–46.

Reports

1. Abildgaard, A, Danielsen, H, Iversen, B and al, et. Bruk av digital mammografi i screeningvirksomhet. 1998.
2. Pedersen, K. Prøveprosjekt med mammografiscreening. Pasientdosemålinger. StrålevernRapport 1998:4. Statens strålevern (NO), 1998.
3. Abildgaard, A, Danielsen, H, Iversen, B and al, et. Forslag til prosjekt for utprøving av digital mammografi i screeningen. Kreftregisteret (NO), 1999.
4. Eriksen, L, Henden, B, Hofvind, S and al, et. Opplæring av fagpersonell til mammografiscreening. 1999.
5. Ottestad, L and Wang, H. Prøveprosjekt med masseundersøkelse for brystkreft ved mammografi. Forskningsrapport nr. 2. Oslo: Kreftregisteret (NO), 1999.

6. Ertzaas, AK, Hofvind, S and Thoresen, S. Mammografiprogrammet i Norge: Evaluering av prøveprosjektet 1996-2000. Forskningsrapport nr. 2-2000. Kreftregisteret (NO), 2000.
7. Pedersen, K and Nordanger, J. Mammografiscreening. Teknisk kvalitetskontroll - resultater og evaluering etter fire års prøveprosjekt. StrålevernRapport 2000:2. Østerås: Statens strålevern, 2000.
8. Intraduktale epitelproliferasjoner. Bildekompendium. Kvalitetssikring i patologiarbeidet. Forskningsrapport nr. 1-2002. Oslo: Kreftregisteret (NO), 2002.
9. Bredholt, K, Hauge, IH, Ormberg, I and Pedersen, K. Kvalitetskontroll i mammografi. Konstanskontroller. [Quality control in mammography. Constancy tests]. Strålevern Rapport 2003:14. Østerås: Statens strålevern, 2003.
10. Kvalitetsmanualen i Mammografiprogrammet. Oslo: Kreftregisteret (NO), 2003.
11. Pedersen, K, Johansen, S, Rønning, F and Bjurstam, N. Digitalisering av analoge screeningbilder. Mammografiprogrammet Troms og Finnmark. StrålevernRapport2004:7. Østerås: Statens strålevern (NO), 2004.
12. Pedersen, K, Johansen, S, Rønning, F and Bjurstam, N. Digitisation of prior screening mammograms. Norwegian Breast Cancer Screening Program Troms and Finnmark. StrålevernRapport2004:8. Østerås: Statens strålevern (NO), 2004.
13. Digital mammografiscreening. Utfordringer og løsningsforslag i Mammografiprogrammet. Oslo: Kreftregisteret (NO), 2005.
14. Hauge, IH and Pedersen, K. Stråledose til screena kvinner i Mammografiprogrammet. [Radiation doses to screened women in the Norwegian Breast Cancer Screening Program]. Strålevern Rapport 2005:12. Østerås: Statens strålevern, 2005.
15. Ormberg, I, Pedersen, K and Bredholt, K. Statens strålevern i Mammografiprogrammet Databaseprogram for kvalitetskontrollresultater [The Norwegian Radiation Protection Authority in the Norwegian Breast Cancer Screening Program – A database program for quality control results]. StrålevernRapport 2005:9. Østerås: Statens strålevern (NO), 2005.
16. Pedersen, K, Vee, B, Fevang, E and Iversen, B. Digital mammografiscreening. Opplæring og kompetansebygging i Mammografi-programmet. Oslo: Kreftregisteret (NO), 2005.
17. Hofvind, S, Huber, T, Sørsum, R and al, et. Utforming, testing, prosedyrer og anbefalinger ved innføring av nytt spørreskjema i mammografiprogrammet. 2006.
18. Hofvind, S, Thoresen, S and Langmark, F. En pilotstudie av mammografiaktiviteten ved to private røntgeninstitutter i Norge. Oslo: Kreftregisteret (NO), 2006.
19. Ormberg, I, Pedersen, K and Bredholt, K. Statens strålevern i Mammografiprogrammet. Resultater fra teknisk kvalitetskontroll hentet fra databaseprogrammet TKK. [The Norwegian Radiation Protection Authority in the Norwegian Breast Cancer Screening Program – Results from technical quality control obtained from the database program TKK]. Strålevern Rapport 2006:2. Østerås: Statens strålevern, 2006.
20. Pedersen, K and Hauge, IH. Straaledoser ved analog og digital mammografi i mammografiprogrammet i Troms og Finnmark høsten 2004 [Radiation doses with analog and digital technique in the breast screening program of Troms and Finnmark autumn 2004]. StrålevernRapport 2006:17. Østerås: Statens strålevern (NO), 2006.
21. Aas, G, Sørsum, R, Ertzaas, AK et al. Utvidelse av aldersgruppen i Mammografiprogrammet? Momenter ved inklusjon av aldersgruppene 45-49 år og 70-74 år. Part 2. Vol. 2. Utvidelse av aldersgruppen i Mammografiprogrammet? Oslo: Kreftregisteret (NO), 2007.
22. Hauge, IH, Bredholt, K and Pedersen, K. Stråledose til screena kvinner i Mammografiprogrammet i 2005 og 2006 [Radiation doses to screened women in the Norwegian Breast Cancer Screening Program in 2005 and 2006]. StrålevernRapport 2007:6. Østerås: Statens strålevern (NO), 2007.
23. Hofvind, S, Ertzaas, AK, Sørsum, R, Damtjernhaug, B, Haldorsen, T and Steen, R. Utvidelse av aldersgruppen i Mammografiprogrammet? Bakgrunnsinformasjon for en konsekvensanalyse. Part 1. Vol. 1. Utvidelse av aldersgruppen i Mammografiprogrammet? Oslo: Kreftregisteret (NO), 2008.
24. Sørsum, R, Hofvind, S, Haldorsen, T, Steen, R, Damtjernhaug, B and Skaane, P. Oslo-prosjektet. Mammografiscreening for kvinner 45-49 år i perioden oktober 1999 – juni 2002. Part 3. Vol. 3. Utvidelse av aldersgruppen i Mammografiprogrammet? Oslo: Kreftregisteret (NO), 2008.
25. Pedersen, K, Landmark, ID, Bredholt, K and Hauge, IH. Teknisk kvalitetskontroll – konstanskontroller for digitale mammografisystemer (Supplement til kapittel 10, Kvalitetsmanualen i Mammografiprogrammet). StrålevernRapport 2009:5. Østerås: Statens strålevern (NO), 2009.
26. Hofvind, S and Sanderud, A. Bruk av mammografi i Norge i 2005 og 2008. Oslo: Høgskolen i Oslo (NO), 2010.
27. Pedersen, K, Bredholt, K, Landmark, ID, Istad, TSJ, Almen, A and Hauge, IH. Teknisk kvalitetskontroll – statuskontroller for digitale mammografisystemer (Erstatning for kapittel 11 i Kvalitetsmanualen i Mammografiprogrammet). StrålevernRapport 2010:8. Østerås: Statens strålevern (NO), 2010.
28. Hoff, SR, Iversen, B, Lømo, J, Pedersen, K and Skaane, P. Tomosyntese i mammografiscreening. Status report as of December 2015. Oslo: Kreftregisteret (NO), 2015.
29. Hofvind, S, Sagstad, S, Sebuodegard, S and Holen, Å. Mammografiprogrammet Resultater fra prosessindikatorer 2006-2013/14. Oslo: Kreftregisteret (NO), 2015.

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