Tidsskriftet Tidsskrift for Den norske legeforening

Cancer trends and population structure in Norway 1990–2016

ORIGINAL ARTICLE

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BACKGROUND

The composition of the Norwegian population has changed, and immigrants currently account for nearly 14 % of the population. We do not know how this affects the situation with regard to cancer. In this study we present the incidence of cancer in the Norwegian-born portion of the population in order to gain an impression of how this incidence has changed, disregarding the effect of immigration.

MATERIAL AND METHOD

Data from the Cancer Registry of Norway and population data from Statistics Norway were used to estimate age-standardised incidence rates for cancer in Norway in the period 1990–2016.

RESULTS

The study population encompassed 6 703 675 persons, whereof 82.3 % were defined as Norwegian-born. The total rates of all forms of cancer among the Norwegian-born and the population as a whole stayed more or less identical. In the last five-year period (2012–2016), the rates for the Norwegian-born portion of the population were 2 % higher than the national rates, and melanoma and cervical cancer had the greatest differences in percentage, with 6–8 % higher rates. The rate of liver cancer was 3–4 % lower in the Norwegian-born population when compared to the population as a whole.

INTERPRETATION
National rates have so far provided a good indication of cancer trends in the Norwegian-born portion of the population. Since the differences in rates increased towards the end of the period, country of birth may be a key factor to consider in the presentation of cancer incidence.

Main message

In the period 1990–2016, the incidence rates for the major forms of cancer, i.e. prostate, breast, colorectal and lung cancer, in the Norwegian-born population were approximately equal to those in the population as a whole.

Over the last five-year period, the rates of all forms of cancer overall were 2 % higher among the Norwegian-born, when compared to the rates for the population as a whole.

Data suggest that it will be increasingly important to take the composition of the population into account when presenting cancer incidence at the national level.

Since 1953 we have had a near-complete overview of cancer incidence in Norway, and the incidence rates for all types of cancer as a whole are nearly twice as high today as they were 60 years ago.

Since we started registration of cancer, the population has increased by nearly two million, and there are more elderly people. This would indicate more cases of cancer overall, but the age-adjusted cancer rate has not been affected. In recent years the proportion of immigrants has increased, from 2.5 % in 1984 to nearly 14 % in 2017 (1). We have recently shown that immigrants have a lower incidence of all types of cancer as a whole, but with a higher risk of liver cancer in both sexes and of lung cancer in men (2). Thus over time, the proportion of the population with a varying risk of cancer has increased, and it is therefore interesting to investigate whether this has affected the national cancer rates that are published annually in the report *Cancer in Norway* (3). This publication provides an overview of cancer trends in the entire population, but we do not know whether immigration has influenced the situation with regard to cancer, and thus whether the national rates provide a fully adequate picture of the trend in cancer prevalence in the Norwegian-born portion of the population. Changes in the rates are also difficult to interpret, since the Cancer Registry of Norway does not include any information on country of birth. Liver cancer provides one example. Here we have seen an increase in incidence, and immigration has been put forward as an explanation of this increase (3), since a number of immigrant groups have higher incidence rates (2).

We have previously shown that the cancer incidence among immigrants differs from that of the Norwegian-born (2), but we have no knowledge of the extent to which this affects national rates. The main objective of this study is to show the risk development for cancer in the Norwegian-born portion of the population

(non-immigrants), to see whether the national rates for all cancers in total as well as for specific cancers provide a fully adequate picture of cancer trends in this part of the population.

Material and method

This study has been approved by the Regional Committee for Medical and Health Research Ethics (REK) (reference code 2013/2376).

We included all persons who had been registered as resident in Norway for 12 months or more during the period 1990–2016. To study the Norwegian-born portion of the population separately, we linked vital registry data with data from Statistics Norway with the aid of the national ID number. This number is given at birth to persons born in Norway and to immigrants six months after their arrival. We retrieved information on each person's country of birth and his/her parents' country of birth from Statistics Norway.

Persons born in Norway or abroad with at least one Norwegian-born parent were defined in our study as Norwegian-born, and the entire population of Norway was defined as the total population. Persons defined as first- or second-generation immigrants were not included in the Norwegian-born portion of the population.

From the Cancer Registry of Norway we linked all registered cases of cancer in the follow-up period (1 January 1990–31 December 2016) to this information. Different types of cancer were defined according to the following ICD-10 codes (4): C00–96, D32–33, D35.2–35.4, D42–43, D44.3–44.5, D45–47 (all types of cancer in total), C16 (malignant neoplasm of stomach), C18–C20 (malignant neoplasm of colon/rectum), C22 (malignant neoplasm of liver), C33–34 (malignant neoplasm of trachea, bronchus and lung), C43 (malignant melanoma of skin), C53 (malignant neoplasm of cervix uteri), C50 (malignant neoplasm of breast), C61 (malignant neoplasm of prostate) and C73 (malignant neoplasm of thyroid gland). The persons were monitored from 1 January 1990 until whichever of the following happened first: date of cancer diagnosis, death, emigration or the end date of the study (31 December 2016).

To study cancer among the Norwegian-born and the population as a whole, we have used the same method as in *Cancer in Norway* (3). To express cancer risk we have estimated annual age-standardised rates in five-year age groups, meaning that we have estimated age-specific rates within each five-year age group. Each age group was subsequently ascribed a different weight, based on the Norwegian population as of 2014. Age-standardised rates are by definition independent of the age effect, thus permitting a comparison of cancer incidence between groups with a different age composition over time. The rates are presented per 100 000 person-years. To estimate person-years we used the average of all persons resident as of 1 January and 31 December for the year in question, and for multi-year periods we used the sum of the averages. Separate estimates were made for the Norwegian-born portion of the population and the total population.

We estimated a 95 % confidence interval (CI) for the age-adjusted rates and assumed that the incidence followed the Poisson distribution. The statistical analysis and preparation of graphs were undertaken with the aid of Stata, version 15 (5).

Results

The total population encompassed 6 703 675 persons, of which 5 516 117 (82.3 %) were defined as Norwegian-born. The study included 777 449 cases of cancer recorded by the Cancer Registry of Norway in the period 1990–2016, and the majority had been diagnosed among the Norwegian-born (745 647 (95.9 %)).

Figure 1 shows that that the incidence of all types of cancer as a whole increased in the period 1990–2016, among the Norwegian-born as well as in the total population.

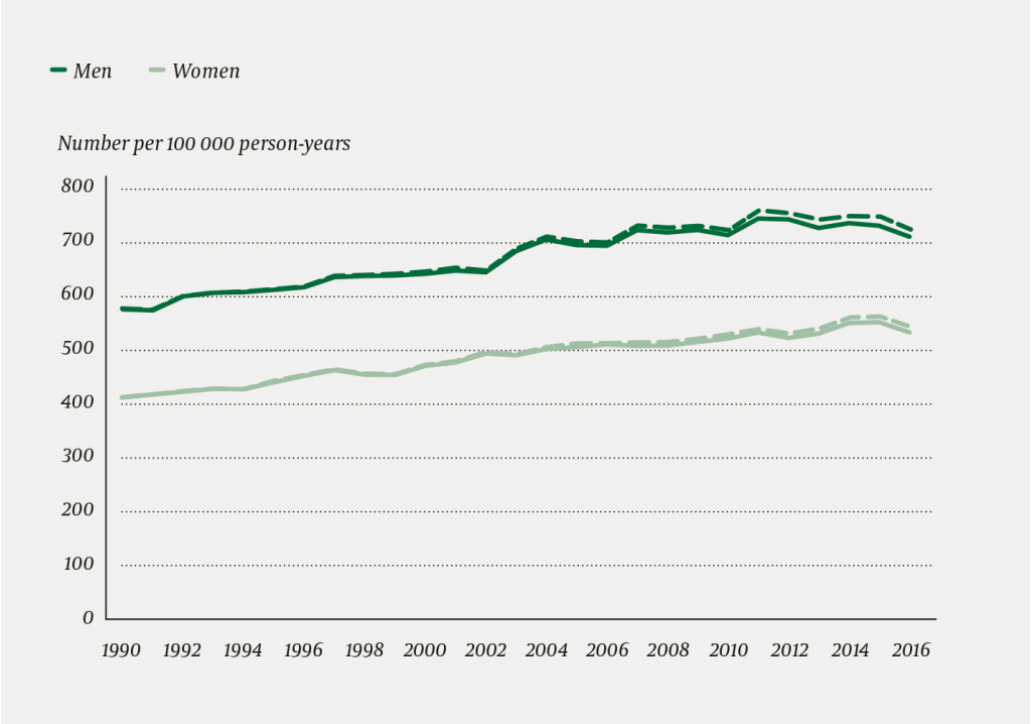

Figure 1 Change in the incidence of all types of cancer among the Norwegian-born (broken line) and in the population as a whole (solid line), shown as age-standardised incidence rates (Norwegian standard) in the period 1990–2016.

The age-standardised incidence rates for selected types of cancer, for the total population and the Norwegian-born, are shown in Figure 2 (men) and Figure 3 (women). The incidence rates for the Norwegian-born population were close to those of the total population for the major types of cancer: prostate, breast, stomach and lung cancer.

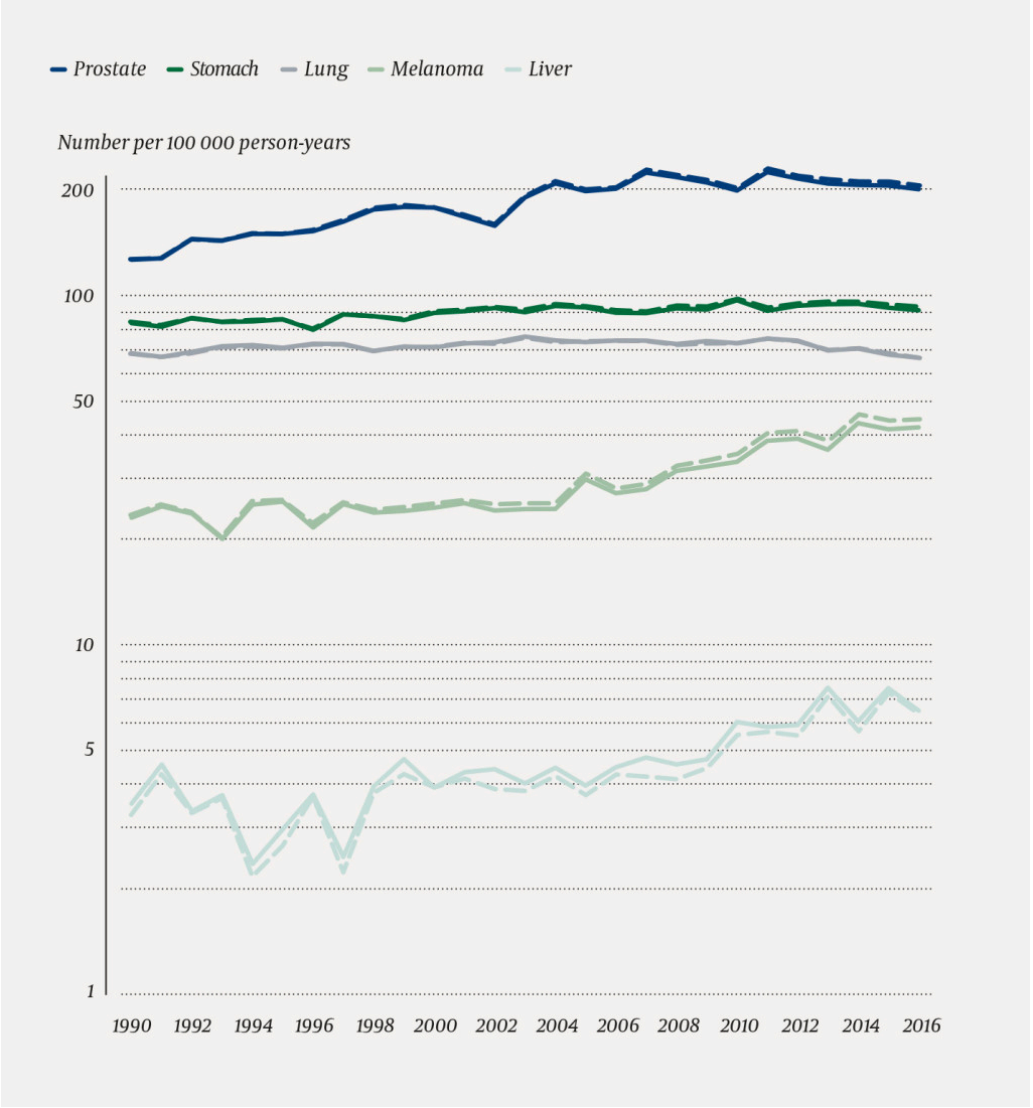

Figure 2 Men. Age-standardised incidence rates (Norwegian standard) for selected types of cancer in the total population (solid line) and the Norwegian-born (broken line) in the period 1990–2016 (semi-logarithmic scale).

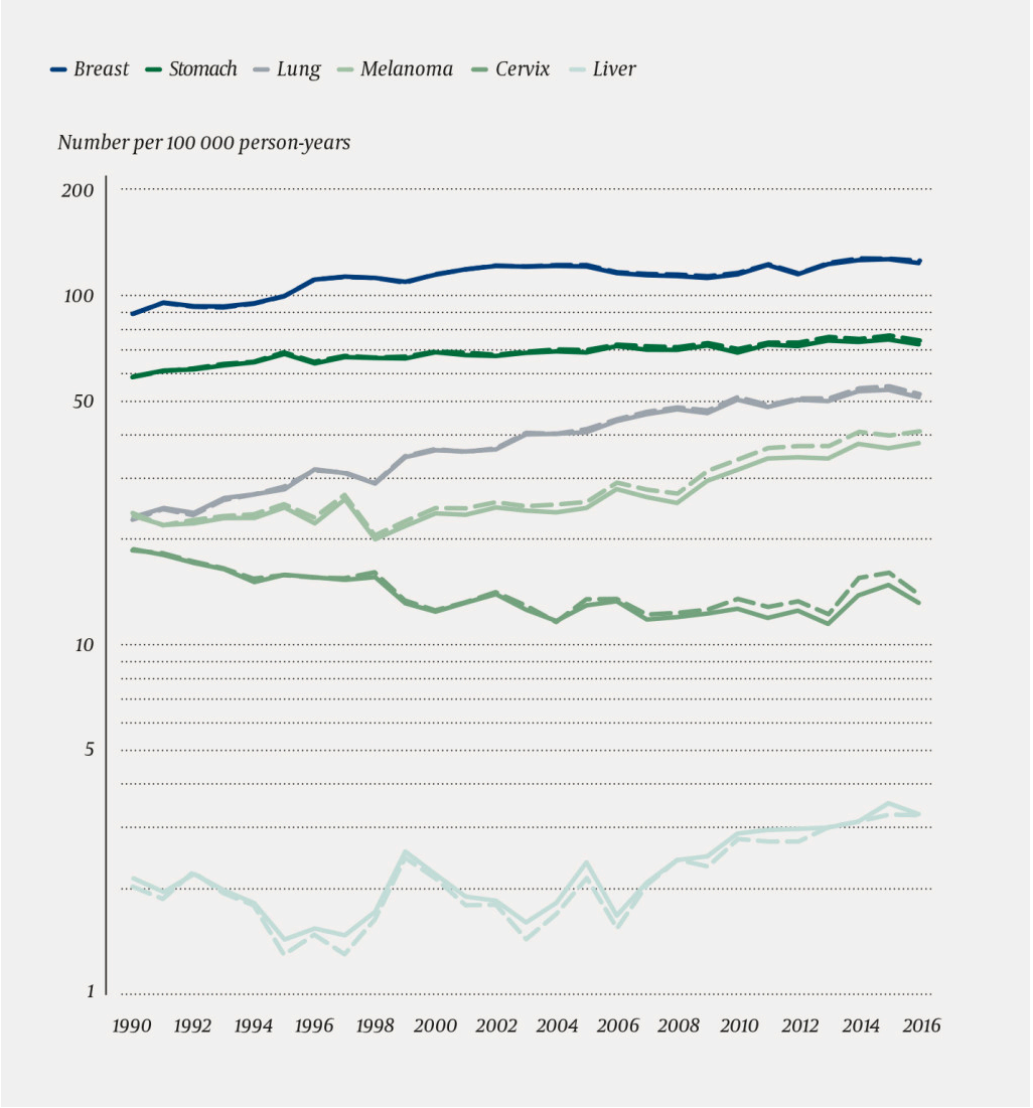

Figure 3 Women. Age-standardised incidence rates (Norwegian standard) for selected types of cancer in the total population (solid line) and the Norwegian-born (broken line) in the period 1990–2016 (semi-logarithmic scale).

Figure 1 shows that the rates for the Norwegian-born portion of the population have remained somewhat higher than the national rates since the turn of the millennium. To quantify the differences in rates for the Norwegian-born and the total population we chose the last five-year period (2012–16) (Tables 1 and 2). For all types of cancer as a whole, the rates for the Norwegian-born were 2 % higher than the rates for the total population. Differences for the individual types of cancer varied from -6 % to +8 %. Melanoma and cancer of the cervix uteri were the types of cancer that showed the greatest positive percentage-wise differences between the rates. For melanoma, the rates for Norwegian-born men were 6 % higher than the national rates, while the rates for Norwegian-born women were 8 % higher. The rates for cancer of the cervix uteri were 8 % higher for Norwegian-born women when compared to the national rates. On the other hand, the rates for cancer of the liver among the Norwegian-born were 4 % lower for men and 3 % lower for women when compared to the rate in the total population. Cancer of the thyroid gland occurred 6 % less frequently among Norwegian-born women than in the total population. Since this is a relatively rare type of cancer, this corresponds to a difference of less than one case per 100 000 person-years (Tables 1 and 2).

Table 1

Age-standardised (Norwegian standard) incidence rates (ASR) per 100 000 person-years for all types of cancer as a whole and selected types of cancer for the total population of men in Norway and Norwegian-born men, 2012–16. CI = confidence interval.

	Total population, men (person-years = 12 933 458)		Norwegian-born men (person-years = 10 898 580)		Difference
ICD-10 code	**Number**	**ASR (CI)**	**Number**	**ASR (CI)**	**(%)[1]**
C00–96 All types of cancer	86 379	733.4 (728.4–38.3)	81 636	747.7 (742.5–752.9)	1.9
C16 Stomach	1483	12.9 (12.2–13.6)	1 364	12.7 (12.1–13.5)	-1.6
C18–20 Colon/rectum	10 807	93.1 (91.3–94.9)	10 278	94.9 (93.1–96.8)	1.9
C22 Liver	805	6.8 (6.3–7.3)	708	6.5 (6.0–7.0)	-4.4
C33–34 Lung	8 062	69.1 (67.5–70.6)	7 586	69.2 (67.7–70.8)	0.1
C43 Melanoma	4 867	40.6 (39.5–41.8)	4 696	42.9 (41.7–44.2)	5.7
C61 Prostate	24 944	208.0 (205.4–210.6)	23 940	213.0 (210.3–215.8)	2.4
C73 Thyroid gland	552	4.4 (4.1–4.8)	482	4.4 (4.0–4.8)	0

[1]Percentage difference between the age-standardised incidence rates for the total population and the age-standardised incidence rates for the Norwegian-born.

Tabell 2

Age-standardised (Norwegian standard) incidence rates (ASR) per 100 000 person-years for all types of cancer as a whole and selected types of cancer for the total population of women in Norway and Norwegian-born women, 2012–2016. CI = confidence interval.

	Total population, women (person-years = 12 775 013)		Norwegian-born women (person-years = 10 864 589)		Difference[1]
ICD-10 code	**Number**	**ASR (CI)**	**Number**	**ASR (CI)**	**(%)**
C00–96 All types of cancer	73 280	542.6 (538.7–546.6)	68 553	552.3 (548.1–556.5)	1.8
C16 Stomach	849	6.1 (5.7–6.5)	784	6.0 (5.6–6.4)	-1.6
C18–20 Colon/rectum	10 247	73.9 (72.5–75.4)	9 812	75.7 (74.2–77.2)	2.4
C22 Liver	447	3.2 (2.9–3.6)	408	3.1 (2.8–3.5)	-3.1
C33–34 Lung	7 071	52.1 (50.9–53.4)	6 754	53.1 (51.8–54.4)	1.9
C43 Melanoma	4 833	36.5 (35.4–37.5)	4 670	39.5 (38.3–40.6)	8.2
C50 Breast	16 251	123.9 (122.0–125.8)	14 857	125.0 (123.0–127.0)	0.9
C53 Cervix uteri	1 680	13.1 (12.5–13.8)	1 510	14.2 (13.5–15.0)	8.4
C73 Thyroid gland	1 298	10.1 (9.5–10.6)	1 073	9.5 (9.0–10.1)	-5.9

[1]Percentage difference between the age-standardised incidence rates for the total population and the age-standardised incidence rates for the Norwegian-born

Discussion

This study shows that in recent years, there are minor differences between the incidence rates presented for the total population of Norway and the rates that are shown if only the Norwegian-born are included. So far, the national incidence rates have provided a good picture of the cancer risk in the Norwegian-born portion of the population. For all types of cancer as a whole, the Norwegian-born have somewhat higher rates than the total population. We saw the greatest differences for melanoma and cancer of the cervix uteri. Since the early 2000s there has been an increase in the incidence of liver cancer in the population, and there is speculation as to whether this increase could be attributable to immigration (3). In this study we saw that there has also been an increase in the incidence of liver cancer among the Norwegian-born, even though the rates were lower than in the total population.

Our previous study has shown that the incidence rates for all types of cancer as a whole are lower among immigrants than in the rest of the population, while immigrants have a higher incidence of lung cancer in men and liver cancer in both genders (2). This study shows that in spite of this observation, the national incidence rates have so far provided a good picture of the cancer risk among the Norwegian-born. The increasing differences between the rates for the Norwegian-born and the total population towards the end of the period nevertheless show that this might change, both because the proportion of immigrants is increasing and because the age composition is changing, whereby the number of elderly people in this group is increasing.

There has been some speculation as to whether the decreasing incidence rate for lung cancer among men could partly be ascribed to a fall in the proportion of men who are smokers, caused by an increase in the proportion of non-smoking immigrants (6). This is not likely, however, since the incidence rate for lung cancer is higher among immigrant men in general (2), and this study shows that the rates of lung cancer declined towards the end of the study period, both in the total population and among Norwegian-born men.

During the period of study, there has been an increase in the incidence rates for cancer of the liver and thyroid gland. Hepatitis B and C are known risk factors for liver cancer (7), and increasing immigration from countries with a high prevalence of this type of cancer has been put forward as a possible explanation of the increasing incidence in liver cancers. However, our results show only a minor difference when comparing the Norwegian-born and the total population. This means that the increase in the national rates for liver cancer is a reality also among the Norwegian-born, and cannot be attributed to increased immigration alone. The incidence of liver cancer is increasing also in the United States, and this increase is observed across ethnicities (8).

Over the last decade, increasing incidence rates for cancer of the thyroid gland have also been observed in the other Nordic countries (9). Our results showed a higher incidence rate for cancer of the thyroid gland in the total female population, but as for liver cancer, we could also see an increase in the Norwegian-born portion of the population. We assume that this increase can be explained by higher rates of detection, and to a lesser extent can be attributed to immigration. Over the period of study, the differences between the Norwegian-born and the total population increased with regard to many of the types of cancer. In the same period, immigrants have accounted for an increasing proportion of the population of Norway. On 1 January 2018, immigrants accounted for 33.1 % of the population of Oslo (10), and it is reasonable to assume that cancer incidence in this group may have an effect on incidence rates in the total population. For example, a review of cancer rates by county in 2013 showed especially low rates of prostate cancer in Oslo (11). This may possibly be due to the city's large immigrant population, which has a low prevalence of prostate cancer (2). This study shows only a negligible difference between the national rate of prostate cancer and the rate among the Norwegian-born.

Although the national rates have until now provided an adequate picture of cancer incidence in Norway, it will be crucial to take the composition of the population into account in future presentations of cancer incidence at the national level, thus to be able to analyse the development of cancer risk in sub-groups of the population. To date, we have had little knowledge about cancer incidence in the Norwegian-born portion of the population. Existing knowledge has been based on stand-alone studies, because country of birth and national background have not been registered as variables in the Cancer Registry of Norway. In light of a proposal for an amendment to the Regulations concerning the Cancer Registry of Norway (12), the Ministry of Health and Care Services has now revised Section 1–7 of the regulations to meet precisely this need (13).

This study population is large, based on the total population of Norway over a given period of time. Data from the Cancer Registry of Norway have been shown to be near-complete and have a high validity (14). They will thus provide a reliable picture of actual cancer incidence among the Norwegian-born as well as the total population. The population in this research study nevertheless differs somewhat from the population that the Cancer Registry of Norway uses in its annual publication of cancer incidence rates in Norway, and the incidence rates in this study are somewhat higher that those that were presented at the national level in 2017 (3).

The incidence of some types of cancer may be low and thus render the rates vulnerable to random variations. We have therefore presented the development in incidence rates over the last 27 years.

Conclusion

The national rates presented for the Norwegian population as a whole have so far provided an adequate picture of cancer development in the Norwegian-born portion of the population. Although the cancer incidence among immigrants is different from that of the Norwegian-born, this does not appear to affect the national rates to any significant extent. Since the differences between the rates for the Norwegian-born and the total population increased towards the end of the period, it might nevertheless be important to take the composition of the population into account when presenting cancer incidence at the national level in the future.

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Publisert: 22 November 2018. Tidsskr Nor Legeforen. DOI: 10.4045/tidsskr.17.0938
Received 30.10.2017, first revision submitted 14.3.2018, accepted 10.10.2018.