Cancer in Greenlandic Inuit 1973-1997

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ABSTRACT

Objectives. During the second half of the 20th century living conditions of the Inuit populations in the Arctic have undergone major transitions. The objective was to investigate how the cancer pattern was affected by these changes, using data from the Danish Cancer Registry and the Civil Registration System. Results. In the period 1973-1997 total cancer incidence increased by 4% per 5 years for men and 6% per 5 years for women. The incidence of lung, stomach, breast and colon cancer increased in both sexes, whereas the incidence of cervical cancer decreased. Conclusions. Thus, the overall cancer incidence among Greenlandic Inuit is increasing as a result of increases in several cancers that are common in Western populations. In contrast to global trends, a significant increase in the incidence of stomach cancer in both sexes was observed.

Keywords: Danish Cancer Registry, incidence, lung, stomach, breast, colon

INTRODUCTION

In the beginning of the 20th century malignant diseases were virtually non-existing in the Inuit (1). During the second half of the 20th century, the living conditions of Inuit populations in Greenland, Canada and Alaska have undergone major transitions, including rapid urbanisation, shifting of the work force from traditional to modern occupations, and dramatic changes from a diet mainly based on sea mammals towards a more Western diet (2-4). Using population-based registries in Greenland and Denmark, we present an analysis of the cancer pattern in Greenland in the period 1973-1997.

METHODS

All individuals in Greenland and Denmark are registered in the Civil Registration System (CRS) with a unique personal identification number. A Greenland was defined as a person born in Greenland. Based on the CRS, information on all individuals born in Greenland and alive on January 1, 1973 or later was retrieved, in total 72,331 individuals. Information on cancer cases was retrieved from the Danish Cancer Registry (DCR)(5). Cancers in Greenlanders living in Denmark at the time of diagnosis were included in the study. The follow-up period started January 1, 1973, or at date of birth, whichever occurred last, and ended at the date of cancer diagnosis, death, emigration, disappearance or December 31, 1997, whichever occurred first. The expected number of cancers in Greenland in 1988-1997 was calculated by applying age and period-specific incidence rates from Denmark (excluding Greenland) to the cohort at risk in the period 1988-1997. The ratios of observed to expected cancers (SIR) were used equivalent to the relative risk (RR). Possible trends in incidence rates were estimated using log-linear Poisson regression.

RESULTS

There was an overall increasing 5-year trend of total cancer incidence of 4% in men and 6% in women, with significant increases for cancers of the stomach (24%), lung (23%) and colon (12%) in both sexes and for breast cancer (14%) among women (Table I). A significant decreasing 5-year trend was observed for cancer of the uterine cervix (-10%). Between 1973-1987 and 1988-1997 the age-standardised incidence rate for all cancers combined increased by 11.8% in men from 248.5 to 277.9 per 100,000 person-years, and in women...
by 12.2% from 269.4 to 302.2 per 100,000 person-years (Tables II a and b). During 1988-97 cancers of the lung, stomach and oesophagus were the three predominant types of cancer among men, whereas cancers of the lung, breast and cervix were the predominant types among women. Compared to the Danish population, incidences of cancers of the nasopharynx, oesophagus and salivary gland are high among Inuit, while incidences of cancers of the breast, skin, testis and prostate are low (Table III).

DISCUSSION
The present study documents a five-year increase in the number of cancer cases among Greenlanders of 4% and 6% in men and women, respectively, with increases in cancer of the lung, breast, colon and stomach and a decrease in cancer of the cervix. With the exception of stomach and cervical cancers rates, the change in the overall pattern is consistent with the leading forms of cancer in the Western populations.

Lung cancer is strongly associated with smoking, and the trend in lung cancer rates among Inuit most likely reflects the changes in smoking prevalence. The import of cigarettes to Greenland has increased from 5.2 cigarettes per inhabitant per day in 1950 to 11.1 in 1980. (2) Although import statistics indicate a decreasing consumption in the nineties, 80% of the adult population smoked in 1993 (6). The increase in lung cancer rates is particularly pronounced among women.

In recent decades stomach cancer has declined globally, and increasing rates as observed in Greenland are unparalleled in industrialised countries. In Greenland high nitrosamine contents have been found in certain dried, unsalted fish preparations (7), but there is no indication of an increased consumption of these traditional foods, whereas the consumption of vegetables and fruit, which have a protective effect, has increased (8). The association between helicobacter pylori and non-cardia stomach

Table I. Relative change in incidence rates per 5 years ($RR_{5\text{year}}$) in the period 1973-1997, adjusted for age.

| Site          | $RR_{5\text{year}}$  | CI (95%)  |
|---------------|----------------------|-----------|
| Both sexes    |                      |           |
| Stomach      | 1.24                 | (1.07-1.43)|
| Colon        | 1.12                 | (0.99-1.27)|
| Lung         | 1.23                 | (1.14-1.31)|
| Females      |                      |           |
| Breast       | 1.14                 | (1.04-1.26)|
| Cervix       | 0.90                 | (0.83-0.98)|
| All malignant neoplasms | | |
| Male         | 1.04                 | (1.00-1.09)|
| Female       | 1.06                 | (1.02-1.10)|

Table II a. Numbers of selected cancers and incidence rates of males per 100,000 person-years in Greenland, by gender in 1973-1987 and 1988-1997.

| Males | ICD codes a | 1973-1987 | 1988-1997 |
|-------|-------------|-----------|-----------|
|       | Count | Crude rate | AS rate b | Count | Crude rate | AS rate b |
| Salivary glands | 142 | 9 | 2.4 | 3.8 | 9 | 3.2 | 3.9 |
| Nasopharynx | 146 | 34 | 9.2 | 14.7 | 21 | 7.4 | 10.3 |
| Oesophagus | 150 | 36 | 9.7 | 19.6 | 39 | 13.8 | 21.9 |
| Stomach | 151 | 18 | 4.8 | 8.0 | 43 | 15.2 | 22.1 |
| Colon | 153 | 26 | 7.0 | 15.5 | 30 | 10.6 | 18.2 |
| Rectum | 154 | 18 | 4.8 | 9.4 | 15 | 5.3 | 9.7 |
| Liver | 155.0 | 12 | 3.2 | 5.5 | 11 | 3.9 | 8.0 |
| Lung | 162.0-162.1 | 123 | 33.1 | 63.5 | 133 | 47.0 | 80.4 |
| Breast | 170 | 1 | 0.3 | 0.6 | 0 | 0.0 | 0.0 |
| Prostate | 177 | 5 | 1.3 | 2.7 | 3 | 1.1 | 2.0 |
| Testis | 178 | 8 | 2.2 | 2.3 | 3 | 1.1 | 1.0 |
| Melanoma of skin | 190 | 2 | 0.5 | 0.6 | 2 | 0.7 | 1.1 |
| Non-Hodgkin's lymphoma | 200, 202 | 9 | 2.4 | 3.7 | 15 | 5.3 | 6.7 |
| Leukemia | 204 | 7 | 1.9 | 2.3 | 12 | 4.2 | 4.3 |

All malignant neoplasms | 140-205 | 500 | 134.7 | 248.5 | 500 | 176.7 | 277.9 |

a ICD 7th revision.
b Directly age-adjusted using world standard.
cancer seems well established (9). Time series of the seroprevalence of Helicobacter Pylori in Greenland is not available, but a high seroprevalence of CagA-positive H. pylori has been observed in a Canadian Arctic community (10). Smoking increases the risk of stomach cancer, especially in H. pylori infected individuals (11,12). The large increase in stomach cancer rates in men is, however, not accompanied by similar increases in male lung cancer rates, just like the large increase in female lung cancer rates is not accompanied by increases in female stomach cancer rates.

The incidence of breast cancer in Inuit women has increased markedly in the past 25 years. Despite this the risk of breast cancer among the Inuit is still approximately half of that in the Danish population. The increase is observed in women older than 50 years, and the overall pattern has changed from a typical low-risk country with stagnating or falling rates after menopause to a pattern common-

Table II b. Numbers of selected cancers and incidence rates of females per 100,000 person-years in Greenland, by gender in 1973-1987 and 1988-1997.

| Females | ICD codes a | 1973-1987 | 1988-1997 |
|---------|-------------|-----------|-----------|
|         | Count | Crude rate | AS rate b | Count | Crude rate | AS rate b |
| Salivary glands | 142 | 11 | 2.9 | 3.8 | 6 | 2.0 | 2.1 |
| Nasopharynx | 146 | 30 | 7.9 | 11.2 | 22 | 7.5 | 8.0 |
| Oesophagus | 150 | 25 | 6.6 | 10.4 | 20 | 6.8 | 8.7 |
| Stomach | 151 | 19 | 5.0 | 7.4 | 22 | 7.5 | 9.2 |
| Colon | 153 | 42 | 11.0 | 18.6 | 48 | 16.3 | 21.3 |
| Rectum | 154 | 15 | 3.9 | 5.7 | 16 | 5.4 | 6.7 |
| Liver | 155.0 | 3 | 0.8 | 1.2 | 6 | 2.0 | 2.9 |
| Lung | 162.0-162.1 | 75 | 19.7 | 32.2 | 134 | 45.5 | 58.3 |
| Breast | 170 | 102 | 26.7 | 35.0 | 121 | 41.2 | 46.4 |
| Cervix uteri | 171 | 154 | 40.5 | 48.7 | 113 | 38.5 | 36.8 |
| Melanoma of skin | 190 | 0 | 0.0 | 0.0 | 5 | 1.7 | 2.0 |
| Non-Hodgkin’s lymphoma 200, 202 | 204 | 7 | 1.8 | 2.1 | 9 | 3.1 | 3.2 |
| Leukemia | 204 | 12 | 3.1 | 3.7 | 3 | 1.0 | 1.0 |

All malignant neoplasms 140-205 192.3 269.4 764 259.4 302.2
a ICD 7th revision.
b Directly age-adjusted using world standard.

Table III. Standardized Incidence Ratio for selected cancers in Greenland compared with Denmark 1988-1997.

| Females | Site | SIR (95% CI) | Males | Site | SIR (95% CI) |
|---------|------|-------------|------|------|-------------|
| Nasopharynx | 47.5 (29.8-71.9) | Nasopharynx | 27.3 (16.9-41.8) |
| Oesophagus | 5.7 (3.5-8.8) | Salivary glands | 6.5 (3.0-12.3) |
| Salivary glands | 4.5 (1.7-9.9) | Oesophagus | 4.2 (3.0-5.8) |
| Gallbladder and other biliary | 3.3 (1.8-5.4) | Stomach | 2.9 (2.1-4.0) |
| Cervix Uteri | 2.6 (2.1-3.1) | Liver | 1.9 (1.0-3.5) |
| Mouth | 2.4 (1.1-4.8) | Pancreas | 1.7 (1.1-2.6) |
| Stomach | 2.2 (1.4-3.4) | Lung | 1.6 (1.3-1.8) |
| Lung | 2.1 (1.7-2.5) | | |
| Pancreas | 1.9 (1.2-2.7) | | |
| Breast | 0.6 (0.5-0.7) | Brain and nervous system | 0.3 (0.2-0.6) |
| Brain and nervous system | 0.6 (0.4-0.9) | Other skin | 0.2 (0.1-0.3) |
| Bladder | 0.3 (0.1-0.7) | Bladder | 0.2 (0.1-0.4) |
| Leukemia | 0.2 (0.0-0.5) | Melanoma of skin | 0.1 (0.0-0.3) |
| Corpus uteri | 0.2 (0.1-0.4) | Testis | 0.1 (0.0-0.3) |
| Other skin | 0.1 (0.1-0.2) | Hodgkin’s disease | 0.1 (0.0-0.7) |
| Melanoma of skin | 0.1 (0.0-0.3) | Prostate | 0.1 (0.0-0.2) |
ly seen in Western countries with increasing rates after the menopause (13).

A significant decreasing trend for cancer of the cervix was observed, whereas no significant trend for cervical carcinoma in situ was evident. However, compared with Danes the risk of cancer of the cervix is still high among the Inuit. Women in Greenland have more sexual partners and earlier age at first intercourse than Danish women, (14) but similar rates of HPV infection in cervical lesions (15).

In Greenland the majority of NPCs and salivary gland carcinomas are of the undifferentiated type (16), and both diseases are believed to be influenced by environmental factors (especially the Epstein-Barr virus), but also to be associated with a particular genetic constitution (17). Although rates of the two cancers in Greenland showed a minor decrease during the period, no significant trend was observed, and compared to Caucasian populations the rates remain high. This indicates exposure to risk factors that have not changed or that have changed all too recently to influence the incidence of these cancers.

The age distributions in the Inuit societies are changing, as the proportion of the elderly increases. The increasing number of elderly people in the cancer-prone age groups is partly responsible for the increasing cancer burden, indicated by the large increase in overall crude rates compared with age-standardised rates. This development combined with increases in absolute rates of a variety of cancers, in particular lung, stomach, colon and breast cancer, constitute a significant challenge for the Greenland society in the decades to come.

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