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Cancer risk among health care personnel in Finland, 1971—1980

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SANKILA R, KARJALAINEN S, LÄÄRÄ E, PUKKALA E, TEPPÖ L. Cancer risk among health care personnel in Finland, 1971—1980. *Scand J Work Environ Health* 1990;16:252—7. Standardized incidence ratios were calculated for the assessment of cancer risk among Finnish health care personnel in 1971—1980. The overall relative cancer risk among the men was low when compared with that of all economically active men, mainly due to the low relative risk of lung cancer. The cancer risk of female health care personnel was increased when compared with that of all economically active women. The relative risk of breast cancer among registered nurses was high, being twice that of practical nurses, who had an average risk. In contrast, the risk of lymphomas, leukemia, and primary liver carcinoma was low among registered nurses and high among practical nurses. Although specific occupational exposures could not be assessed, the results did not imply any alarming major hazards related to health care work itself.

Key terms: neoplasms, nurses, occupational diseases, physicians.

Health care personnel face potential risks of cancer in their occupational environment, particularly from exposure to ionizing radiation (1—5) and cytostatic drugs (6). In patient care there is a risk of exposure to viruses associated with various cancers, such as the hepatitis-B virus (primary hepatoma) and the Epstein-Barr virus (nasopharyngeal carcinoma and Burkitt's lymphoma) (7). Hodgkin's disease may have a viral etiology (8, 9), and certain malignancies (eg, Kaposi's sarcoma and non-Hodgkin's lymphomas) are connected with infections caused by human immunodeficiency viruses (10—12). Exposure to anesthetic gases has been suspected of increasing the risk of cancer among operating-room personnel (13—17). Ethylene oxide, a sterilizing agent, has been suspected of increasing the risk of leukemia (18—21).

With the exception of the documented increase in the incidence of cancer among radiologists and other radiation workers early in this century (1), there is no evidence of increased cancer risks caused by occupational exposures in health care. As long as radiation exposure has not exceeded current safety standards, it has not been possible to attribute cancer cases to radiation (1).

On the other hand, occupational safety standards are strict in this field, and the avoidance of occupational health hazards is emphasized in both basic and continued education. New, and even unlikely, risk factors are readily reported in the literature (22). Hence,

the potential occupational risk factors may, indeed, be of minor importance in the cancer morbidity of health care personnel.

This descriptive study was carried out to estimate the relative cancer risks of different health care occupations.

Subjects and methods

In the 1970 population census of Finland, information on occupation was recorded for 4.6 million people (98 % of the total population) living in the country on 31 December 1970. The information on occupation from the census was linked with the files of the Finnish Cancer Registry for patients aged 25 to 64 years with a diagnosis of cancer in 1971—1980. This linkage used the unique personal identification number given to everyone residing in Finland. The material consisted of 22 046 cases of cancer among economically active men and 16 806 cases of cancer among economically active women.

The population-based, nationwide Finnish Cancer Registry has been in operation since 1953. All physicians, hospitals, and pathological laboratories are obligated to report all new cancer cases that come to their attention. The Central Statistical Office of Finland informs the Registry of all death certificates on which cancer is mentioned. The Registry data have been shown to be reliable, and their coverage is virtually complete (23).

In the census, occupations were coded according to a modification of the Nordic Classification of Occupations (24), which is equivalent to the International Standard Classification of Occupations (25). Health care personnel were divided into 10 entities: physicians (code 030), dentists (code 031), registered nurses (code

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032), dental nurses and receptionists (code 033), midwives (code 034), psychiatric nurses (code 035), practical nurses and orderlies (code 036), technical assistants (code 037), childrens' nurses (code 038), and a small group of miscellaneous hospital-related occupations, such as patient hostesses and hospital maintenance men (code 039). For the sake of brevity, dental nurses and receptionists have been referred to as dental nurses in this report. The group of practical nurses and orderlies is referred to as orderlies when the results for the men are being presented and as practical nurses when the women are being discussed. Pharmacists, physiotherapists, health officers, masseurs, and a few other very small groups of people in occupations related to health care were excluded from this analysis.

The standardized incidence ratios were calculated by dividing the observed numbers of cancers by the corresponding expected numbers. The expected numbers were obtained by multiplying the age-, sex-, and occupation-specific person-years for 1971–1975 and 1976–1980 (provided by the Central Statistical Office of Finland) by the age-, sex-, and period-specific incidence rates (number of cases per person-year) of the total economically active population.

The observed numbers of cases were assumed to follow a Poisson distribution. The 95 % confidence intervals were calculated for the standardized incidence ratios from the tabulated confidence intervals of the Poisson mean (26). The 95 % confidence intervals for the ratios between the standardized incidence ratios of the registered and practical nurses were calculated by the exact binomial method with the fractiles of the appropriate F distributions (27). A more-detailed comparison was made of the overall and age-specific incidences of breast cancer between the registered and practical nurses with the use of the Poisson log-linear model and maximum likelihood fitting in the statistical analysis (27).

Results

Among the male health care personnel (code 03) the cancer risk, based on 63 cases, was lower, with a standardized incidence ratio (SIR) of 64, than that of all economically active men (table 1). Physicians (code 030) produced 51 % of the person-years at risk among the male health care personnel and constituted the only occupational group among the men with a significantly lower cancer risk (SIR 60) than that of all economically active men (28). In the other low-risk occupations (dentists and psychiatric nurses) the numbers of cases were small, and thus the confidence intervals were wide (table 1).

The relative risk of lung cancer was very low among the male health care personnel and in particular among male physicians (SIR 28 and 25, respectively) (table 1). There were no lung cancer cases among the male dentists (3.5 expected) (table 1). Zero to four cases were observed at other primary sites among the male health care personnel, and the estimated relative risks did not significantly differ from unity.

An elevated cancer risk (SIR 122), as compared with that of all economically active women, was noted for the female health care personnel on the basis of 1089 cases. The two largest health care occupations of registered nurses and practical nurses among the women differed in their cancer risk. Registered nurses had an increased relative risk of cancer (SIR 150), but practical nurses had an average incidence (SIR 104). Dental nurses, midwives, psychiatric nurses, technical assistants, and childrens' nurses also had an elevated risk of cancer (SIR 121–138) (table 2).

The risk of breast cancer was higher than average among the female health care personnel (SIR 137) (table 2). Physicians had an average incidence of breast cancer, but dentists had an elevated risk (SIR 153). These figures are, however, based on small numbers and have wide confidence intervals. The relative risk of breast cancer was high among the registered nurses

Table 1. Observed and expected numbers and the standardized incidence ratios with their 95 % confidence intervals for all cancers and lung cancer among the male health care personnel, aged 25–64 years, by occupation in Finland in 1971–1980. (SIR = standardized incidence ratio, 95 % CI = 95 % confidence interval)

Occupational group ^a	All cancers				Lung cancer			
	Observed	Expected	SIR	95 % CI	Observed	Expected	SIR	95 % CI
All economically active men	22 046	-	100	-	6 910	-	100	-
Health care personnel (03)	63	98.5 ^b	64	49–82	8	28.5 ^b	28	12–55
Physicians ^c (030)	33	55.0	60	41–84	4	16.2	25	7–63
Dentists (031)	6	11.8	51	19–111	—	3.5	0	0–105
Psychiatric nurses (035)	10	14.5	69	33–127	1	3.7	28	1–151
Orderlies (036)	2	1.1	181	22–657	1	0.2	476	12–2652
Miscellaneous (039)	12	14.5	83	43–145	2	4.5	44	5–161

^a Codes of the Nordic Classification of Occupations (24) in parentheses.

^b Includes occupations with no observed cases, such as male registered nurses.

^c Incidence data originally published by Nurminen et al (28).

Table 2. Observed and expected numbers and the standardized incidence ratios with their 95 % confidence intervals for all cancers and breast cancer among the female health care personnel, aged 25–64 years, by occupation in Finland in 1971–1980. (SIR = standardized incidence ratio, 95 % CI = 95 % confidence interval)

Occupational group ^a	All cancers				Breast cancer			
	Observed	Expected	SIR	95 % CI	Observed	Expected	SIR	95 % CI
All economically active women	16 806	-	100	-	5 200	-	100	-
Health care personnel (03)	1 089	890.7	122	115–130	394	287.2	137	124–151
Physicians (030)	19	21.6	88	53–137	7	6.8	102	41–211
Dentists (031)	42	37.2	113	81–153	17	11.1	153	89–245
Registered nurses (032)	392	261.2	150	136–166	163	83.0	196	167–228
Dental nurses (033)	30	21.7	138	93–197	11	6.7	165	82–295
Midwives (034)	46	38.0	121	89–161	18	12.8	141	83–222
Psychiatric nurses (035)	74	58.6	126	99–159	24	19.5	123	79–183
Practical nurses (036)	399	383.9	104	94–115	116	124.7	93	77–112
Technical assistants (037)	13	9.5	137	73–234	2	3.1	64	8–233
Children's nurses (038)	71	55.1	129	101–163	33	18.3	180	124–253
Miscellaneous (039)	3	3.8	79	16–239	3	1.2	250	52–731

^a Codes of the Nordic Classification of Occupations (24) in parentheses.

Table 3. Observed and expected numbers and the standardized incidence ratios with their 95 % confidence intervals for the most common cancers among the female health care personnel, aged 25–64 years, in Finland in 1971–1980. (SIR = standardized incidence ratio, 95 % CI = 95 % confidence interval)

Site	Observed	Expected	SIR	95 % CI
Liver	9	4.6	197	89–371
Rectum	35	22.9	153	106–213
Leukemia	28	19.3	145	96–210
Breast	394	287.2	137	124–151
Melanoma of the skin	46	34.4	134	98–178
Stomach	59	45.3	130	99–168
Kidney	23	18.5	124	79–187
Colon	44	35.7	123	90–165
All sites	1089	890.7	122	115–130
Nervous system	58	48.5	120	91–155
Ovary	85	72.2	118	94–146
Thyroid gland	36	31.5	114	80–158
Lung	31	27.7	112	76–159
Corpus uteri	73	66.3	110	86–138
Cervix uteri	33	47.1	70	48–98

(SIR 196), children's nurses (SIR 180), dental nurses (SIR 165), and midwives (SIR 141). Practical nurses, however, had an SIR of 93, which was slightly lower than the average (table 2), but significantly lower than the risk of breast cancer in the other health care occupations combined (SIR 171).

The risk of cancer was higher for most primary sites among the female health care personnel than among the economically active women as a whole (table 3). The relative risks were highest for cancer of the liver (SIR 197) and rectum (SIR 153), leukemia (SIR 145), and breast cancer (SIR 137). The risks of melanoma of the skin and cancers of the stomach, kidney, and colon were also elevated. Only the risk of cancer of the uterine cervix was low (SIR 70) (table 3).

Table 4. Observed numbers and the standardized incidence ratios for selected cancers among the female registered nurses and practical nurses, aged 25–64 years, in Finland in 1971–1980 with their 95 % confidence intervals and the ratios between the SIR values of the registered and practical nurses with their 95 % confidence intervals. (SIR = standard incidence ratio, 95 % CI = 95 % confidence interval, RSIR = SIR for registered nurses:SIR for practical nurses)

Site	Registered nurses			Practical nurses			RSIR	95 % CI
	Observed	SIR	95 % CI	Observed	SIR	95 % CI		
Breast	163	196	168–229	116	93	77–111	2.11	1.65–2.70
Corpus uteri	32	176	120–270	28	96	64–138	1.83	1.07–3.16
Colon	15	145	81–238	15	97	55–161	1.49	0.68–3.28
Rectum	12	186	97–327	13	129	69–222	1.44	0.60–3.43
All sites	392	150	136–166	399	104	94–115	1.44	1.25–1.66
Nervous system	24	156	100–232	23	114	72–170	1.37	0.74–2.54
Kidney	7	132	53–246	8	100	43–197	1.32	0.41–4.17
Stomach	20	153	93–236	23	117	74–176	1.31	0.68–2.49
Lung	9	114	52–216	11	91	45–163	1.25	0.46–3.33
Melanoma (skin)	16	146	82–236	18	126	75–199	1.16	0.55–2.41
Thyroid gland	13	128	68–218	16	123	70–200	1.04	0.46–2.31
Ovary	23	108	68–162	34	109	75–152	0.99	0.56–1.73
Cervix uteri	10	73	35–134	18	89	53–140	0.82	0.34–1.87
Hodgkin's disease	4	98	27–250	7	151	61–314	0.65	0.14–2.55
Non-Hodgkin's lymphomas	3	75	15–219	9	159	72–300	0.47	0.08–1.89
Leukemia	3	51	10–149	14	172	93–271	0.30	0.05–1.06
Liver	1	76	2–422	5	253	82–589	0.30	0.01–2.68

Figure 1. Age-specific incidence rates for breast cancer among registered nurses and practical nurses in Finland, 1971–1980. (Age at diagnosis in years)

Whereas registered nurses had a high relative risk for cancers of the breast (SIR 196), uterine corpus (SIR 176), and colon (145), practical nurses had incidences close to the average for these cancers (table 4). The situation was reversed for lymphomas, leukemia, and primary hepatoma. Registered nurses had an average or low relative risk and practical nurses a high relative risk (table 4). The lymphoma, leukemia, and liver carcinoma cases were, again, rather few.

The age-specific incidence rates for breast cancer were consistently higher for registered nurses than for practical nurses (figure 1). The ratio of the age-specific incidence rates of these two groups did not vary significantly with age. The age-adjusted estimate of the overall relative risk from the log-linear model was 2.14 (95 % CI 1.69–2.72), almost the same as the ratio between the standardized incidence ratios (ie, 2.11) (table 4).

Discussion

Both the incidence of and mortality from cancer have been low among Finnish physicians (28–30). Cancer mortality has been reported to be low among physicians in other countries, too (31, 32). Finnish physicians smoke less than the general population (33, 34), and their lung cancer risk is lower than that of other professions (35). The risk of cancer mortality related to smoking has been studied among British physicians (36), but otherwise there are few recent data on cancer incidence and mortality for the different medical professions (37–42) other than for radiologists (1–4) and anesthesiologists (13, 14, 16, 17).

In this study more than half of the deficit in the relative cancer morbidity for male health care personnel could be explained by low morbidity from lung cancer (8 observed versus 28.4 expected), which is the most common cancer among Finnish men (43). Lung cancer also explained more than half of the decrease in

the overall relative cancer risk among male physicians. The low lung cancer risk is likely due to the low prevalence of smokers (33, 34).

The women in health care occupations had an elevated risk of cancer. Half of the excess risk could be explained by the excess of breast cancer. It seems unlikely that occupational factors would have had much effect on breast cancer morbidity, but the excess risk and the occupational group differences probably reflect the distribution of the general risk indicators for breast cancer, such as hormonal and lifestyle factors (44).

Practical nurses had a high relative risk of lymphomas, leukemia, and liver carcinoma, whereas registered nurses had an average or low relative incidence of these cancers. Radiation, ethylene oxide, and infections have been suspected of being etiologic factors for these tumors (5, 7, 8, 19). There are no relevant data about the prevalence of exposure to these agents among all nurses nationwide in Finland. In a case-referent study on spontaneous abortions and malformations in the offspring of nurses, Hemminki et al (45) assessed exposure prevalences among 638 pregnant nurses working in certain departments of general hospitals. In this selected group 30 % of the pregnant nurses were exposed to anesthetic gases, 6 % to ethylene oxide, 9 % to cytostatic drugs, and 34 % to X-rays in undefined quantities. The authors suspected that nurses working in operating rooms had been exposed to negligible levels of ethylene oxide since only a few of them had been involved in actually sterilizing the instruments (45). In the Portland-Vancouver metropolitan area the risks of both lymphatic and nonlymphatic leukemia were significantly elevated among registered and practical nurses (42). On the basis of our study we cannot rule out the possibility that the excess risk is attributable to occupational risk factors.

The standardized incidence ratios of different occupational groups are not necessarily strictly comparable (27). The ratio between two standardized incidence

ratios may give a biased estimate of the relative risk between two groups if the age distributions are different and if the relative risk varies greatly across the age categories. In our data, registered nurses had a somewhat different age distribution than practical nurses. For breast cancer the age-specific relative risks were fairly homogeneous, and the adjusted estimate of the overall risk ratio was not materially different from the ratio between the standardized incidence ratios (table 4 and figure 1). As the numbers of cases in individual age groups are generally very small for most cancers, any heterogeneity test (27) would be very insensitive. Nevertheless, the possible bias from this source is probably relatively small in comparison with the magnitude of random error in the relative risk estimates.

In this study, we did not assess specific exposures, and thus it was not possible to estimate the effects of specific occupational risk factors. Our results indicate that there is an increased risk of cancer among female health care personnel, although some of the significant standardized incidence ratios may have been due to the multiple comparisons made. The risk differences between the occupational groups call for further study.

We were only able to analyze the cancer risks of those individuals who were economically active in 1970, as the former occupations of people retired before 1970 were unknown. Considering the long latency of solid tumors and the large proportion of old cancer patients, future studies should also include the retired people with the longest work exposures. With the case-referent approach, the specific exposures (radiation, cytostatics, etc) of health care personnel should be evaluated. Data should also be collected at the individual level on employment histories and personal risk factors such as smoking, hormonal and reproductive history, infectious diseases, and social status.

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