

## Lifestyle and Cancer: Effect of Widowhood and Divorce

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### Abstract

**Limited data are available on the possible changes in cancer risk brought about by widowhood and divorce, an increasing segment of the population. We calculated standardized incidence ratios (SIRs) for cancer among 47,000 widows/widowers and 60,000 divorced people, based on the Swedish Family-Cancer Database. Persons had to be identified with the same civil status in the census of years 1960 and 1970; the comparison group was married people according to the same censuses. Cancers were followed from years 1971 to 1998. Both increased and decreased SIRs were found, and a consistent pattern emerged. The effects on the divorced were always stronger than those in widows/widowers, irrespective of the direction of the effect. Every significant SIR for a cancer site in widows/widowers was accompanied by a more deviant and significant SIR in the divorced. SIRs between divorced men and women ( $r = 0.83$ ,  $P < 0.0001$ ) and between widows and divorcees correlated ( $r = 0.70$ ,  $P < 0.0001$ ). The overall cancer risk for the divorced was 0.92–0.94, and it was a balance between increased risks at tobacco-, alcohol-, and human papilloma virus-related sites, and decreased risks at most other sites. The data suggest that the changes in lifestyle on the loss of a spouse impact on the incidence of almost every type of cancer. The effects were so large that a failure to consider marital status in epidemiological studies may be a source to bias. Understanding these lifestyle changes may provide new insight in cancer prevention.**

### Introduction

Human life involves growing up in a family, building and raising a family, and finally ending in a lonesome life when the spouse has departed either through divorce or death. A number of individuals opt for living alone, never establishing a family, but the large majority who raise a family adapt their way of life to cohabitation with a spouse and children. Once the cohabitation has been terminated, social contacts change, and new habits may be adopted. Although the causes of widowhood and divorce are different, the former being nonoptional and the latter at least to some degree optional, the subsequent changes

in life may follow similar patterns and offer an instructive uncontrolled trial on how changes in lifestyle may impact on the risk of disease, such as cancer. If the effects on cancer were similar after widowhood and divorce, such data would argue that the cause would be the similar life patterns for widows/widowers and divorced people. Few studies have addressed the possible effects of widowhood and divorce on the risk of cancer, although divorce rates are high and increasing in many countries. A series of studies from Norway on widowed and divorced women showed effects on cancer mainly in the latter group (1–4). Divorced men were at an increased risk of pancreatic and prostate cancer (4, 5). In previous studies from the Swedish Family-Cancer Database on women who had children with different men, increases were seen in tobacco-related and sexually transmitted cancers, whereas decreases were noted for sites where risks were attributable to an affluent lifestyle (6, 7). Data on fathers to the last children of these women showed an increased risk of a broad range of cancers (6).

In contrast to the scarcity of cancer studies after widowhood and divorce, more studies have been carried out on other health outcomes, and conceptual frameworks have been proposed to explain the findings (8–10). The underlying factors are complex and include differences in financial and material resources, social support, health-related behavior, and various selection factors (10, 11). Lone mothers have been recognized as a vulnerable group (12). In Sweden, lone mothers have been characterized by having fewer children, residence in rental apartments, higher proportion of unemployment and receiving of welfare benefits, poor health status, and risk of lung cancer (12, 13). A large proportion of the unemployed lone mothers have been classified as poor.

Because of the lack of data on cancer risks after widowhood and divorce, we carried out a follow-up study on men and women with these life experiences, using married individuals as a reference. The analysis was based on the latest update of the Swedish Family-Cancer Database covering 10.2 million people. In line with previous studies, we hypothesize that tobacco- and alcohol-related and sexually transmitted cancers were more common among lonesome people. As an additional hypothesis we assume that at least some divorced persons were economically deprived and would show a decrease in cancers of affluent lifestyle, such as colon cancer and melanoma.

### Materials and Methods

All of the data in the present study originated from the nationwide Swedish Family-Cancer Database, which covers a main part of the population of the country, *i.e.*, those who were born after year 1932 with their parents (14). The 2000 update of the Family-Cancer Database, covering >10.2 million individuals and 0.76 million invasive cancers, was used to calculate site-specific cancer risks among men and women (14). The database included cancer data from the nationwide Swedish Cancer Registry from years 1961 to 1998 (15). The present study covered practically only the parental generation, because few offspring had experienced a loss of spouse or a divorce by the

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Table 1 Follow-up of civil status in four censuses in men and women

Civil status	1960	1970		1980			1990			
		From 1960	New	From 1960	From 1970	New	From 1960	From 1970	From 1980	New
In men										
Married, living together	1,213,605	1,051,783	473,710	812,257	394,208	325,942	542,969	326,238	261,483	376,206
Widower	16,759	10,671	28,105	5,849	16,066	44,000	2,169	7,324	21,233	54,552
Divorce	35,947	21,547	54,087	14,381	35,655	126,632	7,717	23,271	79,352	127,284
In women										
Married, living together	1,212,967	1,047,142	480,205	805,992	397,994	329,553	537,527	327,340	263,243	379,189
Widow	41,589	35,411	78,565	27,851	64,321	134,473	17,345	43,841	97,791	168,963
Divorce	40,559	28,708	60,300	24,282	45,722	138,252	18,867	36,719	99,109	137,292

first census of year 1960. All of the individuals in the parent generation were parents, and we, thus, had no possibility to stratify the data according to parenthood. The analyses covered all of the men and women in the Family-Cancer Database that were identified from the national census of 1960 and 1970 with the same civil status. Altogether, four national censuses have been linked to the Database, *i.e.*, those years 1960, 1970, 1980, and 1990. The present condition of being able to identify a person in two censuses with the same civil status classification (*i.e.*, married, living together, widow/widower, or divorced) ensured that the civil status had been constant usually at least a decade. However, we cannot exclude the possibility of civil status changes in the years intervening between the censuses, but such changes are likely to be rare. In Table 1 we show population dynamics in these civil status classifications. The Database contains information from census on the address code of each person. The code cannot be used for geographic localization but it can be used to check the number of individuals living in the same household. We used this code to check to what extent widows/widowers and divorcees lived alone.

The following ICD-7 codes were pooled: "upper aerodigestive" cancer (larynx, lip, mouth, and pharynx) and "leukemia" (leukemia, polycythemia vera, and myelofibrosis). Rectal cancer was separated to anus and mucosal rectum. Skin cancer was squamous cell carcinoma because basal cell carcinoma of the skin has not been registered in the Cancer Registry. Follow-up was started January 1, 1971, and it was terminated on diagnosis of cancer, death, emigration, or the closing data of the study, December 31, 1998. SIRs<sup>2</sup> were calculated as the ratio of observed (O) to expected (E) number of cases. The expected numbers were calculated from 5-year-age-, sex-, tumor type-, 10-year period-, region- (large cities and the rest of the country), and socio-economic status- (manual workers, blue collar worker, professionals, and other) specific standard incidence rates for all of the men and women who were married and lived with a spouse in the census of years 1960 and 1970. The data on residential region and socio-economic status were obtained from a national census. For female cancers, additional adjustments were made for parity and age at first birth, both calculated from the Database (16). 95% CIs were calculated assuming a Poisson distribution (17). Data on cancer sites were reported in the study if at least 50 cases were recorded in the combined widower or divorced groups.

## Results

Table 1 shows the numbers of individuals in the study and the dynamics of civil status change based on the Swedish Family-

Cancer Database. In the year 1960, 1.21 million men reported themselves as married and living together with a spouse. Ten years later, 1.05 million had kept the same civil status. This was the male reference group in this study, which accumulated 21.4 million person-years at risk during the follow-up period, covering years 1971 to 1998. The number of widowers decreased from 16,759 to 10,671 between years 1960 and 1970, with accumulated person-years of 127,000. Of the 35,947 divorced men in 1960, 21,547 maintained the civil status in 1970; they contributed 346,000 person-years. The number of married women was identical to the number of men in 1960 and almost identical in 1970. However, the number of divorced women was somewhat larger and that of widows much larger than the numbers in the corresponding male groups. Table 1 shows also the numbers of individuals entering the civil status designation at each census. Fewer men than women maintained the civil status "widower/widow" or "divorce" between two censuses. For example, 59.9% of divorced men of year 1960 remained divorced in year 1970; for women the percentage was 70.8. Category "new" shows that marriage was most common in the census of year 1970; widowhood has steadily increased; the number of divorced people increased to the census of year 1980 and then stabilized. Comparing the numbers of newly married people in year 1980 and those of a newly divorced people in 1990 gives a crude approximation of divorce rate, 39% for men and 42% for women. Adding up the numbers of individuals in each civil status in the census of year 1990, 1.5 million men and women were married, 85,000 were widowers (4.6% of all studied men in the 1990 census), 238,000 (13.1%) were divorced men, 328,000 (15.5%) were widows, and 292,000 (13.8%) were divorced women.

Table 2 shows SIRs for cancer in men who had been widowers or divorcees at the census of years 1960 and 1970, compared with men who were married and cohabited with their wife. The overall SIR for widowers was 1.04, of borderline significance because of large numbers. Esophageal cancer was in excess, SIR 1.70 and also upper aerodigestive tract and lung cancers were moderately increased, SIRs 1.27 and 1.15, respectively. Data for divorced men showed many significant deviations from unity, weighting the overall risk to an SIR of 0.94. Esophageal and anal cancers showed the highest increases of 2.49 and 2.13, respectively. Cancer at the upper aerodigestive tract (1.69), lung (1.35), liver (1.27), and pancreas (1.20) were also in excess. Even more sites showed a significant decrease: melanoma (0.49), endocrine glands (0.59), squamous cell carcinoma of the skin (0.60), multiple myeloma (0.65), nervous system (0.67), non-Hodgkin's lymphoma (0.68), prostate (0.78), colon (0.81), and leukemia (0.81).

A similar analysis of female cancers is shown in Table 3. Among widows, SIR at three sites was increased: cervix (1.67), upper aerodigestive tract (1.23), and pancreas (1.12). There was

<sup>2</sup> The abbreviations used are: SIR, standardized incidence ratio; CI, confidence interval.

Table 2 SIR for cancer in widowers and divorced men

Cancer site	Widowers				Divorced			
	O	SIR	95% CI		O	SIR	95% CI	
Upper aerodigestive tract	80	1.27 <sup>a</sup>	1.01 <sup>a</sup>	1.59 <sup>a</sup>	287	1.69 <sup>a</sup>	1.50 <sup>a</sup>	1.90 <sup>a</sup>
Salivary glands	7	1.45	0.57	3.00	12	1.05	0.54	1.83
Esophagus	39	1.70 <sup>a</sup>	1.21 <sup>a</sup>	2.33 <sup>a</sup>	148	2.49 <sup>a</sup>	2.11 <sup>a</sup>	2.93 <sup>a</sup>
Stomach	191	1.12	0.97	1.30	286	1.01	0.89	1.13
Small intestine	10	1.11	0.53	2.05	21	0.87	0.54	1.33
Colon	190	1.13	0.97	1.30	297	0.81 <sup>a</sup>	0.72 <sup>a</sup>	0.91 <sup>a</sup>
Rectum	104	0.94	0.77	1.14	246	0.98	0.86	1.11
Anus	2	0.90	0.08	3.31	13	2.13 <sup>a</sup>	1.13 <sup>a</sup>	3.66 <sup>a</sup>
Liver	85	1.17	0.93	1.44	189	1.27 <sup>a</sup>	1.10 <sup>a</sup>	1.46 <sup>a</sup>
Pancreas	92	1.14	0.92	1.40	195	1.20 <sup>a</sup>	1.03 <sup>a</sup>	1.38 <sup>a</sup>
Lung	242	1.15 <sup>a</sup>	1.01 <sup>a</sup>	1.31 <sup>a</sup>	815	1.35 <sup>a</sup>	1.26 <sup>a</sup>	1.44 <sup>a</sup>
Prostate	709	1.01	0.93	1.08	1067	0.78 <sup>a</sup>	0.74 <sup>a</sup>	0.83 <sup>a</sup>
Other male genitals	9	1.32	0.60	2.51	19	1.28	0.77	2.00
Kidney	67	0.93	0.72	1.19	154	0.82 <sup>a</sup>	0.69 <sup>a</sup>	0.96 <sup>a</sup>
Urinary bladder	130	0.86	0.72	1.02	327	0.85 <sup>a</sup>	0.76 <sup>a</sup>	0.95 <sup>a</sup>
Melanoma	22	0.72	0.45	1.09	60	0.49 <sup>a</sup>	0.37 <sup>a</sup>	0.63 <sup>a</sup>
Skin	107	0.99	0.81	1.20	122	0.60 <sup>a</sup>	0.49 <sup>a</sup>	0.71 <sup>a</sup>
Nervous system	37	1.13	0.80	1.56	79	0.67 <sup>a</sup>	0.53 <sup>a</sup>	0.83 <sup>a</sup>
Thyroid gland	6	0.81	0.29	1.78	17	0.86	0.50	1.38
Endocrine glands	18	1.46	0.86	2.31	29	0.59 <sup>a</sup>	0.39 <sup>a</sup>	0.84 <sup>a</sup>
Connective tissue	10	0.81	0.39	1.50	21	0.67	0.41	1.02
Non-Hodgkin's lymphoma	43	0.74	0.54	1.00	103	0.68 <sup>a</sup>	0.56 <sup>a</sup>	0.83 <sup>a</sup>
Hodgkin's disease	10	0.97	0.46	1.78	23	1.09	0.69	1.63
Myeloma	47	1.19	0.88	1.59	54	0.65 <sup>a</sup>	0.49 <sup>a</sup>	0.85 <sup>a</sup>
Leukemia	66	0.98	0.76	1.25	121	0.81 <sup>a</sup>	0.67 <sup>a</sup>	0.97 <sup>a</sup>
All	2323	1.04 <sup>a</sup>	1.00 <sup>a</sup>	1.09 <sup>a</sup>	4705	0.94 <sup>a</sup>	0.92 <sup>a</sup>	0.97 <sup>a</sup>

<sup>a</sup> 95% CI does not include 1.00.

a decrease at three sites: melanoma (0.77), skin (0.80), and non-Hodgkin's lymphoma (0.81). All cancer was decreased among divorcees (SIR 0.92). Among the common male and female sites there was an agreement between Tables 2 and 3, with two notable exceptions. Among women no increase of esophageal nor anal cancer was noted. Among the female sites, cervical cancer showed the highest SIR of 2.63, the highest in the whole study. Cancer at the breast (0.78), endometrium (0.74), and ovary (0.84) were decreased to an equal extent.

We tested for correlations between the SIRs in the previous Tables. Among men, the SIRs between the widowers and the divorced did not correlate (Spearman correlation,  $r = 0.33$ ,  $P = 0.10$ ), but there was a correlation between female widows and divorcees ( $r = 0.70$ ,  $P < 0.0001$ ). SIRs for widowers and widows did not correlate ( $r = 0.11$ ,  $P = 0.60$ ), but there was a high correlation between the male and female divorced ( $r = 0.83$ ,  $P < 0.0001$ ). To illustrate the remarkable correlations, and the deviations thereof, we plotted the SIRs on male and female divorcees from Table 2 and 3 in Fig. 1. We show only the sites with the data for either gender were significant. The stars on top of the bars indicate that the SIR differed significantly from 1.00. We ordered the sites from those that were increased on the left to those that were decreased on the right.

We carried out analysis on the age at which the person had become widow/widower or divorced. However, the effects were not systematic, probably because of remarriage and cohabitation (data not shown). We had a possibility to check to what extent widows/widowers and divorced lived alone using address codes. Among those who gave the same civil status in the census of year 1960 and 1970, 70.2% of widowers and 80.3% of widows lived alone. For male and female divorced the percentages were 80.2 and 74.8, respectively. We did not attempt to analyze who the cohabitants were, and we could not

exclude that they were children, other relatives, or used help. We calculated SIRs for all of the groups (living alone or with someone) but the differences were not large (data not shown). Some additional analyses were carried out on specific birth cohorts. There were no large differences in the attained family sizes in the groups of different civil status. Nor was there difference in the proportion of adult children who lived in a different county from their mother. However, divorced fathers lived more commonly in another county from their adult children, compared with their married counterparts.

## Discussion

Widowhood and divorce are becoming more common in many societies. Our cross-sectional data from the census of 1990 showed that among the three civil status groups covered, widows and divorced men and women each accounted for 13–15% of the population of the same gender; widowers were a smaller group, 4.6%. However, comparing longitudinally the data from years 1980 and 1990, the crude divorce rates were found to be 39% for men and 42% for women. Divorce rates have changed over time, and we noted in Table 1 that the number of new divorced persons more than doubled between years 1970 and 1980, and stabilized thereafter. The present study covered those who gave the same civil status in the census of years 1960 and 1970, the period when divorce was rarer than it was toward the end of the century. Thus, caution should be warranted in attempts to transpose the findings to future cancer risks of the generations of common divorce.

The present study was based on the Swedish Family-Cancer Database, in which cancer data originate from the Swedish Cancer Registry and the civil status data from national censuses, conducted by Statistics Sweden. Census forms are

Table 3 SIR for cancer in widows and divorcees

Cancer site	Widows				Divorcees			
	O	SIR	95% CI		O	SIR	95% CI	
Upper aerodigestive tract	97	1.23 <sup>a</sup>	1.00 <sup>a</sup>	1.50 <sup>a</sup>	108	1.57 <sup>a</sup>	1.29 <sup>a</sup>	1.89 <sup>a</sup>
Salivary glands	20	0.97	0.59	1.50	13	0.87	0.46	1.49
Esophagus	53	1.14	0.85	1.49	30	0.94	0.64	1.35
Stomach	357	1.02	0.92	1.13	212	0.98	0.85	1.12
Small intestine	42	1.14	0.82	1.55	25	0.83	0.53	1.22
Colon	683	0.97	0.90	1.05	444	0.80 <sup>a</sup>	0.73 <sup>a</sup>	0.88 <sup>a</sup>
Rectum	298	0.94	0.83	1.05	186	0.74 <sup>a</sup>	0.63 <sup>a</sup>	0.85 <sup>a</sup>
Anus	24	1.22	0.78	1.82	26	1.38	0.90	2.03
Liver	385	1.06	0.96	1.18	237	1.00	0.88	1.14
Pancreas	304	1.12 <sup>a</sup>	1.00 <sup>a</sup>	1.26 <sup>a</sup>	223	1.14 <sup>a</sup>	1.00 <sup>a</sup>	1.30 <sup>a</sup>
Lung	266	0.96	0.85	1.09	454	1.45 <sup>a</sup>	1.32 <sup>a</sup>	1.59 <sup>a</sup>
Breast	1373	0.94	0.89	1.00	1205	0.78 <sup>a</sup>	0.74 <sup>a</sup>	0.82 <sup>a</sup>
Cervix	214	1.67 <sup>a</sup>	1.45 <sup>a</sup>	1.91 <sup>a</sup>	444	2.64 <sup>a</sup>	2.40 <sup>a</sup>	2.90 <sup>a</sup>
Endometrium	279	0.91	0.80	1.02	288	0.74 <sup>a</sup>	0.66 <sup>a</sup>	0.83 <sup>a</sup>
Ovary	315	0.97	0.87	1.09	298	0.84 <sup>a</sup>	0.75 <sup>a</sup>	0.94 <sup>a</sup>
Other female genitals	79	1.06	0.84	1.32	66	1.21	0.94	1.54
Kidney	229	0.99	0.86	1.13	157	0.82 <sup>a</sup>	0.70 <sup>a</sup>	0.96 <sup>a</sup>
Urinary bladder	196	1.05	0.90	1.20	186	1.12	0.96	1.29
Melanoma	104	0.77 <sup>a</sup>	0.63 <sup>a</sup>	0.94 <sup>a</sup>	103	0.63 <sup>a</sup>	0.51 <sup>a</sup>	0.76 <sup>a</sup>
Skin	234	0.80 <sup>a</sup>	0.70 <sup>a</sup>	0.91 <sup>a</sup>	131	0.67 <sup>a</sup>	0.56 <sup>a</sup>	0.80 <sup>a</sup>
Nervous system	154	0.91	0.77	1.07	148	0.77 <sup>a</sup>	0.65 <sup>a</sup>	0.90 <sup>a</sup>
Thyroid gland	67	1.11	0.86	1.41	54	0.91	0.68	1.19
Endocrine glands	140	0.88	0.74	1.04	140	0.78 <sup>a</sup>	0.66 <sup>a</sup>	0.92 <sup>a</sup>
Connective tissue	45	1.05	0.77	1.41	31	0.74	0.50	1.05
Non-Hodgkin's lymphoma	163	0.81 <sup>a</sup>	0.69 <sup>a</sup>	0.95 <sup>a</sup>	136	0.75 <sup>a</sup>	0.63 <sup>a</sup>	0.89 <sup>a</sup>
Hodgkin's disease	26	0.84	0.55	1.23	18	0.92	0.55	1.46
Myeloma	135	1.10	0.92	1.30	74	0.79	0.62	1.00
Leukemia	194	1.03	0.89	1.18	139	0.86	0.72	1.02
All	6476	0.98	0.96	1.01	5576	0.92 <sup>a</sup>	0.89 <sup>a</sup>	0.94 <sup>a</sup>

<sup>a</sup> 95% CI does not include 1.00.

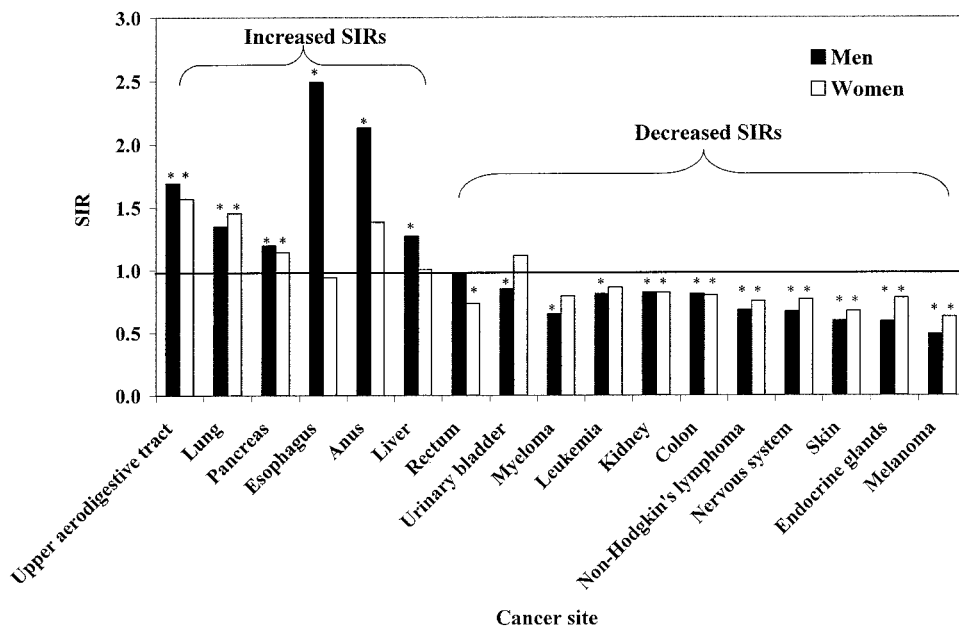


Fig. 1. SIR for cancer for male and female divorcees at sites for which the SIR in Table 2 and 3 is significant for at least one gender. \* shows that the 95CIs for the SIR did not include 1.00

individually filled in, and they may contain minor inaccuracies regarding civil status. The data on civil status were available in 10-year intervals, with no information from the intervening years. Moreover, widowed and divorced people may find new companions, and they may cohabit in an out-of-wedlock rela-

tionship. On the basis of address codes, 20–30% of the widows/widowers and divorced people lived together with someone, such as a partner, relative, or used servant. If these uncertainties had any effect on the results, the bias should be toward null. Although we cannot exclude the presence of such a bias, the

results between men and women, and widows/widowers and divorcees showed such consistent patterns that a large bias was unlikely. Because of the way that the Family-Cancer Database was constructed, almost all of the individuals included in the present study were parents, and we had no possibility to analyze the data separately for those who had never had children. An additional technical point is that the data were adjusted for region (large cities and the rest of the country), period, and socio-economic status, and for women additionally for parity and age at first birth. Moreover, because the study covered a large part of the Swedish population, sampling issues appear irrelevant.

This cancer study tells a revealing story about the life of those lacking a life companion because of long-term widowhood or divorce. The consistency of the findings is rare in related studies on complex socio-economic and behavioral-lifestyle factors. One of the consistencies is that the effects on divorced people were always stronger than those in widows/widowers, irrespective of the direction of the effect. Every significant SIR for a cancer site in widows/widowers was accompanied by a more deviant and significant SIR in the divorced. Also the correlation was highest between the male and female divorced ( $r = 0.83$ ,  $P < 0.0001$ ), although it was also highly significant between female widows and divorcees ( $r = 0.70$ ,  $P < 0.0001$ ). The correlation between the male and female divorced was remarkably high, although the present selection criteria (same civil status in two censuses) were not equal for both genders. The data of Table 1 suggested that men remained divorced for a shorter period than women, thus imposing some differential selection for the male and female divorced. An average widowhood was brought about later than an average divorce, and a widowhood was an involuntary event, both of these factors suggesting that widowhood causes lesser changes in lifestyle than did divorce. The similar changes in the risk of cancer among widows/widowers and the divorced argue strongly that the changes in cancer rates were in part brought about by changes in lifestyle upon separation from the spouse rather than solely by a pre-existing character of these populations. An additional point arguing to the same direction was that the attained family sized of all of the civic status groups were not different. We discussed the results under three subheadings: "Increased Risks," "Decreased Risks," and "Is Affluent Lifestyle Related to Most Cancer?"

**Increased Risks.** Cancer of the upper aerodigestive tract and the pancreas was increased for all of the widows/widowers and the divorced; lung and esophageal cancer was increased for all of the male widowers and divorced, and lung cancer also for divorcees, who had additionally an increased risk of cervical cancer. Three carcinogenic exposures and lack of balanced nutrition appear to explain all of the observed excess risks among widow(er)s and divorced people. An excess of lung cancer in widowers and in male and female divorced was consistent with the more than average tobacco smoking in these groups. Pancreatic cancer followed also the pattern. An excess of upper aerodigestive cancer in all of the study groups was consistent with more than average consumption of alcohol and tobacco in these groups. Among Swedish lone mothers, surveyed in the 1990s, 50% were daily smokers, and 6% were considered high alcohol consumers, compared with 25 and 2% of the married mothers (13). Particularly telling was the high SIR of 2.49 for esophageal cancer in male divorcees and that of 1.70 in widowers, whereas for women no risk was observed. The difference between genders is likely to be related to alcohol consumption and to poor nutrition of men, whereas women with cooking experience and use of vegetables manage well and

evade a risk (18, 19). The reason for the lack of effects on gastric cancer, for which dietary protective factors are also important (20), is that alcohol has no effect and tobacco has only a weak carcinogenic effect on the stomach (21, 22).

The third lifestyle factor was HPV, the infection that predisposes to cervical cancer in women with multiple partners (23, 24). Divorcees showed a high risk of 2.64 for cervical cancer. Anal cancer is also related to HPV infections (25), and the high risk in divorced men may suggest homosexual practices among some divorced men.

A common denominator to the above cancers is that they are more common in the socially disadvantaged groups in many western societies (26, 27). Stomach cancer is another neoplasm showing an increasing gradient in the poorer social groups but it lacks a strong lifestyle-related risk factor. Notably, SIRs for stomach cancer did not differ in any of the studied groups from those of the married. These data suggest that our adjustment for socio-economic group worked, and that alcohol and tobacco consumption and sexual habit of widows/widowers and divorcees were peculiar to their life situation rather than to their socio-economic group.

**Decreased Risks.** Divorced people had a decreased risk of male and female cancer at many sites: colon, kidney, skin (melanoma and squamous cell carcinoma), nervous system, and nonthyroid endocrine glands. Divorced men had a decreased risk of prostate and bladder cancer, and of non-Hodgkin's lymphoma; divorcees had a decreased risk of breast, endometrial, and ovarian cancer. Among the divorced, these decreased risks weighted more than increased risks, and the overall SIR for cancer was 0.94 for divorced men and 0.92 for divorcees. Widowers had a decreased risk of melanoma and skin cancer and non-Hodgkin's lymphoma. SIR for all cancer was 1.04 for widowers and 0.98 for widows.

The incidence of cancers of the colon, breast, and prostate, as well as for melanoma and non-Hodgkin's lymphoma has been increasing throughout the western world over the past decades, and the incidence of these cancers is highest in the most affluent countries (28–30). Consistently, almost all of the immigrant nationalities in Sweden show lower rates of these cancers than native Swedes (31). These are also the types of cancer that are most common in the most privileged social classes according to studies in many countries, which are summarized in an IARC publication (26). The reasons for the high rates of these neoplasms are only partially known.

These data on protective effects against cancers of affluent lifestyle support the notion that widows/widowers, and particularly, the divorced, experience cancer rates similar to disadvantaged social groups. Although these data are fully consistent with previous Norwegian and our results on women, the reasons remain speculative (1, 6). In Sweden, the share of occupationally active women has been historically high compared with other western countries. It is likely that the private economy of less educated women was precarious, as they were often in custody of their children, and their occupational careers were probably sacrificed because of domestic duties (13). However, for men and educated women the economic aspects were not equally obvious, although one earning person per household does not match the income of two earning persons. We speculate that the protective effects were in part because of economically deprived lifestyle and a more fit condition because of a single person's household and need for new social contacts. Compared with married persons in the same social class, these factors result in lifestyle of less obesity, more physical activity, and less solar exposure, which are protective against some of

the cancers for which the risk was decreased, in line with our initial hypothesis. On the basis of a recent study from the Family-Cancer Database, melanoma was shown to have the steepest socio-economic gradient of all neoplasms in Sweden (27). The reasons are assumed to be affordability of holiday making in sunny southern countries (32).

**Is Affluent Lifestyle Related To Most Cancer?** In addition to the cancer of affluent lifestyle, divorcees experienced a decreased risk of kidney (0.82 for men and women), bladder (0.85 for men, 1.12, not significant, for women), squamous cell skin (0.60 for men, 0.67 for women), nervous system (0.67 for men, 0.77 for women), and endocrine gland (0.59 for men and 0.78 for women) tumors, and for multiple myeloma (0.65 for men, 0.79, not significant, for women) and leukemia (0.81 for men and 0.86, not significant, for women). We did not consider rectal cancer because of its similarity to colon cancer. It is noteworthy that the kidney and the bladder are tobacco-related sites, and they have changed to an opposite direction than lung cancer. The implication is that among nonsmoking divorced persons the true decrease in the risk for kidney and bladder cancer would have been larger. The listed cancers have a high incidence in the affluent westernized countries in the world, but they are not related to a particular social class, based on the data that are available for the most of these sites (26, 30). However, we find no other explanation to these findings but an affirmative to the question posed in the subheading. Because practically nothing is known about the etiology of many of these cancers, divorced persons would appear an attractive study population for probing novel risk factors.

In summary, changes in cancer risks among widowers/widows were similar to but weaker than those among the divorced. The overall cancer risk for the divorced was 0.92–0.94, and it was a balance of increased risks at tobacco-, alcohol-, and HPV-related sites, and decreased risks at most other sites. The data suggest that the changes in lifestyle on the loss of a spouse impact on the incidence of almost every type of cancer. The effects among the divorced were so large that a failure to consider their civil status could cause bias in lifestyle and nutrition related epidemiological studies. Understanding these lifestyle changes may provide new insight in cancer prevention.

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### References

- Kvikstad, A., Vatten, L. J., Tretli, S., and Kvinnsland, S. Widowhood and divorce related to cancer risk in middle-aged women. A nested case-control study among Norwegian women born between 1935 and 1954. *Int. J. Cancer*, 58: 512–516, 1994.
- Kvikstad, A., Vatten, L. J., Tretli, S., and Kvinnsland, S. Death of a husband or marital divorce related to risk of breast cancer in middle-aged women. A nested case-control study among Norwegian women born 1935–1954. *Eur. J. Cancer*, 30A: 473–477, 1994.
- Bjorge, T., and Kravdal, O. Reproductive variables and risk of uterine cervical cancer in Norwegian registry data. *Cancer Causes Control*, 7: 351–357, 1996.
- Nilsen, T. I., and Vatten, L. J. A prospective study of lifestyle factors and the risk of pancreatic cancer in Nord-Trøndelag, Norway. *Cancer Causes Control*, 11: 645–652, 2000.
- Lund Nilsen, T. I., Johnsen, R., and Vatten, L. J. Socio-economic and lifestyle factors associated with the risk of prostate cancer. *Br. J. Cancer*, 82: 1358–1363, 2000.
- Hemminki, K., and Jiang, Y. Life style and cancer: effect of divorce. *Int. J. Cancer*, 98: 316–319, 2002.
- Li, X., and Hemminki, K. Cancer risks in women who had children with different partners from the Swedish Family-Cancer Database. *Eur. J. Cancer Prev.*, 11: 433–438, 2002.
- Waldron, I., Weiss, C. C., and Hughes, M. E. Marital status effects on health: are there differences between never married women and divorced and separated women? *Soc. Sci. Med.*, 45: 1387–1397, 1997.
- Whitehead, M., Burstrom, B., and Diderichsen, F. Social policies and the pathways to inequalities in health: a comparative analysis of lone mothers in Britain and Sweden. *Soc. Sci. Med.*, 50: 255–270, 2000.
- Kiecolt-Glaser, J. K., and Newton, T. L. Marriage and health: his and hers. *Psychol. Bull.*, 127: 472–503, 2001.
- Yngwe, M. A., Diderichsen, F., Whitehead, M., Holland, P., and Burstrom, B. The role of income differences in explaining social inequalities in self rated health in Sweden and Britain. *J. Epidemiol. Community Health*, 55: 556–561, 2001.
- Burstrom, B., Diderichsen, F., Shouls, S., and Whitehead, M. Lone mothers in Sweden: trends in health and socioeconomic circumstances, 1979–1995. *J. Epidemiol. Community Health*, 53: 750–756, 1999.
- Ringbäck Weitoft, H., Haglund, B., Hjern, A., and Rosen, M. Mortality, severe morbidity and injury among long-term lone mothers in Sweden. *Int. J. Epidemiol.*, 31: 573–580, 2002.
- Hemminki, K., Li, X., Plna, K., Granström, C., and Vaitinen, P. The nation-wide Swedish Family-Cancer Database: updated structure and familial rates. *Acta. Oncol.*, 40: 772–777, 2001.
- Hemminki, K., and Li, X. Familial carcinoid tumors and subsequent cancers: a nation-wide epidemiological study from Sweden. *Int. J. Cancer*, 94: 444–448, 2001.
- Hemminki, K., and Mutanen, P. Birth order, family size, and the risk of cancer in young and middle-aged adults. *Br. J. Cancer*, 84: 1466–1471, 2001.
- Esteve, J., Benhamou, E., and Raymond, L. *Statistical Methods in Cancer Res.* IARC Scientific Publication. Lyon: IARC, 1994.
- World Cancer Research Fund. *Food, Nutrition and the Prevention of Cancer: a global perspective.* Washington, DC: American Institute of Cancer Res., 1997.
- Hamilton, S., and Aaltonen, L. (eds.). *Tumours of the digestive system.* World Health Organization Classification of Tumours. Lyon: IARC, 2000.
- Ekstrom, A. M., Serafini, M., Nyren, O., Hansson, L. E., Ye, W., and Wolk, A. Dietary antioxidant intake and the risk of cardia cancer and noncardia cancer of the intestinal and diffuse types: a population-based case-control study in Sweden. *Int. J. Cancer*, 87: 133–140, 2000.
- Kelley, J. R., and Duggan, J. M. Gastric cancer epidemiology and risk factors. *J. Clin. Epidemiol.*, 56: 1–9, 2003.
- IARC. *IARC Monographs. Tobacco smoke and involuntary smoking.* Lyon: IARC, 2003.
- IARC. *Human papillomaviruses.* IARC Monographs on the Carcinogenic Risks to Humans. Lyon: IARC, 1995.
- Zur Hausen, H. Viruses in human cancers. *Eur. J. Cancer*, 35: 1174–1181, 1999.
- Frisch, M., Glimelius, B., van den Brule, A., Wohlfahrt, J., Meijer, C., Walboomers, J., Goldman, S., Svensson, C., Adami, H.-O., and Melbye, M. Sexually transmitted infection as a cause of anal cancer. *N. Engl. J. Med.*, 337: 1350–1358, 1997.
- IARC. *Social Inequalities and Cancer.* IARC Sci Publ. No. 138. Lyon, France: IARC, 1997.
- Hemminki, K., Zhang, H., and Czene, K. Socioeconomic factors in cancer in Sweden. *Int. J. Cancer*, 105: 692–700, 2003.
- Wingo, P., Ries, L., Giovina, G., Miller, D., Rosenberg, H., Shopland, D., Thun, M., and Edwards, B. Annual report to the nation on the status of cancer, 1973–1996, with a special section on lung cancer and tobacco smoking. *J. Natl. Cancer Inst.*, 91: 675–690, 1999.
- Parkin, D., Pisani, P., and Ferlay, J. *Global cancer statistics.* CA Cancer J. Clin., 49: 33–64, 1999.
- IARC (ed.). *GLOBOCAN 2000. Cancer Incidence, Mortality and Prevalence Worldwide.* Lyon, France: IARC Press, 2001.
- Hemminki, K., Li, X., and Czene, K. Cancer risks in first generation immigrants to Sweden. *Int. J. Cancer*, 99: 218–228, 2002.
- Boldeman, C., Branstrom, R., Dal, H., Kristjansson, S., Rodvall, Y., Jansson, B., and Ullen, H. Tanning habits and sunburn in a Swedish population age 13–50 years. *Eur. J. Cancer*, 37: 2441–2448, 2001.

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