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Children, family and cancer survival in Norway

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ABSTRACT

Models for all-cause mortality among 45000 men and women with cancer in 12 different sites were estimated, using register and census data for complete Norwegian birth cohorts. This observed-survival method seemed to be an adequate approach. The results support the idea that women who were pregnant shortly before a breast cancer diagnosis may have a poorer prognosis than others. In principle, such an effect may also reflect that these women have a young child during the follow-up period, and are burdened by that. However, this social explanation can hardly be very important, given the absence of a corresponding significant effect in men and for other cancer sites in women. Breast cancer is different from other malignancies also with respect to the effect of parenthood more generally, regardless of the timing of the pregnancies. On the whole, male and female cancer patients with children experience a lower mortality than the childless, although without a special advantage associated with adult children. This suggests a social effect, perhaps operating through a link between parenthood, life style and general health. No parity effect was seen for breast cancer, however, which may signal that the social effect is set off against an adverse physiological effect of motherhood for this particular cancer. Among men, both marriage and parenthood were associated with a good prognosis. Married male cancer patients with children had a mortality 1/3 lower than that among the childless and never-married. Women who had never married did not have the same disadvantage.

Some studies have addressed the importance of education, social status, or marital status for cancer survival. The results are quite mixed, but, on the whole, the evidence suggests that people who have high education or are married fare better than others when faced with a malignant disease. For example, these groups have been found to have a survival advantage of about one year (as a crude average over many sites) even in the supposedly egalitarian Norwegian society, with a public health care system[1,2]. Because stage at the time of diagnosis has been controlled for in many of these studies, the socio-demographic gradients must be a result of differences in people's health at the time of diagnosis or health behaviour afterwards (so-called 'host factors'), the treatment that is offered, or the patients' ability to make the best out of this treatment. Documentation of such differentials in survival and identification of the casual pathways may, of course, serve as important underpinning for health policy discussions.

There are many possible reasons why marital status may have a bearing on host factors that are crucial for the development of the disease, or on treatment. For example, partners may provide care and other kinds of assistance, add to the socio-economic resources, or exert social control on behaviour. There may also be a selection of healthy people into marriage. In addition, the presence of children is linked with marital status (although to a lesser extent among young cohorts in Nordic countries than in many other populations), and may contribute to the relationship through similar mechanisms. For example, the poor prognosis among the never-married has been suggested to be partly due to a lack of support from or involvement with children. (The divorced and widowed have no partner to rely on either, but may benefit from parenthood, depending on the contact they have with their children.)

Little is actually known, however, about the importance of children for prognosis. Some authors have estimated the effect of the patients' number of children, but the results are mixed, and the reasons for any such effect are poorly understood. The main underlying idea is

that there may be hormonal or other physiological effects of a pregnancy on the malignant development. Hardly any attention has been paid to the possibility that children may be a source of support or for other reasons be linked with a healthier lifestyle or contribute to a more efficient treatment. In accordance with this biomedical perspective, the focus has been on women exclusively. However, one may learn much from taking a look at men as well. If effects are found, and they are similar in men and women, a social or behavioural explanation seems most plausible.

Some studies have also addressed the impact of a pregnancy shortly before diagnosis on cancer survival, and discussed the potential importance of various physiological processes, as well as a possible delay in diagnosis and treatment. However, the fact that patients who were pregnant at this time also have a fairly young child, who may be less of a support than older children and actually very demanding, has been overlooked. Estimates for men would give an impression of the relevance of this explanation.

Many of these studies of reproductive factors as determinants of cancer survival have been on breast cancer, some have been on colorectal cancer or malignant melanoma, and a smaller number on, for example, cervical or ovarian cancer. When searching for possible social effects of childbearing, it is, of course, particularly valuable to consider cancers in other sites than the reproductive organs, and which can occur also in men. In the present study, the survival from 12 common cancers was analysed, for men as well as women. One main objective was to estimate effects of number and age of children and pregnancy shortly before diagnosis, and to compare these effects across sexes. Another goal was to check whether a considerable part of the marital status effects in simpler models could be attributed to such reproductive factors. Some attention was also paid to conceptions after diagnosis and age at first birth. The data were from registers and censuses, and cover complete Norwegian birth

cohorts. Whereas most other studies of reproductive factors and cancer survival have included about 1000 patients or fewer, the Norwegian data include 45000.

MATERIALS AND METHODS

Data

The data file includes life histories up through 1999 for all men and women with a Norwegian identification number (i.e., all those who have lived in Norway for some time after 1960), and is an updated version of the file used in previous studies.[1-3] The socio-demographic biographies have been extracted from the Population Censuses of 1960, 1970, 1980 and 1990 and the Norwegian Population Register, and include information about date of death, all changes in residence 1964-1999, marital status as of 1960 and 1971-1999, and educational level as of 1960, 1970, 1980 and 1990. For those born 1936 or later, there are also complete maternity or paternity histories, i.e. date of birth of each child for which the person is registered as mother or father. These register and census data have been linked with data from the Norwegian Cancer Registry, which from 1960 has recorded information on all cancer cases in the population (site, basis for the diagnosis, histological grade and type, and stage of the disease at the time of diagnosis) along with the personal identification number.

The study was restricted to the 31998 women and 13272 men who were born after 1935 and who were at least 20 years old when they were diagnosed with a first cancer in one of the fol1owing twelve sites between 1960 and 1999: stomach (518 women and 811 men), colon (1795, 1631), rectum (948, 1076), pancreas (354, 437), lung (1552, 2273), breast (12076), cervix(4294), ovary (3544), malignant melanoma (4235, 3268), brain (901, 1292), non-

Hodgkin's lymphoma (984, 1366) or leukaemia (797, 1118). Cancers diagnosed at autopsy were excluded.

These were the most common cancers to die from in the relevant ages and years. There were 8772 deaths to women with these cancers within 10 years of diagnosis, whereas the corresponding figure for men was 6327. Inclusion of patients diagnosed with other types of cancer would have expanded the material by one-third, but without giving appreciably different estimates, according to additional model runs.

The highest age considered was 63, which was attained by the 1936 cohort in 1999.

Models

A discrete-time hazard regression model for all-cause mortality in the selected group of cancer patients was estimated. This is essentially the so-called observed-survival approach, whose limitations are discussed below. Each person contributed a series of one-month observation intervals from the time of diagnosis and up to 10 years onwards, unless death or emigration occurred before that, or until the end of 1999.

The focus was on reproductive variables and marital status. Age, period, cancer site, stage, duration since diagnosis, and education can be considered control variables.

The variables were updated every month, and referred to the situation in that month (parity, age of the children, post-diagnostic conception), the beginning of the calendar year (marital status after 1971), the time of the last previous census, which may be up to 10 years earlier (marital status before 1971 and educational level), or the time of the diagnosis (disease characteristics and the pre-diagnostic conception variable). All covariates were categorical. The categories were defined after extensive experimentation, to make sure that no important patterns were concealed.

To make the comparison between the sexes more relevant, models were estimated also for the sub-group of women diagnosed with a cancer in other sites than the breasts and the reproductive organs. Besides, some models were estimated separately for each site (rather than including interactions with the site variable). These are not shown below, except the one for breast cancer, which is a particularly common malignancy.

Preliminary analysis showed that inclusion of histological grade (when relevant) was unimportant for the estimates in focus, just as in previous studies of cancer survival and social or marital status. Histological type and sub-site were included in some models estimated separately for each cancer site, and this also turned out to have no influence on the crucial estimates.

RESULTS

Effects of reproductive variables, education and marital status are shown in Table 1. Age, period, cancer site, stage, and duration since diagnosis were quite important as control variables, in the sense that that their inclusion had an appreciable influence on the estimates in focus, but their effects were as expected and are not shown. Conversely, educational level turned out to be an unimportant control variable, but the effects are nevertheless shown, because of the considerable research interest in social differentials. The effects of education were very similar to those reported in the abovementioned Norwegian study on social gradients in cancer survival, which was based on a larger number of somewhat older women followed only up to 1991.[1]

(Table 1 about here)

Number of children

Female cancer patients with children had a mortality significantly lower than the childless. (This can be seen from Table 1, first column, where parity effects should be interpreted as the difference between the childless women and those with 1-2 or 3 or more children who had not been pregnant after or less than 4 years before diagnosis and who had no adult child.) There was no difference between those who had 1 or 2 children and those who had more. Having only adult children was not associated with any additional advantage.

When the cancers in the breasts and reproductive organs were excluded, parity effects became somewhat stronger (reaching about 25%; see column 2), and they were very similar to those among men (column 4). An effect of adult children was not seen in these models either.

Models estimated separately for each cancer site gave large standard errors, but a significant beneficial effect of having children nevertheless appeared for many sites for both sexes (not shown). Moreover, the estimates pointed in this direction for most of the other sites. A non-significant harmful effect of childbearing was estimated for ovarian cancer (not shown), and there were only weak indications that childbearing was linked with a good prognosis for breast cancer (column 3). These results for breast cancer and ovarian cancer are consistent with the stronger parity effects estimated when cancers in the breasts and reproductive organs were excluded.

Timing of childbearing relative to diagnosis

When all female cancer patients were considered, those who had conceived a child (who was later born live) 10-24 months before diagnosis showed a relatively high mortality, 26% above that of the reference group. The estimate associated with a pregnancy at the time of diagnosis

was of the same size, but not significant. Models estimated separately for all cancer sites showed a significant effect only for breast cancer (not fully shown). When cancers in the breasts and reproductive organs were excluded, the point estimate suggested a harmful effect of a recent pregnancy, but significance was not attained. For men, there was a strong indication of a relatively good prognosis if they had conceived a child who was still not born at the time of diagnosis. However, the estimate for those who had conceived about a year earlier pointed in the opposite direction.

Women who became pregnant after diagnosis had a much lower subsequent mortality than those who did not. The effect was significant also when the cancers in the breasts and reproductive organs were excluded. A weaker, but still significant, effect was estimated for men.

Marital status

Marital status was included in these models. Otherwise, about 6% sharper effects of childbearing would have been seen for men, while estimates for women would have been largely the same (not shown). Never-married male cancer patients had a 16% higher mortality than the married, and the divorced or separated a 11% higher mortality. Both these differences were significant. The estimates suggested a high mortality also for the much smaller group of widowers, but were not significant. Smaller differences were seen among women. A significant 10-12% excess mortality was found for those who were divorced or separated, while there was no excess mortality for the never-married and widowed.

Effects of being never-married (but not of being formerly married) would have been sharper in the absence of reproductive variables in the models. These simple models revealed an excess mortality of 1.45 (CI 1.34-1.59) for never-married men and 1.14 (CI 1.06-1.23) for

never-married women (not shown). (Except for the very high mortality among never-married men, the effects of marital status in these models were of the same size as those found in the previous Norwegian study, which was based on a larger number of somewhat older women followed only up to 1991.[2])

Combined effects of marital status and parity were also estimated (not shown). Most interestingly, married men with children had a mortality 1/3 lower than that of the childless and never-married.

Age at first birth

The importance of age at first birth was checked in models restricted to parous women. No significant effects appeared for either sex (Table 2). Effects have been seen for breast cancer patients in some previous studies, but did not show up here.

(Table 2 about here)

DISCUSSION

Number of children

Models estimated for all cancer sites combined showed that, even when marital status is taken into account, parenthood is linked with improved prognosis. The difference was found to lie between the childless and those with at least one child. When cancers in the breasts and

reproductive organs were excluded, the effects were very similar in men and women. A simple and plausible interpretation would be that, for these sites, the explanation is purely social. However, one cannot exclude the possibility that the social effect of motherhood actually is sharper than that of fatherhood, because of women's often stronger involvement with children, and that this is outweighed by an adverse physiological effect.

Another interesting observation is that there was no additional beneficial effect of having adult children. This suggests that children are not primarily important as, for example, caregivers or to attract additional treatment resources. A more plausible explanation may be that children tend to induce a healthier life-style in their parents. Conversely, there may be a selection of people with good health or health behaviour into parenthood. A better health at the time of diagnosis, or more advantageous health behaviour afterwards, may in turn be important for prognosis. Another possibility is that those who have children, of any age, are particularly eager to put up a fight when faced with a potentially fatal disease.

Such a beneficial effect of parenthood has not been well established in the literature. The association between fatherhood and men's survival prospects has hardly been addressed at all, whereas the studies on women have provided mixed results. For example, no parity effects were seen in Norwegian[4] and Australian[5] women with colorectal cancer, whereas a Canadian study showed a better prognosis for this kind of cancer among parous than nulliparous women[6]. The evidence from some studies of other cancer sites has been no less ambiguous.[7-11] Moreover, none of those have seen significant parity effects have taken them as indications of largely social or behavioural mechanisms.

The results for breast cancer were different. No clear parity effects were seen in the Norwegian data. At least, this lack of effect fits with the diverging estimates reported also for this type of cancer in the literature. In a fairly large study of about 5000 Danish women with breast cancer, Kroman et al. [12] only saw very weak indications of a protective effect of

motherhood. Clear parity effects were not seen by Lethaby et al.[13], Schouten et al. [14] or Reeves et al. [15] either. In contrast to this, however, a relatively poor prognosis among American women with at least one child [16] or at least three children [17] has been reported. Similarly, it was found in a Canadian study that the small group of breast cancer patients with five or more children did not fare quite as well as others.[18]

The absence of a parity effect on breast cancer survival in the Norwegian data is likely to reflect a combination of a social effect, which should be just as relevant for this malignancy as for any other, and an opposite physiological effect.

Pregnancy at the time of diagnosis or shortly before

A review by Antonelli et al.[19] concluded that pregnancy-associated breast cancers might tend to be detected relatively late, but that there was little evidence of a poor survival above and beyond that. However, a more recent large Danish study[20] showed that breast cancer diagnosis sooner than two years after birth was associated with a relatively poor prognosis, irrespective of stage. The risk factor was estimated to be about 1.6. A much larger effect was found in a smaller study from the United States.[17]

The present study lends further support to the idea that a pregnancy-associated breast cancer may be particularly harmful. A relatively poor survival was estimated for women with a breast cancer diagnosed 10-24 months after pregnancy. The effect was not very different from that estimated in the Danish study. No effect was seen among those with a pregnancy 2-4 years before diagnosis.

In addition to the possible delay in diagnosis (less relevant explanation here, where stage has been taken into account), and perhaps also delay in treatment, it has been suggested

that effects of pregnancy may be a result of hormonal or immunological changes. Besides, many women who were pregnant shortly before diagnosis breastfeed at the time of diagnosis. Lactation was associated with a relatively poor prognosis in a Canadian study[18], while there were only weak indications in this direction in Norway[21].

In principle, the estimated effect in the present study, as well as in others, may reflect that women who were pregnant at the time of diagnosis or some time before also had a young child during much of the follow-up period. This could perhaps affect prognosis because of the special burdens associated with young children, to be set off against any general social advantage of parenthood discussed above. However, an effect was not seen in men. This does not exclude the possibility of such a social effect in women, but one would at least expect it to show up generally, and not only for breast cancer. The point estimate suggested a harmful effect for malignant melanoma (not shown), which is one of the cancer types that have received most attention from this perspective in the literature, and for all cancers outside the 'female organs' pooled together, but these effects were not significant. (On the whole, there seems to be little support for such a relationship in other studies also.[19,22]) If the effect of a pregnancy shortly before diagnosis is really weak for these cancers, the social contribution to it must also be weak, and it would be reasonable to conclude that the poor prognosis of pregnancy-related breast cancers largely hinges on physiological factors.

Pregnancy after diagnosis

In two Nordic studies, it was shown that women who became pregnant after breast cancer diagnosis had a better prognosis than others[23,24], and it was concluded in a review that it was not harmful for breast cancer patients to get pregnant[25]. A similar conclusion was drawn with

respect to malignant melanoma[22]. The Norwegian data revealed a more general effect for the cancer sites considered, significant for women as well as men.

A suggested also by others, an obvious explanation for such an effect is that only women who feel rather well and perhaps have heard that they have good survival chances (given recorded stage of the tumour at the time of diagnosis) may consider it wise and have the energy to bear a child. Sankila et al.[24] called this a ”healthy mother effect”. This study suggests that there may also be a “healthy father effect”, although perhaps weaker because the burdens placed on the fathers may be smaller. (The confidence intervals overlapped, though) An adverse physiological effect of pregnancy after diagnosis cannot be excluded, of course. In principle, the “healthy mother effect” may be even stronger than suggested by these estimates, but counteracted by hormonal or other physiological effects.

Marital status

In a previous study of the importance of marital status for cancer survival, it was suggested that childbearing was one among several possible intermediate variables (see further discussion elsewhere[2]). The present study confirmed this, in the sense that inclusion of reproductive variables reduced the excess mortality among the never-married cancer patients to half its original size. However, a significant effect remained for men, and divorce was associated with poor survival for both sexes. The higher mortality among divorced female cancer patients than among other patients who were not married may possibly be a result of selection. Whereas family research has shown a number of individual and community characteristics to influence formation and disruption of marriage in a similar way, it is not impossible that there also are some characteristics that are more strongly linked with being

divorced than being never-married, in addition to having a harmful influence on the development of a malignancy. Moreover, one might speculate whether such selection mechanisms differ by sex, because divorced men did not display a particularly high mortality compared to other men without a spouse.

In conclusion, a man seems to benefit from having a wife, as well as from having children (unless these effects are entirely due to selection). This is less obvious for women, whose entry into marriage is not associated with any survival advantage. For them, it is only childbearing that 'confers protection', in addition to the avoidance of divorce.

Models estimated only for the period after 1970, for which there is annual data on marital status, and for ages above 40, when the never-married are a more select group and less likely to be cohabitants, gave very similar effects (not shown).

Age at first birth

Many studies have shown a sharp relationship between age at first birth and the breast cancer incidence, reflecting perhaps hormonal and immunological processes during pregnancy. Some researchers have therefore also checked its prognostic importance, although it is probably less reasonable to expect an effect of processes so far back in time than of the more recent reproductive events.

Kroman et al.[12] reported significantly better breast cancer prognosis among women who had their first child in their 20s than among those who entered motherhood as teenagers. There were also indications of a relatively poor survival among those who started childbearing late. However, in a Canadian[18] and an American[16] study, age at first birth was not found to affect prognosis. Survival effects were not found in Norwegian[4] and Australian[5] studies of colorectal cancer survival either.

In the present study, age at first birth did not have an effect in any model, not even for breast cancer patients. This indicates that future research perhaps should focus less on this and more on other reproductive variables.

The observed-survival approach

Generally, the observed-survival approach employed in this study does not always give a good impression of the aggressiveness of the disease, because some of the deaths may be completely unrelated to the disease. Two alternative approaches have been often used in cancer survival studies: the relative-survival approach (which is a comparison of all-cause mortality in cancer patients with that in the 'normal' population), or the corrected-survival approach (in which it is censored when a death not recorded as due to cancer occurs).

The relative-survival approach is usually based on only age, sex and period variations in 'normal' mortality. In a few extended versions, however, other socio-demographic variations have been taken into account. One set-up that allows for this is the following mixed additive-multiplicative hazard model[26]:

(1) $$\mu = e^{\mathbf{bx}} + y \; e^{\mathbf{cx}} \; e^{\mathbf{dz}},$$

where μ is all-cause mortality, **x** is a vector of socio-demographic co-variates (including age), **b** and **c** are effect vectors, and y is a cancer-diagnosis indicator that takes the value 1 from the time of a cancer diagnosis (if any) and otherwise is 0. The co-variate vector **z** includes various characteristics of the cancer, with no counterparts among people without a cancer diagnosis, and **d** is the corresponding effect vector. For a cancer patient with characteristics **x**, mortality is thus $e^{\mathbf{cx}} \; e^{\mathbf{dz}}$ higher than for a similar individual without such a diagnosis. (This model requires data for a combined sample of patients and other people.)

Taking a wider range of socio-demographic variation in 'normal' mortality into account has been shown by Kravdal[26] to be important for the less aggressive cancers that do not strongly dominate mortality, such as localized prostate cancer, but not when several common cancers are pooled together. In his estimation of such 'overall' marital and educational differentials in survival, he found that one might exclude the corresponding variables from the 'normal' mortality without making any large mistake. In fact, one might omit the 'normal' mortality altogether, and simply estimate an all-cause mortality model for patients. The latter is a continuous-time version of the discrete-time model estimated in the present study.

One might expect the consideration of 'normal' mortality to be even less important in this study that includes younger individuals than in the study by Kravdal referred to above. On the other hand, a somewhat different set of cancer sites have been selected and other socio-demographic variables are in focus. To be on the safe side, results from the discrete-time model for cancer patients were therefore compared with those from model (1). (Models for corrected survival could not be estimated, because there were no data on cause of death.) All the socio-demographic variables could not be included simultaneously in (1) because of software constraints, so a large series of comparisons were made, with different variables left out at the time. The differences in the estimates were always very small.

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REFERENCES

[1] Kravdal Ø. Social inequalities in cancer survival. Population Studies 2000; 54: 1-18.

[2] Kravdal Ø. The impact of marital status on cancer survival. Soc Sci Med 2001; 52: 357-68.

[3] Kravdal Ø. Is the relationship between childbearing and cancer incidence due to biology or lifestyle? Examples of the importance of using data on men. Int J Epidemiol 1995;24:477-84.

[4] Jacobsen BK, Vollset SE, Kvåle G. Do reproductive factors influence colorectal cancer survival. J Clin Epidemiol 1995; 48: 1119-22.

[5] Kune,GA, Kune S, Watson LF. The effect of family history of cancer, religion, parity and migrant status on survival in colorectal cancer. Eur J Cancer 1992; 28A: 1484-7.

[6] Koch M, McPherson TA, Egedahl RD. Effect of sex and reproductive history on the survival of patients with colorectal cancer. J Chron Dis 1982; 35: 69-72.

[7] Hachisuga T, Fukuda K, Hirakawa T, Kawarabayashi T. The effect of nulliparity on survival in endometrial cancer at different ages. Gynecol Oncol 2001;82:122-6.

[8] Salvesen HB, Akslen LA, Albrektsen G, Iversen OE. Poorer survival of nulliparous women with endometrial carcinoma. Cancer 1998;82:1328-33.

[9] Chi DS, Liao JB, Leon LF, Venkatraman ES, Hensley ML, Bhaskaran D, Hoskins WJ. Identification of prognostic factors in advanced epithelial ovarian carcinoma. Gynecol Oncol 2001;82:532-7.

[10] Egan KM, Quinn JL, Gragoudas ES. Childbearing history associated with improved survival in choroidal melanoma. Arch Ophthalmol 1999;117:939-42.

[11] Kravdal Ø, Hansen S. The importance of childbearing for Hodgkin's disease: New evidence from incidence and mortality models. Int J Epidemiol 1996;25:737-43.

[12] Kroman N, Wohlfart J, West Andersen K, Mouridsen HT, Westergaard T, Melbye M. Parity, age at first childbirth and the prognosis of primary breast cancer. Br J Cancer 1998; 78: 1529-33.

[13] Lethaby AE, Mason BH, Harvey VJ, Holdaway IM. Survival of women with node negative breast cancer in the Auckland region. N Z Med J 1996;109:330-3.

[14] Schouten LJ, Hupperets PS, Jager JJ, Volovics L, Wils JA, Verbeek AL, Blijham GH. Prognostic significance of etiological risk factors in early breast cancer. Breast Cancer Res Treat 1997;43:217-23.

[15] Reeves GK, Patterson J, Vessey MP, Yeates D, Jones L. Hormonal and other factors in relation to survival among breast cancer patients. Int J Cancer 2000; 89:293-9.

[16] Mohle-Boetani JC, Grosser S, Whittemore AS, Malec M, Kampert JB, Paffenberger RS. Body size, reproductive factors, and breast cancer survival. Preventive Medicine 1988; 17: 634-42.

[17] Olson SH., Zauber AG, Tang J, Harlap S. Relation of time since last birth and parity to survival of young women with breast cancer. Epidemiology 1998; 9: 669-71.

[18] Lees AW, Jenkins HJ, May CL, Cherian G, Lam EWH, Hanson J. Risk factors and 10-year breast cancer survival in northern Alberta. Breast Cancer Res Treat 1989; 13: 143-51.

[19] Antonelli NM, Dotters DJ, Katz VL, Kuller JA. Cancer in pregnancy: a review of the literature. Part I. Obstet Gynecol Surv 1996;51:125-34.

[20] Kroman N, Wohlfart J, West Andersen K, Mouridsen HT, Westergaard T, Melbye M. Time since childbirth and prognosis in primary breast cancer: population based study. Br Med J 1997; 315: 851-5.

[21] Tretli S, Kvalheim G, Thoresen S, Høst H. Survival of breast cancer patients diagnosed during pregnancy or lactation. Br J Cancer 1988; 58: 382-4.

[22] Katz VL, Farmer RM, Dotters D. Focus on primary care: from nevus to neoplasm: myths of melanoma in pregnancy. Obstet Gynecol Surv 2002;57:112-9.

[23] von Schultz E, Johansson H, Wilking L, Rutqvist LE. Influnce of prior and subsequent pregnancy on breast cancer prognosis. J Clin Oncol 1995; 13: 430-4.

[24] Sankila R, Heinavaara S, Hakulinen T. Survival of breast cancer patients after subsequent term pregnancy: "healthy mother effect." Am J Obstet Gynecol 1994; 170: 818-23.

[25] Surbone A, Petrek JA. Childbearing issues in breast carcinoma survivors. Cancer 1997; 79:1271-8.

[26] Kravdal Ø. A cancer survival model that takes sociodemographic variations in 'normal' mortality into account: comparison with other models. J Epidemiol Commun Health 2002; 56: 309-18.

TABLE 1. Estimated effects (with 95% CI) of reproductive and other socio-demographic variables on mortality among Norwegian cancer patients 1960-1999[a]

	WOMEN		WOMEN, CANCER IN BREASTS, CERVIX AND OVARIES EXCLUDED		WOMEN, BREAST CANCER		MEN	
	Estimate	N	Estimate	N	Estimate	N	Estimate	N
PARITY								
0 child[b]	1	1255	1	641	1	340	1	1416
1-2 children	0.85* (0.78-0.93)	4380	0.78* (0.67-0.88)	2158	0.91 (0.76-1.08)	1319	0.76* (0.68-0.85)	2863
3+ children	0.88* (0.79-0.97)	3137	0.76* (0.66-0.84)	1660	1.02 (0.85-1.23)	863	0.77* (0.68-0.87)	2048
AT LEAST ONE ADULT CHILD								
No[b]	1	3241	1	1611	1	1000	1	2809
Yes	1.01 (0.94-1.09)	5531	1.02 (0.91-1.14)	2848	1.01 (0.89-1.15)	1522	1.07 (0.98-1.17)	3518
A CHILD CONCEIVED BEFORE DIAGNOSIS								
0-9 months before	1.21 (0.89-1.66)	41	1.32 (0.89-1.97)	26	1.28 (0.70-2.34)	11	0.81 (0.65-1.01)	87
10-24 months before	1.26* (1.10-1.43)	259	1.18 (0.97-1.43)	126	1.56* (1.23-1.97)	86	1.12 (0.96-1.32)	181
25-48 months before	1.06 (0.95-1.18)	430	1.01 (0.85-1.19)	183	1.10 (0.93-1.32)	167	1.03 (0.90-1.16)	314
No[b]	1	8042	1	4124	1	2258	1	5745
A CHILD CONCEIVED AFTER DIAGNOSIS								
No[b]	1	8712	1	4418	1	2506	1	6211
Yes	0.45* (0.35-0.59)	60	0.52* (0.38-0.72)	41	0.59* (0.36-0.97)	16	0.71* (0.59-0.87)	116
MARITAL STATUS								
Never-married	1.06 (0.97-1.16)	1006	0.96 (0.84-1.09)	517	1.10 (0.93-1.29)	260	1.16* (1.05-1.28)	1197
Married[b]	1	5997	1	3034	1	1806	1	4120
Divorced/separated	1.10* (1.03-1.17)	1367	1.12* (1.03-1.22)	699	1.08 (0.96-1.21)	346	1.11* (1.03-1.20)	937
Widowed	1.07 (0.96-1.18)	402	0.94 (0.81-1.08)	209	1.33* (1.09-1.62)	110	1.21 (0.95-1.54)	73
EDUCATION								
9 years[b]	1	3259	1	1743	1	757	1	2179
10-12 years	0.91* (0.87-0.96)	4152	0.93* (0.87-0.99)	2091	0.88* (0.80-0.97)	1264	0.91* (0.86-0.97)	3027
13-16 years	0.83* (0.78-0.89)	1233	0.86* (0.78-0.96)	569	0.78* (0.69-0.88)	448	0.84* (0.77-0.91)	815
17- years	0.76* (0.64-0.91)	128	0.81 (0.61-1.06)	56	0.76 (0.57-1.01)	53	0.78* (0.69-0.88)	306

[a] Also age, period, cancer site (except in the breast cancer model), stage, and duration since diagnosis were included in the model. These effects were as expected and can be obtained from the author.
[b] Reference group

* significant at the 0.05 level; N = number of deaths in this group

TABLE 2. Estimated effects (with 95% CI) of age at first birth on mortality among Norwegian cancer patients 1960-1999[a]

	WOMEN		WOMEN, CANCER IN BREASTS, CERVIX AND OVARIES EXCLUDED		WOMEN, BREAST CANCER		MEN	
	Estimate	N	Estimate	N	Estimate	N	Estimate	N
AGE AT FIRST BIRTH (years)								
-19	0.95 (0.88-1.02)	1182	0.93 (0.84-1.03)	628	1.07 (0.92-1.24)	261	1.13 (0.95-1.35)	156
20-22[b]	1	2408	1	1266	1	605	1	981
23-25	0.99 (0.93-1.05)	1915	0.97 (0.88-1.06)	963	1.00 (0.88-1.12)	599	0.98 (0.90-1.06)	1424
26-28	0.94 (0.87-1.02)	1094	0.92 (0.82-1.03)	536	0.88 (0.77-1.02)	358	1.00 (0.92-1.10)	1114
29+	1.01 (0.92-1.11)	917	1.02 (0.90-1.16)	424	1.00 (0.85-1.17)	359	1.00 (0.90-1.11)	1229

[a] Also age, period, cancer site (except in the breast cancer model), stage, duration since diagnosis and the variables shown in Table 1 were included in the models, which were restricted to parous women.
[b] Reference group

N=Number of deaths in this group