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Projected Impact of the Trend toward Delayed Childbearing on Breast Cancer Incidence in the Saarland/FRG

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The protective effect of early age at first birth on breast cancer incidence has been consistently found in many epidemiologic studies [1–3]. Like many other European societies, the Saarland/FRG experienced a «baby boom» in the late 1950ies and early 1960ies which was followed by a sharp decline in fertility rates far below replacement level and a trend toward delayed childbearing during the past decades. It is the aim of this paper to quantify the impact these changes in fertility patterns may have on future breast cancer incidence.

Methods

Estimates of the relative risks of breast cancer associated with age at first birth were adopted from a recent paper by White [2] where median results of 23 studies conducted in Europe and North America [4–22] were presented (see table 1).

Distribution of age at first birth was calculated for non-overlapping 5-year birth cohorts from 1936–40 to 1956–60, whose fertility experience at ages 15–19, 20–24 and 25–29 was examined in five year intervals. This method of birth cohort analysis, first described in another context by Frost [23] and further explained in a more systematic methodological review by Case [24], is illustrated in figure 1: For example, for the cohort born between 1936–40, the proportion of women having their first birth at age intervals «a» was estimated by $5 \cdot B_a^1/F_a$ in 1955 (a = 15–19), 1960 (a = 20–24) and 1965 (a = 25–29), where B_a^1 represents the number of first births to all women born in 1936–40 during the given year, which was abstracted from (unpublished) vital statistics, and F_a represents the number of women in the cohort on December 31 of the given year. Stillbirths of at least 35 cm body length (1955–1975) resp. at least 1000 g birth weight (1980,1985) were also included. In the vital statistics for the Federal Republic of Germany, illegitimate and legitimate births are reported separately. However, no information on birth order is given for illegitimate births, and birth order information for legitimate births is restricted to the current marriage. Assuming the proportion of births of order 2 or higher among illegitimate births and among first births of current marriages being very small for the young ages considered here, the sum of both numbers was taken as total number of first births, which is therefore slightly overestimated. The proportion of women childless at age 30 was calculated as

$$1 - 5 \times \sum_{a = 15\text{–}19}^{25\text{–}29} B_a^1/F_a$$

In addition, projections of the fertility experience of the birth cohorts 1961–65 and 1966–70 were calculated under the assumption that the proportion of women having a first child at age interval «a» among those childless at the beginning of this age interval would remain constant from 1985 to 1995.

Tab. 1. Relative risk of breast cancer due to age at first birth (from reference 2)

Age at first birth	Relative risk
< 20	0.8
20–24	1.0
25–29	1.3
≧ 30 or nulliparous	1.5

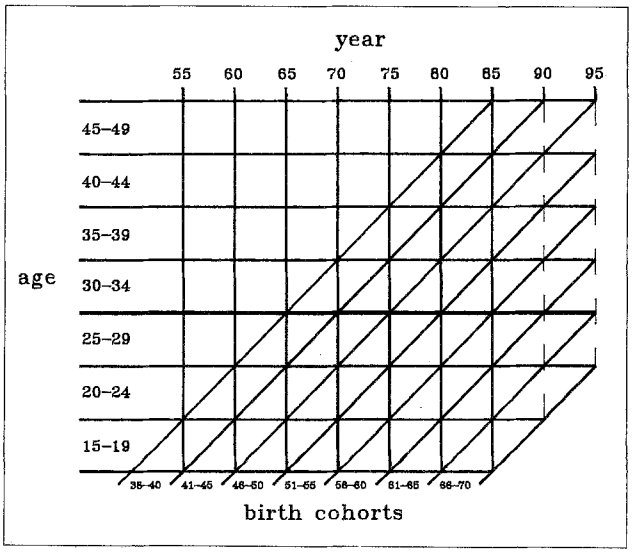

Fig. 1. Principle of analysis of fertility patterns and projections of future breast cancer incidence by birth cohorts

Excess incidence for birth cohorts y = 1941–45 to 1966–70 compared to the 1936–40 cohort was calculated as

$$\left(\sum_{a=15-19}^{\geqq 30} P_a(y)\cdot RR_a \Big/ \sum_{a=15-19}^{\geqq 30} P_a\,(1936\text{–}40)\cdot RR_a\right) - 1$$

where $P_a(y)$ represents the proportion of women in cohort «y» having their first birth at age «a» and RR_a represents the corresponding relative risk (see table 1). This excess incidence is assumed to be independent of age.

Finally, data of the population-based cancer registry of the Saarland, which was in effect since the late 1960ies (25), were used to estimate the cumulative risk of breast cancer before age 50 for the 1936–40 birth cohort as

$$1 - \exp\left(-5 \times \sum_{a=30-34}^{45-49} I_a\right)$$

where I_a represents age-specific incidence rates for ages a = 30–34, 35–39, 40–44 and 45–49 in 1970, 1975, 1980 and 1985 (breast cancer before age 30 is very rare and was neglected here). Cumulative incidence for birth cohorts 1956–60 to 1966–70 was projected based on estimated excess incidence due to changes in fertility experience.

Results

Table 2 illustrates the recent trend toward delayed childbearing (and nulliparity). For example, the estimated proportion of women childless at age 30 rose from 9.4% for the 1936–40 cohort to 32.9% for the 1956–60 cohort, and is projected to rise further close to 40% for later cohorts. There was an initial increase of the proportion of first births before age 20, followed by a later decline, while the proportion of first births at age 20–24 was sharply declining from the 1941–45 to the 1951–55 and later birth cohorts.

Tab. 2. Distribution of age at first birth, estimated excess incidence of breast cancer due to changes in fertility experience (E.I.), and cumulative incidence before age 50 (C.I.)

	Age at first birth					
Cohort	15–19	20–24	25–29	≧30[1]	E.I.	C.I.
1936–40	9.5%	55.7%	25.4%	9.4%	0.0%[2]	1.52%
1941–45	15.7%	54.7%	18.2%	11.4%	− 2.2%[3]	1.49%[3]
1946–50	12.4%	43.5%	21.2%	22.9%	+ 4.4%[3]	1.59%[3]
1951–55	16.2%	29.2%	26.6%	27.6%	+ 7.4%[3]	1.63%[3]
1956–60	10.7%	30.2%	26.2%	32.9%	+10.6%[3]	1.68%[3]
1961–65	8.6%	24.3%	29.7%[3]	37.4%[3]	+14.0%[3]	1.73%[3]
1966–70	5.8%	25.0%[3]	30.7%[3]	38.5%[3]	+15.3%[3]	1.75%[3]

[1] or nulliparous
[2] reference cohort
[3] projected

The 1941–45 cohort showed the most favourable pattern of fertility with regard to breast cancer incidence. There is, however, a steady and substantial increase in the estimated excess incidence due to the trend toward delayed childbearing in all younger birth cohorts. Compared to the women born around 1940, excess incidence is estimated as about + 15% for women born in the 1960 ies. The cumulative incidence of breast cancer before age 50 was 1.52% for the 1936–40 cohort and is projected to rise from 1.49% for the 1941–45 cohort to 1.75% for the 1966–70 cohort.

Discussion

The projections presented in this paper are based on the implicit assumption, that the association between age at first birth and breast cancer incidence is causal, which, as a result of the consistent findings in numerous controlled studies, is widely accepted [2, 3]. In case the association was not causal, but due to an unidentified confounder, the projections might still be valid, if the prevalence of this potential confounder, which by definition would have to be correlated with fertility experience [26], was subject to similar time trends as observed for age at first birth during the past decades. It has also been assumed that the association between age at first birth and risk of breast cancer applies to women of all ages which is consistent with published results [1].

The problem with the use of vital statistics data, which inevitably caused a slight overestimation of the proportion of first births before age 30, has been mentioned above. Given the small proportion of illegitimate births of little over ten percent in FRG, the vast majority of which are likely to be first births, and an average age of divorced women at second marriage of about 35 years [27, p 71], the distortion of the age distribution should be very small. Furthermore, as the distortion applies to all birth cohorts, the potential bias does to some degree cancel out in the calculation of excess incidence. Even if 10% of all births classified as first births here were truly births of higher order, the expected cumulative incidence up to age 50 for the 1966–70 cohort would still be as high as 1.72% (compared to 1.75% if there was no misclassification and 1.52% in the 1936–40 cohort). Another limitation of the use of vital statistics was that sufficiently detailed fertility information was not provided before 1955. On the other hand, vital statistics, almost universally collected data, are a useful tool to estimate distribution of age at first birth in the absence of detailed fertility surveys, which also often suffer from problems such as recall bias or selective survival.

Changes in risk factors other than age at first birth (most of which are still very controversial) may further modify future breast cancer incidence rates. The projections presented here quantify the expected increase in incidence due to the delay in childbearing alone: Compared to the birth cohorts around 1940, the projected attributable increase for the large «baby boom»

birth cohorts of the late 1950ies and 1960ies is in the range of 10 to over 15%, indicating a substantial public health impact in both relative and absolute terms, which is worth to be taken into account in health policy decisions such as the implementation of screening programmes.

Breast cancer has been the most common cancer in females in the Saarland since the beginning of population based registration in the late 1960 ies. A substantial increase in age specific breast cancer incidence rates in birth cohorts preceeding the cohorts considered here has been observed, as can be seen from figure 2. If this trend which is likely to be due to causes other than fertility patterns will continue, it will further add to the projected rise of breast cancer incidence due to delayed childbearing.

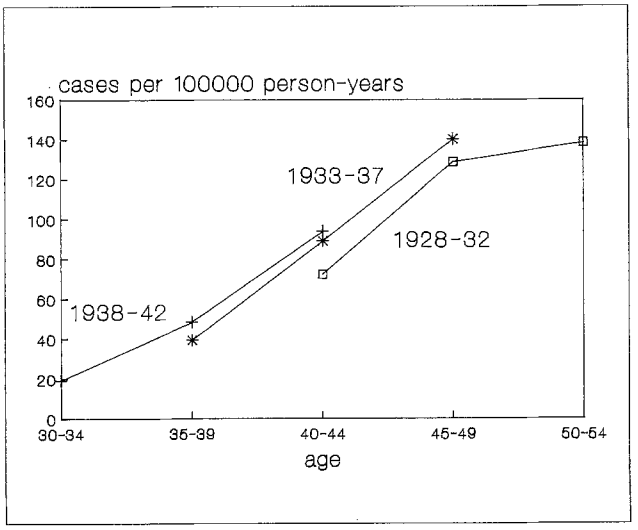

Fig. 2. Birth cohort and age specific breast cancer incidence in the Saarland 1968–87

The patterns of fertility of the Saarland and other parts of FRG have shown very similar trends in the past (see table 3). A comparable impact on breast cancer incidence can therefore be expected for the FRG. Given the steady rise of breast cancer mortality rates in the FRG over the last decades [29, p 16], which, despite a nationwide screening program for almost twenty years, is still ongoing, this stresses the need for more effective screening procedures such as routinely used mammography by trained investigators in the future.

Tab. 3. Crude birth rate (births per 1000 persons) in the Saarland and the FRG 1955–1985. (sources: 27, p. 70, and 28, p. 9)

	Saarland	FRG
1955	18.1	15.7
1960	19.6	17.4
1965	17.9	17.7
1970	11.9	13.4
1975	8.7	9.7
1980	9.8	10.1
1985	9.3	9.6

Summary

The potential impact of the trend toward delayed childbearing or nulliparity on future breast cancer incidence is quantitatively assessed for the Saarland/FRG. Distribution of age at first birth is estimated from vital statistics for seven five-year birth cohorts from 1936–40 to 1966–70. Estimates of the relative risks associated with age at first birth or nulliparity are based on median results of 23 controlled epidemiologic studies conducted in Europe and North America. Compared to the birth cohorts around 1940, a steady increase in incidence up to about +15% is projected for the younger cohorts indicating a substantial public health impact. Using data of the population based cancer registry of the Saarland, the cumulative incidence of breast cancer up to age 50 is calculated as 1.52% for the 1936–40 birth cohort and is projected to rise to 1.75% in the 1966–70 cohort. Similar changes in fertility patterns have been observed in other parts of the FRG. Given the continuing rise in mortality from breast cancer in the FRG this stressses the need for more effective screening procedures.

Résumé

Estimation de l'impact de l'augmentation de l'âge au premier enfant sur l'incidence du cancer du sein dans le Saarland

L'influence d'une première grossesse tardive sur l'incidence du cancer de sein est quantitativement étudiée dans le Saarland. La répartition par âge lors du premier accouchement est estimée pour des groupes de naissance 1936–40, 1941–45, 1946–50, 1951–55, 1956–60, 1961–65 et 1966–70 selon les statistiques démographiques. Les estimations de l'association entre l'âge lors du premier accouchement et le risque de cancer de sein sont basées sur 23 études contrôlées, effectuées en Europe et en Amérique du Nord. Comparé avec les naissances de 1936–40 et 1941–45, l'incidence projetée pour les naissances les plus récentes sera à peu près 15% plus élevée. Le registre du cancer de Saarland montre pour les naissances de 1936–40 une incidence cumulée de cancer de sein jusqu'à l'âge de 50 ans de 1.52%. La valeur projetée pour les naissances les plus récentes est 1.75%. Dans les autres parties de la République fédérale allemande on trouve des modifications semblables dans les taux de fertilité. Etant donné que la mortalité par cancer du sein augmente, un programme de prévention efficace doît être mis sur pied.

Zusammenfassung

Projektion des Effekts veränderter Fertilitätsraten auf die Brustkrebsinzidenz: eine Studie aus dem Saarland

Der mögliche Einfluss des Trends hin zu späterer Erstgeburt bzw Nulliparität auf die künftige Brustkrebsinzidenz wird für das Saarland quantitativ untersucht. Die Verteilung des Alters bei der Erstgeburt wird aus Vitalstatistiken für sieben 5-Jahres Geburtskohorten von 1936–40 bis 1966–70 geschätzt. Die Schätzungen des Zusammenhangs zwischen Alter bei der Erstgeburt und Brustkrebsrisiko beruhen auf 23 in Europa und Nordamerika durchgeführten kontrollierten epidemiologischen Studien. Im Vergleich zu den Geburtskohorten um 1940 liegt die projizierte künftige Inzidenz jüngerer Geburtskohorten um bis zu 15% höher. Aus den Daten des bevölkerungsbezogenen Krebsregisters des Saarlands ergeben sich eine kumulative Brustkrebsinzidenz bis zum 50. Lebensjahr von 1.52% für die Geburtskohorte 1936–40 und projizierte Werte bis zu 1.75% für die jüngeren Geburtskohorten. Die übrige Bundesrepublik erlebte vergleichbare Veränderungen des Gebärverhaltens. Vor dem Hintergrund anhaltend steigender Mortalitätsraten an Brustkrebs sollte die Entwicklung eines effektiveren Vorsorgeprogramms dringend forciert werden.

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