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Injury deaths, suicides and homicides associated with pregnancy, Finland 1987–2000

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Background: Only few studies have been carried out on the relationship between pregnancy and deaths from external causes. **Methods:** Information on deaths from external causes among women aged 15–49 years in Finland in 1987–2000 ($n = 5299$) was linked to three national health registers to identify pregnancy-associated deaths ($n = 212$). **Results:** The mortality rate for women during pregnancy and within 1 year of pregnancy termination from external causes was lower than mortality from external causes among non-pregnant women (relative risk 0.79; 95% confidence interval 0.69–0.91). Owing to elevated suicide and homicide rates, however, an increased risk was observed for women after abortions, especially in the age group of 15–24 years. **Conclusions:** The low rate of deaths from external causes suggests the protective effect of childbirth, but the elevated risk after a terminated pregnancy needs to be recognized in the provision of health care and social services.

Keywords: birth, external cause of death, induced abortion, register linkage study, spontaneous abortion

By definition, maternal deaths as defined by the International Classification of Diseases (ICD), 9th and 10th revisions, do not include accidental or incidental deaths.[1,2] To obtain a broader view of causes of death during and after pregnancy, the Centers for Disease Control and the American College of Obstetricians and Gynecologists have introduced the definition of pregnancy-associated death. This category includes all deaths occurring among pregnant women or within 1 year of the termination of the pregnancy, irrespective of the cause of death or site of pregnancy.[3]

Previous studies have shown that deaths are less frequent after a birth than among non-pregnant women. However, compared with the year after birth, the risk for a pregnancy-associated death is higher after a spontaneous abortion or an induced abortion.[4,5] The few studies on pregnancy-associated deaths from external causes, i.e. deaths due to unintentional accidental or intentional injury, have only included suicides[6] or motor vehicle traffic accidents.[7]

Our aim was to investigate pregnancy-associated mortality from external causes by using data collected from several Finnish administrative registers. Mortality rates were calculated separately for deaths after live or stillbirths, deaths after spontaneous abortions and ectopic pregnancies, and deaths after induced abortions. We then compared these age-adjusted mortality rates by cause (unintentional injury, suicide and homicide) during pregnancy and the year following pregnancy with the mortality rate among non-pregnant women.

Methods

All the 5299 deaths from external causes involving ICD 9 codes E800–E999 or ICD 10 codes V00–Y98 among women of reproductive age (15–49 years), between 1987 and 2000, were identified from the Finnish Cause-of-Death Register. The register contains data from the death certificates written either by the physician who took care of the patient or by the physician performing the autopsy. All death certificates are checked by a physician in the provincial government and by medical experts at Statistics Finland. The register is believed to include comprehensive information on all deaths of Finnish citizens and permanent residents who died in Finland, and at least basic information on deaths of Finnish citizens that occurred abroad. Information on deaths of visitors to Finland and other non-permanent residents, however, is not collected.

Information from the death register was linked to the following three health care registers, all of which are maintained by the National Research and Development Centre for Welfare and Health (STAKES).

Medical Birth Register

All live births and stillbirths with a gestational age of at least 22 weeks or with a birth weight of at least 500 g are included in the register. Less than 1% of all deliveries are missing from the Medical Birth Register, but information on those deliveries is obtained from the Central Population Register and the Cause-of-Death Register. After data linkage, the Medical Birth Register is considered complete in terms of numbers of births and newborns. Two data quality studies found that the majority of the content of the Register corresponded well or satisfactorily with the hospital record data.[8]

Register on Induced Abortions

This register collects data on all induced abortions performed in Finland. According to the national legislation, a permit is needed to terminate a pregnancy, and notification that a termination has been performed must be sent to STAKES within 1 month of the procedure. A 1993 data quality study showed that >99% of induced abortions listed in hospital records were reported to the register, and that for most variables, agreement existed between the register data and the hospital record.[9]

Hospital Discharge Register

This register collects information for all in-patient episodes in health-care institutions using ICD codes (ICD 9 in 1987–1995 and ICD 10 in 1996–2000), and is the major source of

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information on pregnancies ending in spontaneous abortion and ectopic pregnancies. According to a data quality study conducted in 1986, which compared register information and hospital records, 95% of hospitalizations were registered and 97% of main diagnoses concerning pregnancy, birth and puerperium were correctly reported at the three-digit ICD code level.[10] A death that occurred during pregnancy or after a spontaneous abortion or an ectopic pregnancy is included in the register only if the woman was hospitalized. Approximately 75% of spontaneous abortions and ectopic pregnancies are treated in hospitals.[11]

The different registers were linked using women's unique personal identification numbers as keys. The ethics committee at STAKES approved the study protocol. Separate permits to use administrative register data were received from STAKES, Statistics Finland and the Data Protection Authority.

During the study period, the data sources included information on 865 988 live births or stillbirths, 156 789 induced abortions, and 118 490 spontaneous abortions or ectopic pregnancies. In total, 212 deaths were identified in which the woman was pregnant or had been pregnant within 1 year before her death.

Deaths from external causes were further divided into: deaths due to unintentional injury (ICD 9 E800–E949 and E970–E999; ICD 10 V00–X59 and Y10–Y98); suicides (ICD 9 E950–E959; ICD 10 X60–X84); and homicides (ICD 9 E960–E969; ICD 10 X85–Y09).

Time trends were studied by dividing the study period into three periods: (i) 1987–1990; (ii) 1991–1995; and (iii) 1996–2000.

Pregnancy-associated mortality from external causes was calculated per 100 000 total pregnancies. Separate calculations were made for deaths that occurred after births (either after a live birth or stillbirth), including deaths during pregnancy; after spontaneous abortions and ectopic pregnancies; and after induced abortions. These mortality calculations were then compared with the mortality per 100 000 person-years among the non-pregnant population of women of reproductive age. The mortality rates and risk ratios were age-adjusted using the age distribution for all pregnant women.

Differences between groups were tested using the χ^2-test, the *t*-test, the test for relative proportions and Fisher's exact test. Standardized mortality ratios or risk ratios with 95% confidence intervals (CIs) were calculated by dividing the mortality rate among women who were or had been pregnant within the preceding year by the mortality rate among women who had not been pregnant within the preceding year. Ratios were also calculated for women who had died following a specified pregnancy outcome.

Results

Of the 212 observed pregnancy-associated deaths, eight occurred during pregnancy (3.8%), 81 after a birth (34.4%), 39 after a spontaneous abortion or ectopic pregnancy (18.4%), and 92 after an induced abortion (43.4%). Of the deaths, 178 (84.0%) occurred between 43 and 365 days after the termination of pregnancy. The proportion of accidental deaths was the highest among women who had a recent induced abortion (72.5%) or a spontaneous abortion (60.6%). This share was substantially lower among pregnant women or women with a recent childbirth (37.5%) and among non-pregnant women (33.5%).

When compared with non-pregnant women, mortality from external causes was significantly lower for all pregnant women and after a birth (for both, $P < 0.001$), but was higher after a spontaneous abortion or ectopic pregnancy ($P = 0.043$) or after an induced abortion ($P < 0.001$) (table 1). Significantly decreased mortality rates after a birth were observed for deaths due to unintentional injury, suicide and homicide. These cause-specific mortality rates did not differ between deaths among women who had experienced a spontaneous abortion and non-pregnant women, but they were all elevated after an induced abortion ($P < 0.001$ for each cause).

During the study period, mortality from external causes declined for all pregnant women ($P = 0.003$) and for women after a birth ($P = 0.006$) (table 2). For induced abortions, the mortality rate decreased significantly between 1991–1995 and 1996–2000 ($P < 0.001$), mainly as a consequence of the decreased rate of deaths due to unintentional injury ($P = 0.061$) and suicides ($P = 0.010$).

The mortality rate from unintentional injuries was lower among women giving birth than among non-pregnant women in all age groups ($P < 0.001$). However, statistically significantly lower suicide rates were observed only among women younger than 35 years and lower homicide rates only among women aged 25–34 years (table 3). After a spontaneous abortion or an ectopic pregnancy, increased mortality rate from suicides and homicides was observed for women aged 15–24 years. After induced abortion, pregnancy-associated mortality rates were higher from all three causes compared with the mortality among non-pregnant women in all age groups, although some of the differences were statistically non-significant.

Discussion

The risk of pregnancy-associated death from external causes was one-fifth lower than the corresponding mortality among non-pregnant women of reproductive age, but the risk differed

Table 1 Pregnancy-associated mortality per 100 000 pregnancies and mortality among non-pregnant women per 100 000 person-years from external causes by cause of death and by pregnancy outcome

	Pregnancy-associated mortality				Mortality among non-pregnant women, age-adjusted crude (*n*)
	Pregnancy or birth (*n*)	Spontaneous abortion or ectopic pregnancy (*n*)	Induced abortion (*n*)	Total (*n*)	
All external causes	(82) 9.6***	(39) 34.6*	(92) 60.0***	(212) 19.1***	(5087) 24.2 29.9
Unintentional injuries	(32) 3.9***	(15) 14.3 NS	(30) 20.4***	(77) 7.3***	(2431) 10.8 14.7
Suicide	(43) 5.0***	(19) 16.0 NS	(50) 31.9***	(112) 9.8 NS	(2177) 11.8 13.3
Homicide	(6) 0.7**	(5) 4.2 NS	(12) 7.7***	(23) 2.0 NS	(380) 2.1 2.3

Test of relative proportions compared with the age-adjusted mortality among non-pregnant women: NS: not significant; NA: not applicable
***$P < 0.001$; **$P < 0.01$; *$P < 0.05$

Table 2 Pregnancy-associated mortality per 100 000 pregnancies and mortality among non-pregnant women per 100 000 person-years by time period and pregnancy outcome, external causes only

Period	Pregnancy-associated mortality				Mortality among non-pregnant women, age-adjusted crude (*n*)
	Pregnancy or birth (*n*)	Spontaneous abortion or ectopic pregnancy (*n*)	Induced abortion (*n*)	Total (*n*)	
1987–1990	(32) 13.5	(13) 38.3	(28) 59.2	(73) 23.0	(1466) 25.9 31.2
1991–1995	(31) 9.6	(16) 39.3	(40) 75.4	(87) 20.9	(1905) 26.0 32.1
1996–2000	(18) 6.2	(10) 25.8	(24) 45.2	(52) 13.6	(1716) 23.1 28.6
Test for trend	**	NS	NS	**	**

Test of trend comparing data for the period 1987–1990 with data for the period 1996–2000: NS: not significant
$^{**}P < 0.01$

Table 3 Pregnancy-associated mortality per 100 000 pregnancies and mortality among non-pregnant women per 100 000 person-years, by causes of death, age group and pregnancy outcome, external causes, Finland, 1987–2000[a]

	Mortality rate per 100 000 pregnancies					Mortality risk ratio (95% CI)	
	Pregnancy or birth	Spontaneous abortion or ectopic pregnancy	Induced abortion	Total	Non-pregnant women	All pregnancy-associated deaths	Non-pregnant women
Unintentional injuries (*n*)	32	15	30	77	2431		
Age-adjusted	3.7***	13.3 NS	16.3***	6.7***	10.8	0.62 (0.49–0.78)	1.0
15–24 years	2.3***	19.5 NS	28.1 NS	10.2 NS	10.4	0.92 (0.62–1.35)	1.0
25–34 years	3.8***	12.4 NS	13.9***	5.4***	8.5	0.55 (0.39–0.77)	1.0
35–49 years	5.4***	8.7 NS	9.7***	6.6***	18.8	0.34 (0.20–0.59)	1.0
Suicides (*n*)	43	19	50	112	2177		
Age-adjusted	5.5***	16.6 NS	33.8***	9.9 NS	11.8	0.84 (0.69–1.01)	1.0
15–24 years	2.3*	24.3**	28.1***	10.6*	6.7	1.47 (1.00–2.17)	1.0
25–34 years	4.1***	13.9 NS	33.1***	7.5***	10.7	0.61 (0.46–0.81)	1.0
35–49 years	13.1 NS	14.5 NS	37.7**	17.3 NS	16.7	1.01 (0.72–1.42)	1.0
Homicides (*n*)	6	5	12	23	380		
Age-adjusted	0.8**	4.4 NS	8.0***	2.0 NS	2.1	0.95 (0.62–1.46)	1.0
15–24 years	1.1 NS	9.7**	8.9***	3.8**	1.5	2.43 (1.25–4.74)	1.0
25–34 years	0.5*	3.1 NS	7.0*	1.3 NS	1.9	0.62 (0.31–1.22)	1.0
35–49 years	0.8 NS	2.9 NS	6.3 NS	2.0 NS	2.7	0.73 (0.27–1.96)	1.0
All external causes[b] (*n*)	81	39	92	212	5087		
Age-adjusted	10.2***	35.3*	60.3***	19.1***	24.2	0.79 (0.69–0.91)	1.0
15–24 years	6.2***	53.5***	65.1***	24.9 NS	18.4	1.27 (0.99–1.63)	1.0
25–34 years	8.6***	31.0 NS	57.5***	14.9***	21.2	0.61 (0.49–0.74)	1.0
35–49 years	36.2 NS	49.3 NS	40.9 NS	39.3 NS	38.0	0.99 (0.79–1.24)	1.0

a: age-adjustment done by using the age distribution of all pregnant women during the whole study period
b: including deaths for which the cause of death by injury remained unclear
Comparison with non-pregnant women: NS: not significant
$^{***}P < 0.001$; $^{**}P < 0.01$; $^{*}P < 0.05$

according to cause of death, age and the outcome of pregnancy. Our data and study methodology have been shown to be reliable, and no evidence on deteriorated validity regarding the utilized administrative registers has been reported.[4,5,8–10,12] Furthermore, it is unlikely that the change from ICD 9 to ICD 10 classification in Cause-of-Death registration would affect our conclusions, since the mortality rates were analysed in broad categories.

The age-adjusted mortality rates for deaths due to unintentional injuries, suicide and homicide were significantly lower after giving birth than among non-pregnant women, as has been reported previously.[13] Such an effect was not observed after a spontaneous abortion or ectopic pregnancy, and, in fact, the suicide and homicide rates for women younger than 25 years old were higher than those among non-pregnant women.

In the year after undergoing an abortion, a woman's mortality rate for unintentional injuries, suicide and homicide was substantially higher than among non-pregnant women in all age groups combined. While these findings were not statistically significant for deaths resulting from unintentional injuries among women younger than 25 years old and for homicides among women aged 35 years or older, the increased risk was observed for unintentional injuries at all ages. It is unlikely that induced abortion itself causes death due to injury; instead, it is more likely that induced abortions and deaths due to injury share common risk factors.[6] Our register-based data were incomprehensive on these kind of variables, and more detailed background information for example on mental health, social well-being, substance abuse and socio-economic circumstances among the deceased would be necessary for further analysis.

Mortality from external causes decreased much more among recently pregnant women (–41%) than among non-pregnant women (–8%) during the study period. This decrease was the largest for pregnancy-associated deaths after giving birth between the late 1980s and the late 1990s and for deaths after an induced abortion between the early and late 1990s. General improvement in health care and social services may explain the development after a birth, but the situation is more complicated for deaths in the year after an induced abortion.

Changes in the characteristics of women having an induced abortion may help provide an explanation. During the study period, the general rate for induced abortions per 1000 women aged 15–44 years initially decreased significantly from 12 to less than nine in the mid-1990s, but then leveled off at 10 in the late 1990s.[14] The evolution differed by age: the rate of induced abortions among women aged 19 years and younger who, in general, have a relatively low mortality from unintentional injuries, increased, whereas for women aged 20 years or older the rates were more stable. At the same time, a significant increase occurred in the number of non-Finnish-born women in the population, especially women coming from the Russian Federation and the Baltic States, all of which have traditionally had more induced abortions.[15] Since the Finnish Abortion Register does not gather information on women's ethnicity or nationality, we were unable to evaluate the effect of this demographic change. The preliminary results from a register study suggest, however, that non-Finnish women have a lower percentage of teenage induced abortions than do Finnish women.[16]

Beginning in the mid-1990s, some studies reported that the check-up recommended to occur a few weeks after an induced abortion was often omitted.[17] Because no information exists on recent abortion practices, we could not evaluate the effect of this observation. The new recommendation for post-induced abortion care, however, includes the statement that a check-up visit is necessary in order to detect signs of depression and to identify the rare cases of psychosis after an induced abortion.[18] We highly recommend that such a check-up be made routine practice in all other countries where it has not yet been included in the current care practice scheme.

A recent study reported that trauma is now the leading cause of pregnancy-associated deaths in the USA.[19] One way to decrease the number of pregnancy-associated deaths due to injury is to improve traffic safety. A recent US study reported that alcohol was involved in 45% of pregnancy-associated motor vehicle accidents and that 77% of the victims had not used seatbelts.[7]

The recent US study also showed that pregnant women have an 11% higher risk of homicide than do non-pregnant women,[19] and the UK confidential enquiry data showed that 12% of the women had voluntarily reported to a health care professional that they had experienced violence during their pregnancy. Furthermore, 80% of schoolgirls or women younger than 18 years experienced violence in the home.[20] These statistics indicate the importance of action to decrease violence against women, including during pregnancy and after its termination, in order to ensure a safe environment for reproduction.

Key points

- Information on deaths from external causes was linked to three national health registers to identify pregnancy-associated deaths.
- Mortality rates from unintentional injuries, suicides and homicides were lower among women giving birth than among non-pregnant women.
- Mortality rates after an induced abortion were higher from all external causes compared with the mortality among non-pregnant women.
- Increased suicide and homicide rates were observed for women aged 15-24 years with a recent spontaneous abortion or an ectopic pregnancy.
- Elevated mortality risk after a terminated pregnancy has to be recognised in the provision of health care and social services.

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