RESEARCH REPORT

Does parity affect mortality among parous women?

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Objective: To find out whether there is an association between parity and mortality.

Design: Prospective cohort study.

Setting: Northern Finland, 1966–2001.

Participants and methods: 12 055 women in the two northernmost provinces of Finland were followed up from pregnancy in 1966–2001, the coverage percentage being 96%. The data on age, smoking, body mass index, socioeconomic position, age at menarche and age at first birth were collected during pregnancy, and data on deaths were obtained from the National Cause of Death Statistics, maintained by Statistics Finland. The Cox proportional hazard model was used to estimate relative mortality between parity groups.

Results: Total mortality was lowest among the women with 2–4 children (reference group). High parity was associated with an up to twofold risk of mortality from vascular complications, but after adjustment for all background factors, this significance disappeared. Mortality from haemorrhagic stroke was fourfold higher among the women with ≥ 10 births compared with those of the reference group. No differences in cerebral infarction or total cancer mortality were seen between the groups. Primiparity was associated with increased mortality from accidental death (relative risk 2.6, 95% confidence interval 1.6 to 4.4).

Conclusions: High parity was associated with an increased risk of mortality from vascular complications, especially haemorrhagic stroke, and primiparity with an increased risk of accidental death.

Reproductive factors, such as parity and age at first birth, are considered to have long-term effects on women's health. Only a few previous studies dealt with the association between parity and mortality, and their results have been inconsistent. Most of these studies have found a positive association between parity and mortality from cardiovascular and cerebrovascular diseases.^{1–4} However, Steenland *et al*⁵ suggested that these findings may be due, at least in part, to confounding by unmeasured variables related to socioeconomic position. On the other hand, an inverse association between parity and total cancer mortality has been observed.³ As far as we know, previous studies on the effect of parity on total mortality have been unable to control for smoking, body mass index (BMI (weight (kg)/height² (m²))), age at menarche and age at first birth.

Our aim was to study the effect of parity on rates and causes of mortality in a general population of parous women in Finland, taking into account socioeconomic characteristics, smoking and reproductive history. Our *a priori* hypothesis was that multiparity is positively associated with an increased risk of mortality.

MATERIALS AND METHODS

The Northern Finland 1966 Birth Cohort consisted of 12 055 pregnant women with expected dates of delivery in 1966, covering 96% of all deliveries in the region.⁶ The population consisted exclusively of Caucasian women, who were recruited on normal visits to antenatal clinics between the 24th and 28th gestational weeks, when 90% of women filled out a questionnaire including data on parity, sociodemographical and other background factors. The rest of the women completed the same questionnaire later during their pregnancy or soon after delivery.

Every citizen in Finland has a unique personal identification number provided by the Population Registration Centre, since 1967. The identification number was traced for 11 997 (99.5%) women of the cohort. The records for the cohort were linked with the files of Statistics of Finland, to obtain the

dates and causes of death by 30 November 2001. In Finland, 70% of deaths take place in hospitals, and the autopsy rate is 31%.⁷ Reliability regarding the causes of death listed in the national cause-of-death files was deemed adequate for our purposes.⁴

The causes of death were obtained for 97.1% of the study population from the national Cause of Death Statistics, maintained by Statistics Finland, and divided into five main categories according to the International Classification of Diseases 8th–10th revisions

1. cardiovascular diseases, such as hypertensive disease and coronary heart disease, including myocardial infarction (I00–I99)
2. cerebral infarction, including occlusions and stenosis of cerebral arteries (I63 and I65–I66)
3. haemorrhagic stroke (I60–I62)
4. malignant diseases (C00–C97)
5. accidental deaths (injuries and violence, including suicides, V01–Y89).

The final number of births was obtained for 12 002 (99.6%) women, from the 1-year and 14-year follow-up questionnaires of their children using the Northern Finland 1966 Birth Cohort. The women were divided into four parity groups, as generally used in the literature: those with 1, 2–4, 5–9 and ≥ 10 deliveries.^{8,9}

BMI was calculated on self-reported pre-pregnancy weight (kg) divided by height squared (m²) in 1966, and classified as: normal and lean (<25.0 kg/m²), overweight (25.0–29.9 kg/m²) and obese (≥ 30.0 kg/m²). The women were classified for socioeconomic position according to the occupation of the husband or the woman herself, if single, in 1966, into the following categories: white collar, blue collar, unskilled workers (missing values included in the analyses) and farmers. Smoking habits were recorded at

Abbreviation: BMI, body mass index

antenatal clinics in 1966, by asking each woman whether she had been a regular smoker (smoking at least one cigarette a day) or a non-smoker during the 12 months preceding the pregnancy. Data on menarche and age at first birth were also collected using the questionnaire during pregnancy.

Statistical methods

The number of deaths and person-years at risk were calculated for different causes of death by parity. Person-years were calculated from the delivery in 1966 until death or until 30 November 2001. There was no censoring between this period. Age-standardised mortality was calculated as follows: person-years and number of deaths were calculated for each parity group and age category (standardised mortality was achieved by weighted average of age group-specific incidences, which are weighted by each age group's proportion of whole cohort's person-years.) For each cause of death, the Cox proportional hazard model was used to estimate relative mortality between the parity groups. Possible confounders, such as age, BMI, smoking, socioeconomic position, age at menarche and age at first birth, were included in the model.

RESULTS

The numbers of women in the different parity groups in the whole cohort ($n = 12\,002$) were 746 (6%) primiparous, 7913 (66%) with 2–4 deliveries, 2825 (24%) with 5–9 deliveries and 518 (4%) with ≥ 10 deliveries. Table 1 shows the background characteristics of women according to the different parity groups. The mean age of the women at enrolment in 1966 was 27.8 years. The age range of the women alive at the end of 2001 was 49–83 years. High socioeconomic position was most common in the two lowest parity groups. The prevalence of obesity (BMI ≥ 30.0) was 50% higher in the women with ≥ 10 children compared with the primiparous

women. Smoking was most common in the lowest parity group.

Of the whole study population, 1075 (8.9%) women had died by 2001. Table 2 shows the causes and numbers of deaths, and age-adjusted mortality in the different parity groups. The age-adjusted mortality was the lowest among the women with 2–4 children, which was used as a reference group.

In the fully adjusted model (adjusted for age, BMI, smoking, socioeconomic position, age at menarche and age at first birth), primiparous women had a 40% higher total mortality risk than those of the reference group (relative risk (RR) 1.4, 95% confidence interval (CI) 1.0 to 1.9; table 3). Women with ≥ 10 deliveries had a slightly higher total mortality risk than those of the reference group, but after controlling further for age at menarche and age at first birth, significance disappeared (RR 1.2, CI 0.9 to 1.6; table 3).

Cardiovascular mortality increased with increasing parity (table 2), being 60% higher (RR 1.6, 95% CI 1.0 to 2.6) in the highest-parity group compared with those of the reference group after adjustment for age, BMI, smoking and socioeconomic position (table 3). However, after the inclusion of age at menarche and age at first birth in the model, significance disappeared (RR 1.4, 95% CI 0.8 to 2.4). Mortality from haemorrhagic stroke was fourfold higher among the women with ≥ 10 deliveries compared with the reference group, even after adjustment for all available factors. No significant difference in mortality from cerebral infarction was seen between the groups (table 3).

No difference was seen in total cancer mortality between the parity groups (tables 2 and 3). After adjustment only for age, the risk of breast cancer mortality was twofold in the primiparous women compared with the reference group. However, after controlling for all available background factors, the significance disappeared (RR 1.5, 95% CI 0.6 to 3.6; table 3). The multiparous women with ≥ 10 deliveries

Table 1 Background characteristics of 12 002 women of the Northern Finland 1966 Birth Cohort according to parity

	Final parity				p Value*
	1 (n = 746)	2–4 (n = 7913)	5–9 (n = 2825)	≥ 10 (n = 518)	
Age at menarche†	13.6 (1.6)	13.9 (1.4)	14.4 (1.4)	14.2 (1.5)	<0.001
Age at first birth†	24.0 (5.3)	22.8 (3.8)	22.4 (3.4)	22.2 (2.8)	<0.001
Age in 1966†	24.0 (5.3)	26.1 (5.6)	32.2 (6.5)	35.2 (7.1)	<0.001
Age at death†	50.1 (12.0)	53.9 (10.9)	60.2 (11.2)	65.6 (9.3)	<0.001
Age in 2001†	59.4 (5.0)	61.4 (5.5)	67.2 (6.3)	69.6 (7.2)	<0.001
Socioeconomic position in 1966 (%)					<0.001
White collar	19.8	26.4	16.2	13.3	
Blue collar	42.8	37.1	22.2	17.2	
Unskilled workers	26.1	22.7	26.8	19.5	
Farmers	8.2	12.2	33.9	49.0	
Missing	3.1	1.6	0.8	1.0	
Pre-pregnancy BMI in 1966 (%)					<0.001
<25.0	80.4	76.5	56.7	46.5	
25.0–29.9	9.4	14.1	23.5	28.4	
≥ 30.0	0.9	2.0	7.2	10.2	
Missing	9.2	7.5	12.5	14.9	
Smoking before pregnancy in 1966 (%)					<0.001
No	63.8	74.5	81.4	87.8	
Yes	33.8	23.1	15.9	10.8	
Missing	2.4	2.4	2.7	1.4	
Parity in 1966 (%)					<0.001
1	100.0	36.7	7.1	6.6	
2–4		62.4	29.2	14.3	
5–9		0	62.9	32.1	
≥ 10		0	0	45.2	
Missing data in 1966		0.8	0.8	1.9	

BMI, body mass index.

*Student t test for continuous variables, χ^2 test for categorical variables.

†Age represented in years, as mean (SD).

Table 2 Causes and numbers of death and age-adjusted mortality/100 000 person-years according to parity

Mortality	Final parity				Total
	1	2–4	5–9	≥10	
Person-years	24 509	267 514	97 202	18 451	407 676
All deaths, n	69	549	366	91	1075
Rate	350	225	297	322	264
Cardiovascular disease					
Deaths, n	3	84	97	26	210
Rate	21	37	75	91	52
Cerebral infarction					
Deaths, n	6	36	32	7	81
Rate	11	5	11	17	20
Haemorrhagic stroke					
Deaths, n	2	13	12	4	31
Rate	20	14	32	39	8
Malignant disease total					
Deaths all, n	22	228	137	32	419
Rate	120	94	107	118	103
Breast cancer					
Deaths, n	8	50	21	4	83
Rate	45	20	18	12	20
Gynaecological cancer					
Deaths, n	3	28	13	3	47
Rate	18	12	10	9	12
Colorectal cancer					
Deaths, n	1	20	9	4	34
Rate	7	8	6	17	8
Gastric cancer					
Deaths, n	0	18	7	3	28
Rate	0	7	6	14	7
Other digestive tract cancer*					
Deaths, n	4	30	25	9	68
Rate	23	12	19	30	17
Other tumours					
Deaths, n	6	82	62	9	159
Rate	27	34	49	35	39
Accidents					
Deaths, n	19	83	29	2	133
Rate	82	32	29	6	33
Suicides					
Deaths, n	6	33	8	0	47
Rate	24	13	6	0	12
Other cause					
Deaths, n	15	82	53	20	170
Rate	82	34	42	64	42
Unknown cause					
Deaths, n	2	23	6	0	31
Rate	8	9	5	0	8

*Including oesophageal, liver, gall bladder and pancreatic cancer.

had increased mortality from cancers of the digestive tract, including colorectal and gastric cancers (RR 2.0, 95% CI 1.0 to 3.9, fully adjusted model; table 3).

The risk of accidental death was more than twofold higher among the primiparous women compared with the reference group, and the difference persisted in the fully adjusted model (table 3). A clear decreasing trend in suicide mortality was seen with increasing parity (table 2). The mortality for the group “other causes of mortality” (including, eg, asthma, chronic obstructive pulmonary disease and diabetes) seemed to be higher in the primiparous women and in the highest-parity group.

DISCUSSION

The main findings of our prospective study were that: the total mortality was lowest among women with 2–4 children; high parity was associated with an increased risk of mortality from vascular complications, especially haemorrhagic stroke; and primiparity was associated with an increased risk of accidental death, especially suicide.

Our cohort was drawn from a geographically well-defined source population representative of the general population, consisting of all women giving birth in Northern Finland in

1966, and it was virtually homogeneous with regard to ethnic background, language and religion, and covered all socio-demographic strata. The strength of our study was that we could adjust for smoking and BMI, although the data were available only at the time of birth. The previous studies on the association between parity and mortality have not been able to adjust for these confounders at all except the study by Steenland *et al*,⁵ focusing on mortality from heart diseases. The background characteristics of the women were elicited with a questionnaire during pregnancy in 1966; we thus did not have data on their alcohol consumption and possible changes in smoking habits after the delivery in 1966, which may cause a methodological flaw in this study. However, a woman who does not smoke at age 25 will probably not start smoking at a later age. Owing to the study design, we did not have data on certain cardiovascular risk factors, such as measured blood pressure or blood glucose or lipid values. Most of the previous studies have compared mortality between nulliparous and parous women, but our study design only allowed a study of mortality among parous women. In this study, women with high parity differed significantly from those with lower parity by age at the start of follow-up in 1966 and age at death, the mean difference

Table 3 Mortality according to parity after controlling for age, background factors (BMI, smoking and socioeconomic position), age at menarche and age at first birth in 1075 parous women of the Northern Finland 1966 Birth Cohort

Cause of death	n	Parity	Adjusted for age	Adjusted for age and background factors	Adjusted for age, background factors and age at menarche	Adjusted for age, background factors, age at menarche and age at first birth
Total mortality	1075	1	1.4 (1.2 to 2.0)	1.4 (1.1 to 1.9)	1.5 (1.1 to 1.9)	1.4 (1.0 to 1.9)
		2-4	1.0			
		5-9	1.3 (1.1 to 1.5)	1.3 (1.0 to 1.3)	1.1 (1.0 to 1.3)	1.0 (0.9 to 1.2)
		≥10	1.5 (1.2 to 1.9)	1.3 (1.0 to 1.7)	1.2 (1.0 to 1.6)	1.2 (0.9 to 1.6)
Cardiovascular disease	210	1	0.6 (0.2 to 1.8)	0.6 (0.2 to 1.8)	0.6 (0.2 to 1.8)	0.6 (0.2 to 1.9)
		2-4	1.0			
		5-9	1.6 (1.2 to 2.2)	1.4 (1.0 to 1.9)	1.3 (0.9 to 1.8)	1.1 (0.8 to 1.6)
		≥10	2.1 (1.3 to 3.3)	1.6 (1.0 to 2.6)	1.4 (0.9 to 2.4)	1.4 (0.8 to 2.4)
Cerebral infarction	81	1	2.0 (0.8 to 4.7)	1.9 (0.8 to 4.5)	1.9 (0.8 to 4.5)	1.8 (0.7 to 4.5)
		2-4	1.0			
		5-9	1.8 (1.1 to 3.1)	1.8 (1.0 to 3.1)	1.7 (1.0 to 3.0)	1.5 (0.8 to 2.9)
		≥10	1.4 (0.5 to 3.5)	1.2 (0.4 to 3.4)	1.3 (0.5 to 3.6)	1.4 (0.5 to 4.1)
Haemorrhagic stroke	31	1	1.8 (0.4 to 7.9)	1.8 (0.4 to 8.3)	1.9 (0.4 to 8.4)	1.7 (0.4 to 7.7)
		2-4	1.0			
		5-9	2.2 (0.9 to 5.1)	1.9 (0.7 to 4.7)	1.8 (0.7 to 4.6)	1.5 (0.5 to 4.4)
		≥10	3.8 (1.2 to 12.5)	3.4 (1.0 to 12.1)	3.8 (1.1 to 13.5)	4.1 (1.1 to 15.6)
Total cancer	419	1	1.2 (0.8 to 1.9)	1.1 (0.7 to 1.7)	1.6 (0.9 to 2.8)	1.0 (0.6 to 1.7)
		2-4	1.0			
		5-9	1.1 (0.9 to 1.4)	1.1 (0.8 to 1.4)	1.0 (0.8 to 1.3)	1.1 (0.8 to 1.4)
		≥10	1.3 (0.9 to 1.9)	1.2 (0.8 to 1.8)	1.1 (0.7 to 1.7)	1.2 (0.8 to 1.9)
Breast cancer	83	1	2.0 (1.0 to 4.3)	1.5 (0.7 to 3.6)	1.6 (0.7 to 3.7)	1.5 (0.6 to 3.6)
		2-4	1.0			
		5-9	0.8 (0.5 to 1.4)	0.9 (0.5 to 1.6)	0.9 (0.5 to 1.6)	1.1 (0.6 to 2.0)
		≥10	0.8 (0.3 to 2.2)	0.9 (0.3 to 2.6)	0.9 (0.3 to 2.7)	0.8 (0.2 to 2.8)
Cancer of digestive organs*	130	1	0.9 (0.4 to 2.3)	1.3 (0.5 to 3.2)	0.9 (0.4 to 2.4)	0.8 (0.3 to 2.1)
		2-4	1			
		5-9	1.1 (0.7 to 1.7)	1.0 (0.6 to 1.5)	0.9 (0.6 to 1.4)	0.9 (0.5 to 1.5)
		≥10	2.1 (1.2 to 3.8)	1.6 (0.8 to 3.4)	1.5 (0.8 to 3.0)	2.0 (1.0 to 3.9)
Accidental deaths†	133	1	2.5 (1.5 to 4.1)	2.4 (1.4 to 4.0)	2.4 (1.5 to 4.1)	2.6 (1.6 to 4.4)
		2-4	1.0			
		5-9	1.0 (0.6 to 1.5)	0.9 (0.5 to 1.4)	0.9 (0.6 to 1.5)	0.8 (0.5 to 1.4)
		≥10	0.4 (0.1 to 1.4)	0.4 (0.4 to 1.5)	0.4 (0.1 to 1.5)	0.3 (0.1 to 1.5)

BMI, body mass index.

*Including oesophageal, gastric, colorectal, liver, gall bladder and pancreatic cancers.

†Including suicides n = 47.

being 11 years. It must be noted that despite the adjustment for age, there still remains a residual effect of confounding by age.

We found a 40% increase in the total mortality risk for primiparous women and a 30% increase in women with 5-9 and ≥10 deliveries compared with the reference group when age, BMI, smoking and socioeconomic position were adjusted for. Our findings are in accordance with a large prospective Norwegian cohort study¹⁰ and a British retrospective record linkage study, which showed that women with ≥5 children as well as those with only one child had increased mortality.¹¹ However, these studies did not elicit lifestyle factors, such as smoking. The higher mortality among women with only one child may be partly due to selection; certain chronic diseases impair fertility, and women in poor health may restrict their family size. Another explanation for the increased total mortality of primiparous women found in our study arises from the high rate of accidental deaths. Our finding of increased total mortality in the higher parity groups is probably due to the higher risk of mortality from cardiovascular diseases. The maternal strain, both physical and psychological, arising from the stresses of pregnancy and child bearing may have unfavourable effects on women's health.¹¹

A positive association between mortality from cardiovascular diseases and higher parity has also been documented previously.¹⁻³ This association might be confounded by socioeconomic factors, because both cardiovascular diseases and high parity are more common in the lower social

classes.^{2, 12} Here, we were able to confirm that this positive association remained after adjustment for age, BMI, smoking and socioeconomic position. Pregnancy may affect the risk of cardiovascular disease through insulin resistance, which is a potent cardiovascular risk factor in menopausal women.¹³ Insulin resistance is more common in multiparous women, probably partly as a result of weight gain after pregnancy.¹⁴ We found the incidence of obesity to be fivefold in the women with ≥10 children compared with the reference group, suggesting that insulin resistance can partly explain the positive association between high parity and cardiovascular mortality. Because pregnancy in itself is a state of increased insulin resistance, recurrent pregnancies may have an additive effect on later insulin resistance. In the American Cancer Society cohort study, consisting mainly of highly educated women, no increase in heart disease mortality with increasing parity was seen after adjustment for cardiovascular risk factors, but when the authors reanalysed the data of another study with a population more representative of the general population, increased heart disease mortality was seen among the women with ≥6 children.⁵ In addition, Juntunen *et al*¹⁵ found multiparous women to have a clearly higher risk for pregnancy-induced hypertension, which carries an increased risk for later metabolic syndrome.¹⁶

In our study, the women with ≥10 children had had menarche at a later age, and their first delivery at an earlier age than those of the reference group. When we further controlled for these factors, the significant positive association between high parity and cardiovascular disease risk

disappeared. Thus, it seems that later menarche is unlikely to have any protective effect against cardiovascular diseases. Previous studies on the association between age at menarche, age at first birth and cardiovascular disease risk have yielded inconsistent findings.^{17–20}

As regards different cerebrovascular deaths, the risk of mortality from haemorrhagic stroke was fourfold in the highest-parity group, which is consistent with findings reported previously.^{1 2 21} During normal pregnancy, maternal haemodynamic variables show dramatic changes—for example, cardiac output increases by 50% and arterial pressure decreases slightly—which results in a significant decrease in systemic vascular resistance.²² However, multiparous women may have physical strain of the cardiovascular system due to repeated pregnancies. The prevalence of de novo hypertension during pregnancy is higher¹⁵ among multiparous women, and it can be speculated that of remote increase in blood pressure¹⁶ may increase the risk of haemorrhagic stroke. On the contrary, on the basis of a morbidity study of 887 parous women hospitalised due to subarachnoid haemorrhage, high parity was associated with a lower risk of subarachnoid haemorrhage.²³ However, the authors could not explain the biological mechanism underlying this association.

We did not find any association between parity and total cancer mortality. After adjustment only for age, primiparous women had an increased risk for breast cancer mortality compared with those of the reference group. The 5-year survival rates of breast cancer in Finland are about 80%, being above the European average of 73%.²⁴ The good survival rates probably partly explain why we did not find any association between low parity and breast cancer mortality in the fully adjusted model. A twofold risk for mortality from cancer of the digestive organs emerged in our highest-parity group after controlling for all background factors, including age at menarche and age at first birth. Unfortunately, we were unable to analyse the different cancers of digestive organs separately because of their low numbers. The results of previous studies on the association between cancer of the digestive system and parity are contradictory. A few studies have shown a positive relationship between the number of deliveries and the overall risk of gastric cancer morbidity,^{25 26} although Palli *et al*²⁷ could not confirm that. A protective effect of multiparity on colon cancer morbidity has been seen in some studies,²⁸ although some other studies have failed to find any association between parity and mortality from colorectal cancer.²⁹

In this study, the risk of accidental death was over twofold among the primiparous women compared with those of the reference group, and there was a clear tendency towards decreasing suicide rates with an increasing number of children. Two previous studies have reported a positive association between nulliparity and suicide risk.^{3 30} However, as far as we know, there are no previous studies on accidental deaths among different parity groups. The decrease in suicide rates, with the increasing number of children raises the question of whether this is due to a selection of individuals with a low risk of suicide into marriages with many children or the emotional and social support benefits of a large family. In addition to the selection theory, the social network is of central importance. Participation in work and social activities as well as friendships should be taken into account when the quality of the social network is discussed.³⁰

In conclusion, this study, which was representative of a general parous population in Finland, showed the total mortality to be lowest among women with 2–4 children. High parity was associated with an increased risk of mortality from vascular complications, especially haemorrhagic stroke, and primiparity with increased mortality from accidental death.

What is already known on the topic

- Only a few previous studies dealt with the association between parity and mortality, and their results have been inconsistent.
- Most of these studies have found a positive association between parity and mortality from cardiovascular and cerebrovascular diseases.
- These findings may be due, at least in part, to confounding by unmeasured variables related to socioeconomic position, body mass index or reproductive history, which the previous studies have not been able to adjust for.

What the paper adds

- This study, representative of the general parous population, showed the total mortality to be lowest among women with 2–4 children.
- No previous studies were conducted on accidental deaths among different parity groups. The risk of accidental death was more than twofold among the primiparous women compared with the reference group.
- High parity was associated with an increased risk of mortality from vascular complications, especially haemorrhagic stroke even after taking into account various confounding factors.

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REFERENCES

- 1 Beral V. Long term effects of childbearing on health. *J Epidemiol Commun Health* 1985;**39**:343–6.
- 2 Green A, Beral V, Moser K. Mortality in women in relation to their childbearing history. *BMJ* 1988;**297**:391–5.
- 3 Kvåle G, Heuch I, Nilssen S. Parity in relation to mortality and cancer incidence: a prospective study of Norwegian women. *Int J Epidemiol* 1994;**23**:691–9.
- 4 Hinkula M, Kauppila A, Näyhä S, *et al*. Cause-specific mortality of grand multiparous women in Finland. *Am J Epidemiol* 2005;**162**:367–3.
- 5 Steenland K, Lally C, Thun M. Parity and coronary heart disease among women in the American Cancer Society CPS II population. *Epidemiology* 1996;**7**:641–3.
- 6 Rantakallio P. Groups at risk in low birth weight infants and perinatal mortality. *Acta Paediatr Scand* 1969;**193**(suppl):1–71.
- 7 Central Statistical Office of Finland. *Causes of Death 2001*. Central Statistical Office of Finland, Helsinki: Central Statistical Office of Finland, 2002.
- 8 Solomons B. The dangerous multipara. *Lancet* 1934;ii:8–11.
- 9 Babinszki A, Kerenyi T, Torok O, *et al*. Perinatal outcome in grand and great-grand multiparity: effects of parity on obstetric risk factors. *Am J Obstet Gynecol* 1999;**181**:669–74.

- 10 **Lund E**, Arnesen E, Borgan JK. Pattern of childbearing and mortality in married women—a national prospective study from Norway. *J Epidemiol Commun Health* 1990;**44**:237–24.
- 11 **Grundy E**, Tomassini C. Fertility history and health in later life: a record linkage study in England and Wales. *Soc Sci Med* 2005;**61**:217–28.
- 12 **Valkonen T**, Martelin T, Rimpelä A, *et al*. *Sosioekonomiset kuolleisuuserot 1981–1990*. Helsinki: Tilastokeskus, 1992.
- 13 **Gordon T**, Castelli WP, Hjortland MC, *et al*. Diabetes, blood lipids and the role of obesity in coronary heart disease risk for women. *Ann Intern Med* 1977;**87**:393–7.
- 14 **Kaye SA**, Folsom AR, Prineas RJ, *et al*. The association of body fat distribution with lifestyle and reproductive factors in a population study of postmenopausal women. *Int J Obes* 1990;**14**:583–91.
- 15 **Juntunen K**, Kirkinen P, Kauppila A. The clinical outcome in pregnancies of grand grand multiparous women. *Acta Obstet Gynecol Scand* 1997;**76**:755–9.
- 16 **Pouta A**, Hartikainen AL, Sovio U, *et al*. Manifestations of metabolic syndrome after hypertensive pregnancy. *Hypertension* 2004;**43**:825–31.
- 17 **Colditz GA**, Willett WC, Stampfer MJ, *et al*. A prospective study of age at menarche, parity, age at first birth and coronary heart disease in women. *Am J Epidemiol* 1987;**126**:861–70.
- 18 **La Vecchia C**, Decarli A, Franceschi S, *et al*. Menstrual and reproductive factors and risk of myocardial infarction in women under fifty-five years of age. *Am J Obstet Gynecol* 1987;**157**:1108–12.
- 19 **Cooper GS**, Ephross SA, Weinberg CR, *et al*. Menstrual and reproductive risk factors for ischaemic heart disease. *Epidemiology* 1999;**10**:255–59.
- 20 **De Kleijn MJJ**, Van der Schouw YT, Van der Graaf Y. Reproductive history and cardiovascular disease risk in postmenopausal women: a review of the literature. *Maturitas* 1999;**33**:7–36.
- 21 **Qureshi AI**, Giles WH, Croft JB, *et al*. Number of pregnancies and the risk for stroke and stroke subtypes. *Arch Neurol* 1997;**54**:203–6.
- 22 **Brinkman CR**. Biologic adaptation to pregnancy. In: Creasy RK, Resnik R, eds. *Maternal-fetal medicine: principles and practise*. Philadelphia: WB Saunders, 1989:734–45.
- 23 **Gaist D**, Pedersen L, Cnattingius S, *et al*. Parity and risk of subarachnoid hemorrhage in women: a nested case-control study based on national Swedish registries. *Stroke* 2004;**35**:28–33.
- 24 **Berrino F**. Survival of cancer patients in Finland, 1955–1994. *Acta Oncol* 1999;**38**:275–7.
- 25 **Heuch I**, Kvåle G. Menstrual and reproductive factors and risk of gastric cancer: a Norwegian cohort study. *Cancer Causes Control* 2000;**11**:869–74.
- 26 **La Vecchia C**, D'Avanzo B, Franceschi S, *et al*. Menstrual and reproductive factors and gastric-cancer risk in women. *Int J Cancer* 1994;**59**:761–4.
- 27 **Palli D**, Cipriani F, Decarli A, *et al*. Reproductive history and gastric cancer among post-menopausal women. *Int J Cancer* 1994;**56**:812–15.
- 28 **Broeders MM**, Lambe M, Baron JA, *et al*. History of childbearing and colorectal cancer risk in women aged less than 60: an analysis of Swedish routine registry data 1960–1984. *Int J Cancer* 1996;**66**:170–5.
- 29 **Jacobsen BK**, Vollset SE, Kvåle G. Do reproductive factors influence colorectal cancer survival? *J Clin Epidemiol* 1995;**48**:1119–22.
- 30 **Høyer G**, Lund E. Suicide among women related to number of children in marriage. *Arch Gen Psychiatry* 1993;**50**:134–7.

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