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Sickness absence and disability pension in relation to first childbirth: three cohorts of women in Sweden

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ABSTRACT

Objective Childbirth is suggested to be associated with elevated levels of sickness absence (SA) and disability pension (DP). However, detailed knowledge about SA/DP patterns is limited. We aimed to compare SA/DP across different periods among women according to their childbirth status.

Design Register-based cohort study.

Setting Sweden.

Participants We analysed three population-based cohorts of women aged 18-39 years and living in Sweden 31 December 1994, 1999, or 2004.

Primary and secondary outcome measures Annual mean combined SA>14 and DP days.

Methods We compared crude and standardized annual mean net days of SA and DP during the three years preceding and the three years after first childbirth, among women having (1) their first and only birth during the subsequent three years, (2) their first birth and at least another delivery and (3) no childbirths before, nor during the study period.

Results Despite an increase in SA in the year preceding the first childbirth, women who gave birth, and especially women with multiple births, tended to have lower levels of combined SA/DP days throughout the years than women without childbirths. SA/DP across groups varied with age; young women (18-24 years) without childbirths had fewer SA days but more DP days than young women with multiple childbirths, regardless of year.

Conclusions Women with more than one childbirth had lower proportions and fewer days of both SA and DP, as compared to women with one childbirth and to women having no births. Further, women who did not give birth had markedly more DP days. Thus, childbirth does not seem to be associated with higher levels of SA and DP.

Key words Sick leave, disability pension, childbirth, cohort study, postpartum, pregnancy, child delivery

Strengths and limitations of this study

- In this exploratory population-based study using three cohorts from different time periods, we compared trends in sickness absence and disability pension in the years before and after first childbirth among women with one or more childbirths and among women with no childbirth; this study design allowed us to consider health selection into childbirth and cohort effects.
- Further strengths of our study include the large sample size, the nationwide data, the longitudinal design, the high quality of information on childbirth and sickness absence and disability pension and the high employment rate of women in Sweden.
- The main limitation is that we had no information on sickness absence spells shorter than 15 days.

BACKGROUND

In many countries with high labor force participation of women, women have higher levels of sickness absence (SA) and disability pension (DP) than men [1-4]. One suggestion to explain this gender difference focuses on SA during pregnancy and after childbirth [5-8]. Also for DP, pregnancy has been suspected to be a factor behind this gender gap, although findings are less consistent than for SA [8]. Swedish studies have shown that women have higher SA during pregnancy, as well as during the years following childbirth, as compared to other years [5 6 9 10]. Yet, it is unclear whether women have elevated rates of SA in the years before their first childbirth. Findings from twin studies, have shown that women who gave birth had lower average number of SA days compared with their nulliparous twin sisters [5 10 11]. After delivery the average number of SA days were similar in both groups. However, few studies have focused on SA and DP in different groups of women; most have focused on differences between women and men.

Pregnancy and the postpartum period are characterized by important alterations in endocrine, metabolic, immune, and cardiovascular function [12 13]. Changes in immunity in pregnancy may result in higher maternal susceptibility to certain common infectious diseases and in diminished immune responses. This could lead to more severe disease courses in pregnancy, than in the non-pregnant state and consequently to longer SA spells. Similarly, while women's conditions with certain autoimmune diseases improve during pregnancy and may deteriorate after delivery, for others there is a deterioration or no change during gestation [14]. Also, women with a genetic vulnerability or certain risk factors, may experience pregnancy induced hypertension/preeclampsia, gestational diabetes, peri- and postpartum thrombotic events, or peri- and postpartum psychiatric disorders. Several of these conditions reverse shortly after delivery/the postpartum period, but may reappear later in vulnerable women and result in SA or DP [13].

As for SA, a Norwegian study found that the higher SA risk in women in the years after pregnancy disappeared when SA during subsequent pregnancies were accounted for [15]. However, this study included mothers only and no information on DP was included, which means that long-term or permanent reductions in work capacity was not accounted for.

The mean age for first childbirth, and the prevalence of several maternal chronic diseases, of obesity, and in vitro fertilization has increased over the decades, which may contribute to an increase in rates of certain complications related to pregnancy and childbirth [6 16 17] and subsequently higher SA rates during and shortly after pregnancy.

It has also been argued that the combination of paid and unpaid work is one reason why women have higher levels of SA. The notion that the load of combining different roles might increase SA in women is supported by some studies [18-20]. However, other findings have reported a positive association between multiple roles and health and well-being, respectively [21 22]. One exception is single mothers, for whom SA/DP levels are higher than for married and cohabiting mothers, and for whom SA/DP levels increases with the number of children [23].

Nevertheless, there might also be a positive health selection into giving birth, where women not giving birth may have poorer health and thus are unable to, or choose not to deliver a child [5 10 11]. However, with these studies having included twins only, the generalizability to the general population is unclear.

Our aim was to gain knowledge on SA and DP over time in women, in relation to childbirth while accounting for period effects. Specifically, we wanted to compare annual mean net days of SA and DP among women giving and not giving birth, covering a period of three years before and after childbirth. As both childbirth and age are associated with socioeconomic position, another aim was to examine if the relationship between childbirth and SA/DP varied

between age groups. Finally, we aimed to analyze possible period and cohort effects, by including three cohorts.

METHODS

Longitudinal population-based cohort studies were conducted. We created three different population-based cohorts, using the unique personal identity number assigned to all Swedish residents for linkage of microdata from five Swedish nationwide registers, from the following three authorities [24]:

- From Statistics Sweden: The Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA) regarding sociodemographic information, year of immigration, and emigration.

- From the National Board of Health and Welfare: 1) The Medical Birth Register (MBR) for dates of childbirth and parity. This register covers 97-99% of all births in Sweden since 1973 [17]; 2) the National In-Patient Register for information since 1964 on childbirths not found in the MBR [25]. We used main or secondary diagnoses related to childbirth (as defined by the International Classification of Disease (ICD): ICD-7: 660, 670-678; ICD-8: 650-662; ICD-9: 650, 651, 652, 659X, W/659.W-659.X, 669.E,F,G,H,W,X; ICD-10:O75.7-O75.9, O80-84). If a delivery appeared in both registers, the date from the MBR was used. 3) The Causes of Death Register for date of death.

- From the Swedish Social Insurance Agency, information from their register Micro Data for Analysis of Social Insurance (MiDAS) on SA and DP (start and end dates and extent) for the period 1994-2008 [26]. Only SA spells >14 days were included.

In Sweden, all individuals aged 16 years or older and in gainful employment or income benefits, are entitled to sickness benefits from the public sickness insurance system, if unable

to work due to disease or injury. For employees, sick pay is typically paid by the employer during the first 14 days of an SA spell. DP can be granted residents in Sweden aged 19-64 who, due to disease or injury, have a permanently reduced work capacity. Both SA and DP can be granted for full- or part-time (25%, 50% or 75%) of ordinary work hours. Approximately 80% of the lost income, up to a certain limit, is covered by SA benefits, while DP covers up to 65%.

Cohorts

We created three cohorts (Cohort1995, Cohort2000, Cohort2005) of all women living in Sweden and aged 18-39 years 31 December 1994, 1999, or 2004, respectively, using the LISA register. To study SA and DP during the three years prior to three years after first child delivery date, and to allow comparisons with women not having any births during this period, we only included women who resided in Sweden during the three years prior to the respective inclusion year. For each cohort, we identified three groups of women:

- B0: Women having no childbirths registered neither before nor during the follow-up.
- B1: Women having their first childbirth during the index year and no additional births registered during the follow-up.
- B1+: Women having their first childbirth during the index year and at least one more birth during the follow-up.

Thus, all women with a childbirth prior to the index year (1995, 2000, or 2005) were excluded. Each woman was followed for three years after the delivery date (T_0); for the women in B0, T_0 was set to 2 July of each index year. To avoid that the outcome (SA/DP) was influenced by a new pregnancy, any women in the three exposure groups (B0, B1, B1+) having a childbirth in the 43 weeks after Y_{+3} (the third follow-up year) was excluded.

Outcome

We calculated the number of annual mean net SA and DP days for each of the three years preceding T_0 and the three years after, for each cohort, respectively. However, as data on SA and DP was only available from 1994, only one year prior to T_0 was considered for Cohort1995. Part-time SA/DP days were combined, e.g., two days of half-time SA or DP was counted as one net day.

Sociodemographics

The following covariates were included: age (categorized into four groups: 18-24, 25-29, 30-34, and 35-39 years), country of birth (Sweden, other Scandinavian country, other EU 25, and rest of the world), type of living area (based on the H-classification scheme [20]), categorized as: large city (Stockholm, Gothenburg, Malmö); medium-sized city (≥90,000 inhabitants); and small city/village (<90,000 inhabitants)), family situation (married/cohabitant and single), and educational level (categorized as elementary (≤9 years), high school (10–12 years), and university/college (>12 years)). These variables were obtained from the LISA register and were measured on 31 December 1994, 1999, and 2004, respectively.

Statistical analyses

We calculated annual mean numbers of net SA and DP days, starting three years preceding the date of the first childbirth (Y_{-3}) until three years after (Y_{+3}) for the three comparisons groups (B0, B1, B1+) within each cohort. Both crude and standardized mean numbers of net days were calculated. We used a direct standardization using Cohort2005 as the standard population. In the standardization, all sociodemographic variables were taken into account; age (in four categories), country of birth, place of residence, educational level, and family

status (as binary). Women who died or emigrated within three years after child delivery were excluded from the analyses from the year after death or emigration.

Further, for Cohort2005, we calculated the proportion of all women who had DP or at least one SA spell >14 days, respectively, and also the proportion of women with SA among those who had no DP.

As age is strongly associated with both SA/DP and childbirth [6], we also performed analyses stratified by age for Cohort2005, calculating 95% confidence intervals (CI) for the means of the sums of SA and DP net days. All analyses were conducted using SAS 9.4.

The project was approved by the Regional Ethical Review Board in Stockholm, Sweden.

Patient and public involvement

The study participants or the general public were not involved in decisions about the research question, the design of the study, the outcomes, the conduct of the study, the drafting of the paper, nor in the dissemination of the study results.

RESULTS

In all three cohorts, 92 to 93% of the women had no childbirths, that is, they belonged to the group B0 (Table 1). Around 13,000 to 15,000 women had had their first childbirth during the index year (3%) but no more births during the study period, i.e., belonged to group B1. About 21,000 to 25,000 women belonged to B1+, i.e., had their first delivery during the index year and at least one additional childbirth during follow-up (4-5%). Women in B0 were younger (18-24 years), had lower educational level, and were to a higher extent single. A lower rate of women in B1+ were in the oldest age group (i.e., 35-39 years), as compared to women in B0

and B1. Furthermore, women in group B1+ were more likely to have higher education and to be married or cohabiting, than those in B0 and B1.

For Cohort2005, women in B1 had the highest proportion of SA/DP combined during Y_{-3} to Y_{-1}, as well as the highest proportion of SA between Y_{-3} to Y_{+1}, while B1+ had both highest proportion of SA/DP combined and SA the other years (Table 2). The highest proportion of DP was found for B0 during all years, ranging from 3.4% to 5.8%.

Table 1. Characteristics of the three cohorts of women, by cohort and childbirth group[1].

	Cohort1995 N (%)			Cohort2000 N (%)			Cohort2005 N (%)		
	B0[1]	B1[1]	B1+[1]	B0	B1	B1+	B0	B1	B1+
N	450630 (100)	15096 (100)	20902 (100)	455962 (100)	13569 (100)	21347 (100)	453532 (100)	14299 (100)	24673 (100)
Age (years)									
18-24	261574 (58.1)	5464 (36.2)	7385 (35.3)	252830 (55.4)	3982 (29.4)	5475 (25.6)	257219 (56.7)	3688 (25.8)	5284 (21.4)
25-29	89766 (19.9)	5360 (35.5)	9139 (43.7)	98418 (21.6)	4890 (36.0)	9864 (46.2)	92672 (20.4)	4593 (32.1)	10354 (42.0)
30-34	53627 (11.9)	3030 (20.1)	3698 (17.7)	56477 (12.4)	3309 (24.4)	5076 (23.8)	56233 (12.4)	4089 (28.6)	7614 (30.9)
35-39	45663 (10.1)	1242 (8.2)	680 (3.3)	48237 (10.6)	1388 (10.2)	932 (4.4)	47408 (10.5)	1929 (13.5)	1421 (5.8)
Country of birth									
Sweden	408043 (90.5)	1374 (91.1)	19649 (94.0)	405643 (89.0)	11961 (88.2)	19850 (93.0)	397091 (87.6)	12388 (86.6)	22583 (91.5)
Other Scandinavian country	9802 (2.2)	397 (2.6)	347 (1.7)	6404 (1.4)	232 (1.7)	251 (1.2)	4873 (1.1)	200 (1.4)	237 (1.0)
Other EU 25	7229 (1.6)	193 (1.3)	166 (0.8)	6904 (1.5)	180 (1.3)	166 (0.8)	7432 (1.6)	213 (1.5)	242 (1.0)
Rest of the world	25556 (5.7)	752 (5.0)	740 (3.5)	37011 (8.1)	1196 (8.8)	1080 (5.0)	44136 (9.7)	1498 (10.5)	1611 (6.5)
Type of living area									
Large cities	188004 (41.7)	5986 (39.7)	7741 (37.0)	197319 (43.3)	5641 (41.6)	8837 (41.4)	196911 (43.4)	6260 (43.8)	10882 (44.1)
Medium-sized cities	157282 (34.9)	5273 (34.9)	7398 (35.4)	159901 (35.1)	4688 (34.5)	7305 (34.2)	161919 (35.7)	4824 (33.7)	8425 (34.2)
Small cities	105344 (23.4)	3837 (25.4)	5763 (27.6)	98742 (21.7)	3240 (23.9)	5205 (24.4)	94702 (20.9)	3215 (22.5)	5366 (21.8)
Educational level									
Elementary	87363 (19.4)	2305 (15.3)	1923 (9.2)	99867 (21.9)	2506 (18.5)	2055 (9.6)	90510 (20.0)	1815 (12.7)	1757 (7.1)
High school	257971 (57.2)	9055 (60.0)	11972 (57.3)	225774 (49.5)	7148 (52.7)	10263 (48.1)	208184 (45.9)	6751 (47.2)	9516 (38.6)
University	105296 (23.4)	3736 (24.7)	7007 (33.5)	130321 (28.6)	3915 (28.8)	9029 (42.3)	154838 (34.1)	5733 (40.1)	13400 (54.3)
Family situation									
Married or cohabitant	26986 (6.0)	3317 (22.0)	6002 (28.7)	23187 (5.1)	3026 (22.3)	6228 (29.2)	20295 (4.5)	3212 (22.5)	6843 (27.7)
Single	423644 (94.0)	11779 (78.0)	14900 (71.3)	432775 (94.9)	10543 (77.7)	15119 (70.8)	433237 (95.5)	11087 (77.5)	17830 (72.3)

[1]B0= No childbirth, B1=First childbirth during index year (at date T_0) of each cohort and no more children during follow-up, B1+= First childbirth at T_0 and at least one more during follow-up.

Table 2. Proportion of women with a sickness absence (SA) spell >14 days and disability pension (DP) during the six different years before and after childbirth, for Cohort2005, by childbirth group

		Total study population				Of DP recipients, received DP		Of SA recipients, received SA for a period of			
Year	Childbirth group	N	SA/DP[1] (%)	DP[1] (%)	SA[2] (%)	Part of the year (%)	All year (%)	>0-30 days (%)	>30-90 days (%)	>90-180 days (%)	>180 days (%)
Y-3	B0	453532	9.5	3.4	6.6	26.8	73.2	40.0	22.8	13.6	23.6
	B1	14299	12.6	1.4	11.6	53.8	46.2	43.1	22.6	14.9	19.4
	B1+	24673	8.9	0.5	8.6	63.4	36.6	51.0	24.0	12.7	12.3
Y-2	B0	453532	9.5	3.9	6.2	24.3	75.7	34.2	23.3	14.8	27.7
	B1	14299	12.7	2.0	11.4	52.8	47.2	40.8	22.3	14.1	22.8
	B1+	24673	8.6	0.7	8.1	60.9	39.1	45.7	25.5	13.8	14.9
Y-1	B0	453532	10.3	4.5	6.5	25.5	74.5	36.3	23.6	15.3	24.8
	B1	14299	36.2	2.4	35.0	44.7	55.3	37.8	36.9	15.8	9.5
	B1+	24673	30.6	0.8	30.2	50.8	49.2	45.4	35.8	13.3	5.6
Y+1	B0	453532	11.1	5.0	6.9	25.5	74.5	41.1	23.2	13.9	21.9
	B1	14299	10.7	2.4	8.7	36.2	63.8	61.5	22.5	8.4	7.7
	B1+	24673	6.8	0.8	6.1	49.7	50.3	67.9	20.2	6.5	5.4
Y+2[3]	B0	448921	11.8	5.4	7.3	26.5	73.5	43.1	22.6	13.7	20.6
	B1	14270	10.7	2.6	8.7	37.1	62.9	44.1	21.5	14.1	20.3
	B1+	24671	15.1	0.8	14.5	45.4	54.6	50.4	33.4	11.7	4.6
Y+3[3]	B0	443320	12.0	5.8	7.1	27.1	72.9	43.7	23.1	13.2	20.0
	B1	14183	12.7	2.9	10.6	43.0	57.0	44.7	20.9	13.2	21.1
	B1+	24667	19.1	0.8	18.5	47.5	52.5	50.8	34.7	11.0	3.5

[1]Having DP was defined as 1≤DP net annual days≤364. [2]SA spell >14 days after excluding those with full-time DP. [3]Numbers of women in Y_{+2} and Y_{+3} are lower due to the fact that some died or emigrated during these years.

Comparing crude annual mean net SA and DP days, we found a similar pattern regardless of cohort (Figure 1). Group B0 had the highest mean SA/DP days combined, followed by group B1 and group B1+. The only exception to this was year Y_{-1}, that is the year of the first pregnancy for B1 and B1+, when group B0 had the lowest crude number of combined SA and DP days. During all years, the largest difference was found in DP days, where women with no childbirths had up to 10 times the number of DP days as compared to women in group B1+. The standardized mean number of combined SA/DP days showed similar patterns for the three different cohorts (Figure 2). Women with no childbirths (B0) had the highest number of SA/DP days at all years except at Y_{-1}, when B1 had the highest number of SA/DP days, followed by group B1+. Also for standardized number of days, the largest differences were seen for DP. Regardless of year, women in B0 had three to ten times more DP days than did the other groups. SA days were more evenly spread. In Cohort2005 during Y_{-3} and Y_{-2} group B0 and group B1 had similar number of mean SA days (11.3; 10.9 and 11.6; 11.6, respectively). Women with at least one additional childbirth had fewer mean SA days, 7.0 and 7.5 SA days at Y_{-3} and Y_{-2}. The pattern for the association between childbirth and SA/DP was largely similar across cohorts. There was also an increase in SA and DP over time in all groups.

In the age-stratified analyses for Cohort2005, we found that the youngest women (18-24 years) in B1 had the highest mean SA and DP days, whereas B0 women had the lowest mean number of corresponding days (Figure 3). Still, B0 women had slightly more DP days, regardless of year. In the other age groups, B0 women had most DP days during all years, as compared with B1 and B1+, while women in B1+ had lowest number of SA days during all years, except during Y_{-1}.

Women aged 30-39 in B0 had the highest mean SA and DP days, regardless of year. Their combined mean number of SA/DP days varied between 50 and 60, whereas the range was 30-40 in group B1 and 8-25 in B1+.

DISCUSSION

In this exploratory population-based study using three cohorts from different time periods, we found that women who had no childbirths had up to ten times higher rates of DP than their counterparts who gave at least one birth, regardless of cohort and year studied. Women having one additional, subsequent childbirth during follow-up, tended to have fewer days of combined SA and DP, than women having no childbirths. The findings suggest no period effects regarding the linkages between childbirth and the investigated outcomes.

Our finding that women with no childbirths had higher levels of DP is in line with those of a Swedish study of twins up to ten years after childbirth, which reported that the number of DP days was significantly higher in women not giving birth than in their twin sisters who did [10]. Further, this twin study found that except for the year of childbirth, the number of mean annual SA days (including spells >14 days) was similar among women giving birth and those who did not. Our study showed similar results, except that women who had more than one childbirth had slightly fewer mean SA days, than the other two groups of women.

Women with poor health or other characteristics associated with adverse health may decide against going through a pregnancy [19 21]. This may be part of the explanation for the substantially higher levels of DP among women with no childbirths in our study, i.e., a positive health selection into giving birth, or into having more than one birth is likely, as has been suggested by others [10]. However, with improvements in medical care, more women with severe diseases who earlier had to refrain from pregnancy due to disease, might now

choose otherwise. In line with the above mentioned results, another Swedish twin study also indicated a health selection into giving birth [11]. It also emphasized their findings regarding multiple hospitalizations before subsequent DP.

In our study, women aged 30 years or more, with no childbirths, had higher mean SA days than those with one or more childbirths. Mean number of DP days were higher in all age groups among women with no childbirths.

We found that women having a subsequent childbirth during the follow-up (B1+), had fewer days of both SA and DP up until Y_{+2} when the levels became very similar, as compared to the other groups. The most plausible explanation for this is SA due to their subsequent pregnancy. This is in accordance with a Norwegian study reporting that the higher SA risk in women in the years after pregnancy disappeared, when SA during subsequent pregnancies were accounted for [15].

When we analyzed period effects, our results indicated similar patterns between the three exposure groups regardless of cohort. Nevertheless, the levels of SA/DP combined increased in a graded manner from Cohort1995 to Cohort2000 and was highest in Cohort2005.

The strengths of this study include its population-based and longitudinal design, and the use of high-quality and nationwide register data with high completeness, validity and no drop-outs [24]. The use of National Patient Register data in addition to the MBR allowed us to include childbirths not captured by the MBR. Furthermore, we were able to account for factors related both to the occurrence of SA/DP and childbirth such as maternal age, educational level, and type of living area, by means of a standardized analysis taking these variables into account. Another strength is related to characteristics of the Swedish labor market and public insurance system, i.e., high employment rates among women [27] (that is, low health selection bias) and a public sickness insurance covering basically the whole population. However, two study limitations warrant consideration in contextualizing the

present results. First, women who had only given birth outside of Sweden would not appear in the registers and may thus, be incorrectly categorized as not having had any childbirth. This may result in differential misclassification of exposure, and biased levels of SA/DP in women having no childbirths. To mitigate this, and to make sure we had information on their possible SA/DP, we considered women's residence in Sweden for at least three years prior to childbirth as an inclusion criterion. We had no information on SA spells <15 days, this can be considered both a limitation and a strength. The shorter SA spells only represent a limited number of all SA days, and most are self-reported and not verified by any physician certificate [28].

In conclusion, women who had more than one childbirth had lower rates and fewer days of both SA and DP, than women with one childbirth only and women not giving birth. Further, women not giving birth had markedly more DP days. No period effects in the association between childbirth and these outcomes were detected. High levels of SA and DP among parous women appear to be mainly restricted to pregnancy. Yet, more research with longer follow-up periods after childbirth is needed.

Contributors CB conducted the analyses, wrote the first draft and revised the paper; CO contributed to analyses and revised the paper; KL contributed to interpretation of the findings and revised the paper; PS and KA contributed to the conception and design of the study, interpretation of the findings and revised the paper; MV, UL and PL contributed to the design of the study, interpretation of the findings and revised the paper. All authors have read and approved the final version of the manuscript.

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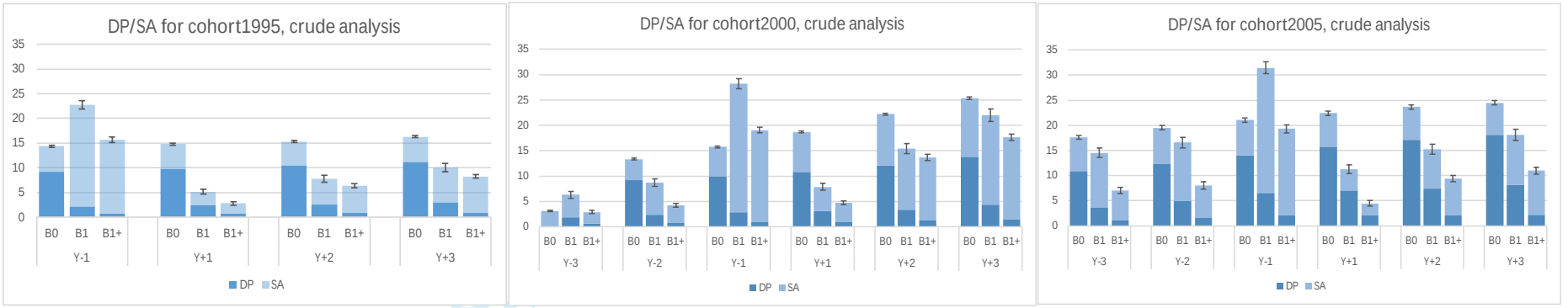
FIGURE LEGENDS

Figure 1. Crude mean annual net days of sickness absence (SA) and disability pension (DP) from Y-3 to Y+3, in Cohort1995, Cohort2000, and Cohort2005, respectively, by childbirth group.

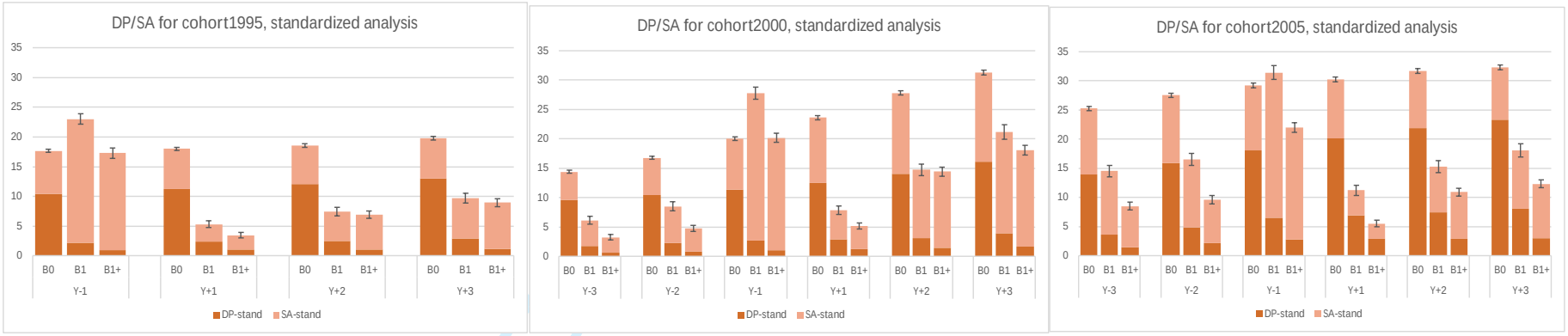
Figure 2. Standardized mean annual net days of sickness absence (SA) and disability pension (DP) from Y-3 to Y+3 in Cohort1995, Cohort2000, and Cohort2005, respectively, by childbirth group.

Figure 3. Crude mean annual net days of sickness absence (SA) and disability pension (DP) from Y-3 to Y+3 in Cohort2005, by age group and childbirth group.



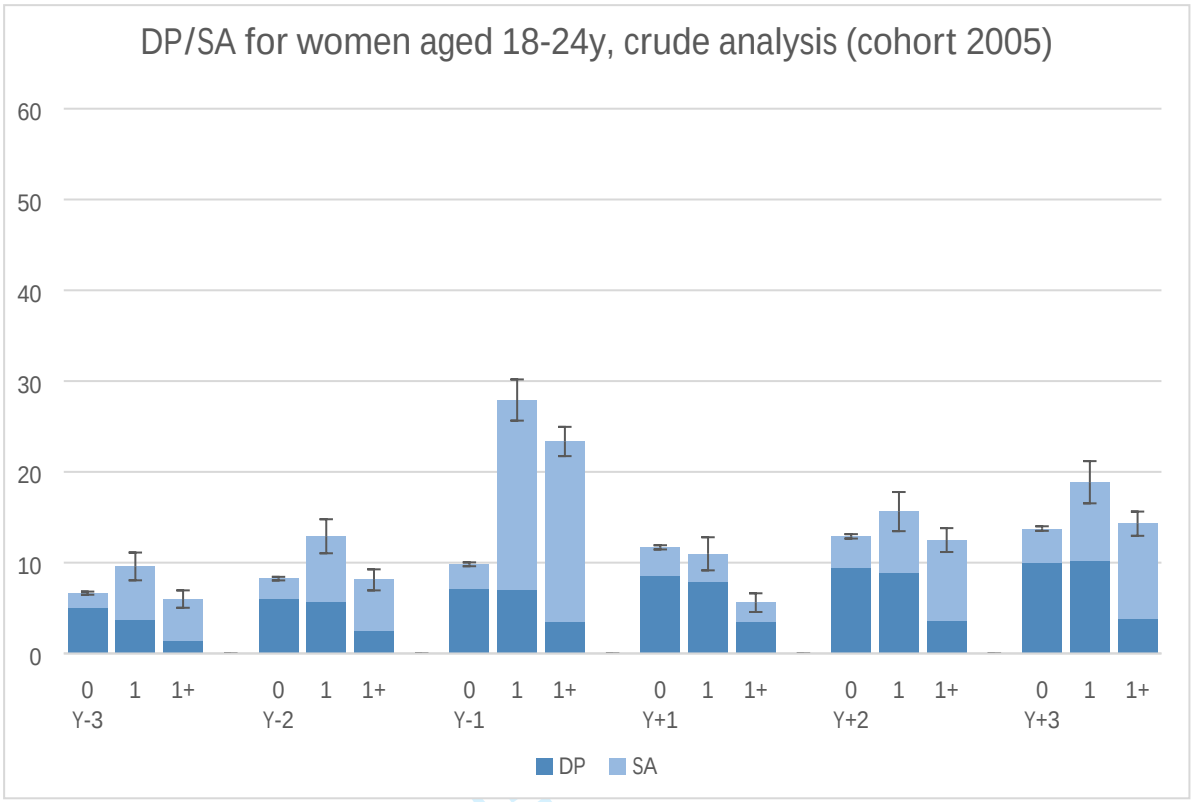
*The vertical lines represent the confidence interval for the sum of SA and DP net days

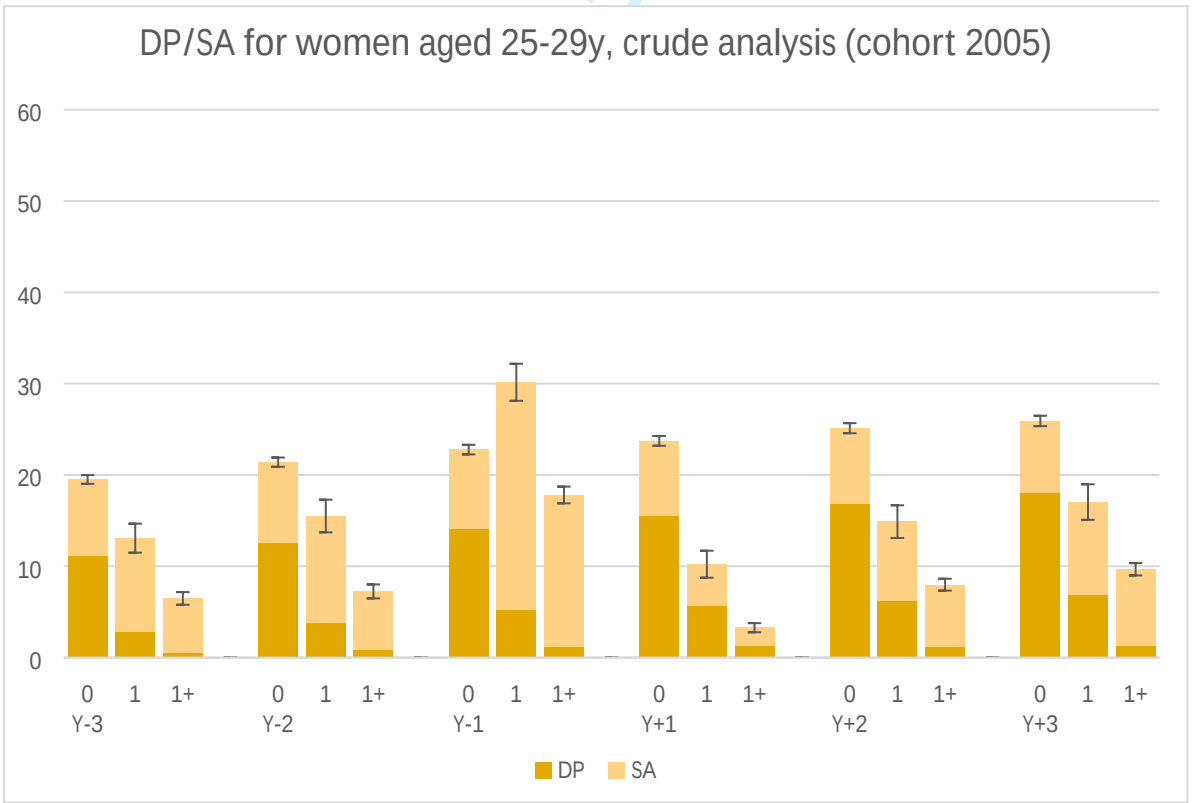
Figure 1.

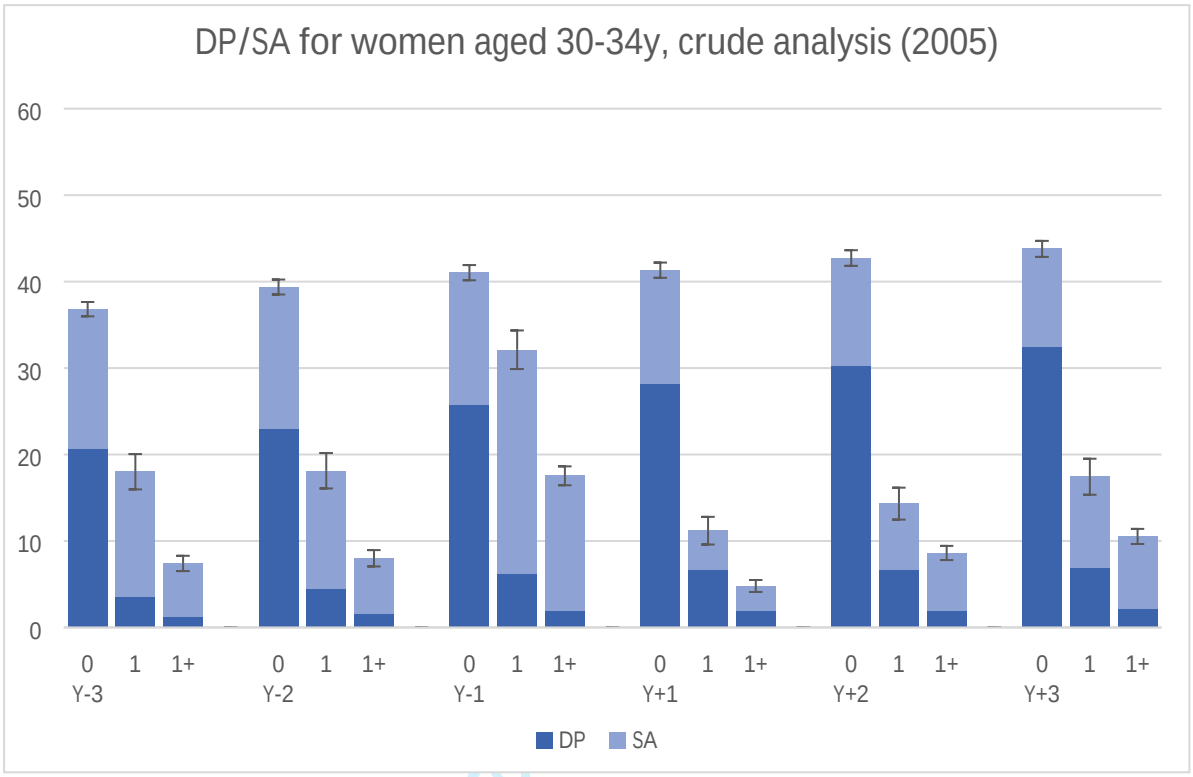


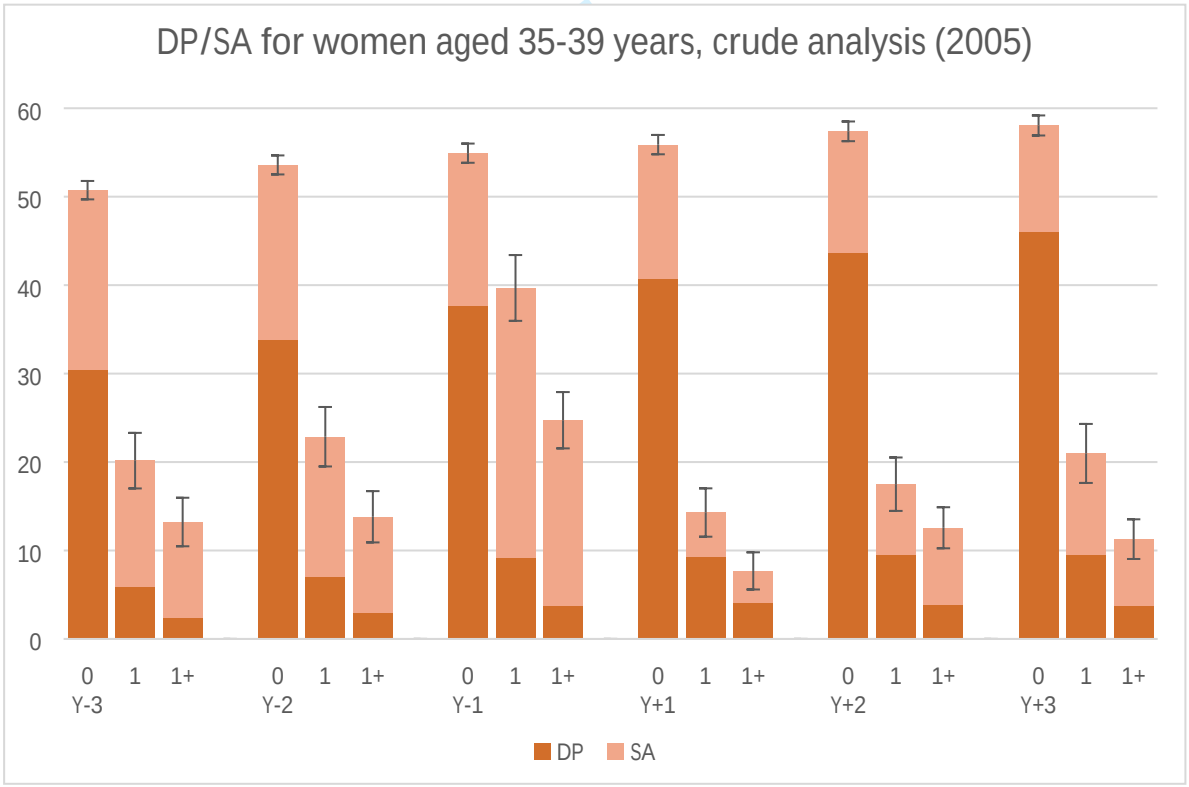
*The vertical lines represent the confidence interval for the sum of SA and DP net days

Figure 2.


DP/SA for women aged 18-24y, crude analysis (cohort 2005)
60
50
40
30
20
10
0
0 1 1+ 0 1 1+ 0 1 1+ 0 1 1+ 0 1 1+ 0 1 1+
Y-3 Y-2 Y-1 Y+1 Y+2 Y+3
DP SA


DP/SA for women aged 25-29y, crude analysis (cohort 2005)
60
50
40
30
20
10
0
0 1 1+ 0 1 1+ 0 1 1+ 0 1 1+ 0 1 1+ 0 1 1+
Y-3 Y-2 Y-1 Y+1 Y+2 Y+3
DP SA





*The vertical lines represent the confidence interval for the sum of SA and DP net days

Figure 3.

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	p. 1, 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	p. 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	p. 4-6
Objectives	3	State specific objectives, including any prespecified hypotheses	p. 5-6
Methods			
Study design	4	Present key elements of study design early in the paper	p. 6-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	p. 6-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	p. 6-8
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	-
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	p. 7, 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	p. 6-8
Bias	9	Describe any efforts to address potential sources of bias	p. 8, 9
Study size	10	Explain how the study size was arrived at	p. 7, 11
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	p. 7-9, 11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	p. 8, 9
		(*b*) Describe any methods used to examine subgroups and interactions	p. 9
		(*c*) Explain how missing data were addressed	-
		(*d*) If applicable, explain how loss to follow-up was addressed	p. 12
		(*e*) Describe any sensitivity analyses	p. 9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	p. 11, 12
		(b) Give reasons for non-participation at each stage	p. 7, 12
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	p. 11
		(b) Indicate number of participants with missing data for each variable of interest	p. 11
		(c) Summarise follow-up time (eg, average and total amount)	-
Outcome data	15*	Report numbers of outcome events or summary measures over time	p. 13, Figures 1-3
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted	Figures 1-3

		estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	p. 8, 11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	p. 13-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	p. 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	p. 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	p. 14-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	p. 15-16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	p. 17

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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Sickness absence and disability pension before and after first childbirth and in nulliparous women: longitudinal analyses of three cohorts in Sweden

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Sickness absence and disability pension before and after first childbirth and in nulliparous women: longitudinal analyses of three cohorts in Sweden

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ABSTRACT

Objective Childbirth is suggested to be associated with elevated levels of sickness absence (SA) and disability pension (DP). However, detailed knowledge about SA/DP patterns around childbirth is lacking. We aimed to compare SA/DP across different time periods among women according to their childbirth status.

Design Register-based longitudinal cohort study.

Setting Sweden.

Participants Three population-based cohorts of nulliparous women aged 18-39 years, living in Sweden 31 December 1994, 1999, or 2004 (nearly 500,000/cohort).

Primary and secondary outcome measures Sum of SA>14 and DP net days/year.

Methods We compared crude and standardized mean SA and DP days/year during the three years preceding and the three years after first childbirth date (Y_{-3} to Y_{+3}), among women having (1) their first and only birth during the subsequent three years (B1), (2) their first birth and at least another delivery (B1+), and (3) no childbirths during follow-up (B0).

Results Despite an increase in SA in the year preceding the first childbirth, women in the B1 group, and especially in B1+, tended to have fewer SA/DP days throughout the years than women in the B0 group. For cohort 2005, the mean SA/DP days/year (95% confidence intervals) in the B0, B1, and B1+ groups were for Y_{-3}: 25.3 (24.9-25.7), 14.5 (13.6-15.5), and 8.5 (7.9-9.2); Y_{-2}: 27.5 (27.1-27.9), 16.6 (15.5-17.6), and 9.6 (8.9-10.4); Y_{-1}: 29.2 (28.8-29.6), 31.4 (30.2-32.6) and 22.0 (21.2-22.9); Y_{+1}: 30.2 (29.8-30.7), 11.2 (10.4-12.1), and 5.5 (5.0-6.1); Y_{+2}: 31.7 (31.3-32.1), 15.3 (14.2-16.3), and 10.9 (10.3-11.6); Y_{+3}: 32.3 (31.9-32.7), 18.1 (17.0-19.3), and 12.4 (11.7-13.0), respectively. These patterns were the same in all three cohorts.

Conclusions Women with more than one childbirth had fewer SA/DP days/year compared to women with one childbirth or with no births. Women who did not give birth had markedly more DP days than those giving birth, suggesting a health selection into childbirth.

Key words Sick leave, disability pension, childbirth, cohort study, postpartum, pregnancy, child delivery

Strengths and limitations of this study

- The study involved longitudinal analyses of both sickness absence and disability pension.
- It was population-based, we included virtually all nulliparous women in Sweden during the study periods.
- By analysing three cohorts of women five years apart we explored potential time-period effects.
- Since we used large, nationwide data, statistical precision in our analyses was high.
- We had no information on sickness absence spells ≤14 days.

BACKGROUND

In many countries with high labour force participation of women, women have higher levels of sickness absence (SA) and disability pension (DP) than men.[1-4] One suggestion to explain this gender difference focuses on SA during pregnancy and after childbirth.[5-8] Also for DP, pregnancy has been suspected to be a factor behind this gender gap, although findings are less consistent than for SA.[8] Swedish studies have shown that women have higher SA during pregnancy, as well as during the years following childbirth, as compared to other years.[5 6 9 10] Yet, it is unclear whether women have elevated rates of SA also during the years preceding their first childbirth. Findings from twin studies, have shown that women who gave birth had lower average number of SA days compared with their nulliparous twin sisters.[5 10 11] After delivery the average number of SA days were similar in both groups. However, few studies have focused on SA and DP in different groups of women; most have focused on gender differences.

Pregnancy and the postpartum period are characterized by important alterations in endocrine, metabolic, immune, and cardiovascular function.[12 13] Changes in immunity in pregnancy may result in higher maternal susceptibility to certain common infectious diseases and in diminished immune responses. This could lead to more severe disease courses in pregnancy, than in the non-pregnant state and consequently to longer SA spells. Similarly, while women's conditions with certain autoimmune diseases improve during pregnancy and may deteriorate after delivery, for others there is a deterioration or no change during gestation.[14] Also, women with a genetic vulnerability or certain risk factors, may experience pregnancy-induced hypertension/preeclampsia, gestational diabetes, peri- and postpartum thrombotic events, or peri- and postpartum psychiatric disorders. Several of these conditions reverse shortly after delivery/the postpartum period, but may reappear later in vulnerable women and

result in SA or DP.[13] Women with in vitro fertilization may have increased SA also in the time preceding conception.

Regarding SA, a Norwegian study found that the higher SA risk in women in the years after pregnancy disappeared when SA during subsequent pregnancies were accounted for.[15] However, this study included mothers only and no information on DP was included, which means that long-term or permanent reductions in work capacity was not accounted for.

The mean age for first childbirth, and the prevalence of several maternal chronic diseases, of obesity, and in vitro fertilization has increased over the past decades, which may contribute to an increase in rates over time of certain complications related to pregnancy and childbirth[6 16 17] and subsequently higher SA rates during and shortly after pregnancy.

It has also been argued that the combination of paid and unpaid work could be one reason for women having higher levels of SA and DP than men.[18-20] However, other findings have reported a positive association between multiple roles and health and well-being, respectively.[21 22] One exception is single mothers, for whom DP levels according to a Swedish study are higher than for married or cohabiting mothers, a difference that increases with the number of children.[23]

There might also be a positive health selection into giving birth, where women not giving birth may have poorer health and thus are unable to, or choose not to give birth.[5 10 11] However, with these three studies having included twins only, the generalizability to the general population is unclear.

Our aim was to gain knowledge on SA and DP over time in women, in relation to childbirth while accounting for period effects. Specifically, we wanted to compare annual mean net days of SA and DP among women giving and not giving birth, covering a period of three years before and after childbirth. As both childbirth and age are associated with socioeconomic

position, another aim was to examine if the association between childbirth and SA/DP varied between age groups.

METHODS

Longitudinal population-based cohort studies were conducted. We created three different population-based cohorts, using the unique personal identity number assigned to all residents in Sweden for linkage of microdata from five Swedish nationwide registers, from the following three authorities:[24]

-From Statistics Sweden: The Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA) regarding sociodemographic information, year of immigration, and emigration.[25]

-From the National Board of Health and Welfare: 1) The Medical Birth Register (MBR) for dates of childbirth and parity. This register covers 97-99% of all births in Sweden since 1973[17]; 2) the National In-Patient Register for information since 1964 on childbirths not found in the MBR.[26] We used main or secondary diagnoses related to childbirth (as defined by the International Classification of Disease (ICD): ICD-7: 660, 670-678; ICD-8: 650-662; ICD-9: 650, 651, 652, 659X, W/659.W-659.X, 669.E,F,G,H,W,X; ICD-10:O75.7-O75.9, O80-84). If a delivery appeared in both registers, the date from the MBR was used. 3) The Causes of Death Register for date of death.

-From the Swedish Social Insurance Agency, information from their register Micro Data for Analysis of Social Insurance (MiDAS) on SA and DP (start and end dates and extent) for the period 1994-2008 [27]. Only SA spells >14 days were included.

In Sweden, all individuals aged 16 years or older with income from work or unemployment benefits, are entitled to sickness absence benefits from the public sickness insurance system, if

unable to work due to disease or injury. There is one waiting day and a physician certificate is needed from day 8. For employees, sick pay is paid by the employer during the first 14 days of a SA spell. People aged 19-64 who, who due to disease or injury have a long-term or permanently reduced work capacity can be granted DP. Both SA and DP can be granted for full- or part-time (25%, 50% or 75%) of ordinary work hours. Approximately 80% of the lost income, up to a certain limit, is covered by SA benefits, while DP covers up to 65%. Parents can stay home to care for a sick child for 60 days/year/child, with benefits at the same level as SA. There is no waiting day. The number of days can be prolonged in the case of severe disease of the child (e.g., cancer).

Cohorts

We created three cohorts (Cohort1995, Cohort2000, Cohort2005) of all women living in Sweden and aged 18-39 years on 31 December 1994, 1999, or 2004, respectively, using the LISA register. To study SA and DP during the three years prior to three years after first child delivery date (T_0), and to allow comparisons with women not having any births during this period, we only included women who resided in Sweden during the three years prior to the respective inclusion year. To handle that the outcome (SA/DP) might be influenced by a new pregnancy, all women were followed up also for a new childbirth in the 43 weeks after Y_{+3}. For each cohort, we identified three groups of women:

- B0: Women having no childbirths registered neither before nor during the follow-up.
- B1: Women having their first childbirth during the index year and no additional births registered during the follow-up.
- B1+: Women having their first childbirth during the index year and at least one more birth during the follow-up.

Thus, all women with a childbirth prior to the index year (1995, 2000, or 2005) were excluded. For the women in B0, T_0 was set to 2 July of each index year.

Outcome

We calculated the number of annual mean net SA and DP days for each of the three years preceding T_0 and the three years after, for each cohort, respectively. However, as data on SA and DP was only available from 1994, only one year prior to T_0 was considered for Cohort1995. Part-time SA/DP days were combined, e.g., two days of half-time SA or DP was counted as one net day.

Sociodemographics

The following covariates were included: age (categorized into four groups: 18-24, 25-29, 30-34, and 35-39 years), country of birth (Sweden, other Scandinavian country, other EU 25, and rest of the world), type of living area (based on the H-classification scheme[20]), categorized as: large city (Stockholm, Gothenburg, Malmö); medium-sized city (≥90,000 inhabitants); and small city/village (<90,000 inhabitants)), family situation (married/cohabitant and single), and educational level (categorized as elementary (≤9 years), high school (10–12 years), and university/college (>12 years)). These variables were obtained from the LISA register and were measured on 31 December 1994, 1999, and 2004, respectively.

Statistical analyses

We calculated annual mean numbers of net SA and DP days, starting three years preceding the date of the first childbirth (Y_{-3}) until three years after (Y_{+3}) for the three comparisons groups (B0, B1, B1+) within each cohort. Both crude and standardized mean numbers of net

days were calculated. We used a direct standardization using Cohort2005 as the standard population. In the standardization, all sociodemographic variables were taken into account; age (in four categories), country of birth, place of residence, educational level, and family status (as binary). Women who died or emigrated within three years after child delivery were excluded from the analyses from the year after death or emigration.

Further, for Cohort2005, we calculated the proportion of all women who had DP or at least one SA spell >14 days, respectively, and also the proportion of women with SA among those who had no DP.

As age is strongly associated with both SA/DP and childbirth,[6] we also performed analyses stratified by age for Cohort2005, calculating 95% confidence intervals (CI) for the means of the sums of SA and DP net days. All analyses were conducted using SAS 9.4.

The project was approved by the Regional Ethical Review Board in Stockholm, Sweden.

Patient and public involvement

The study participants or the general public were not involved in decisions about the research question, the design of the study, the outcomes, the conduct of the study, the drafting of the paper, nor in the dissemination of the study results.

RESULTS

In all three cohorts, 92-93% of the women had no childbirths, that is, they belonged to the group B0 (Table 1). Around 13,000 to 15,000 women had had their first childbirth during the index year (3%) but no more births during the study period, i.e., belonged to group B1. About 21,000 to 25,000 women belonged to B1+, i.e., had their first delivery during the index year and at least one additional childbirth during follow-up (4-5%). Women in B0 were younger

(18-24 years), had lower educational level, and were to a higher extent single. A lower rate of women in B1+ were in the oldest age group (i.e., 35-39 years), as compared to women in B0 and B1. Furthermore, women in group B1+ were more likely to have higher education and to be married or cohabiting, than those in B0 and B1.

For Cohort2005, women in B1 had the highest proportion of SA/DP combined during Y_{-3} to Y_{-1}, as well as the highest proportion of SA between Y_{-3} to Y_{+1}, while B1+ had both highest proportion of SA/DP combined and SA the other years (Table 2). The highest proportions of women on DP were found for B0 during all years, ranging from 3.4% to 5.8%. Among DP recipients, the proportion on part-time DP was lowest in B0 and highest in B1+ (Table 2). Among SA recipients, women in B1+ were more likely to have shorter SA spells than women in B0 or B1+ (Table 2).

Table 1. Characteristics of the three cohorts of women, by cohort and childbirth group[1].

	Cohort 1995 (N=486,628) (%)			Cohort 2000 (N=490,878) (%)			Cohort 2005 (N=492,504) (%)		
	B0[1]	B1[1]	B1+[1]	B0	B1	B1+	B0	B1	B1+
N	450630	15096	20902	455962	13569	21347	453532	14299	24673
Age (years)									
18-24	58.1	36.2	35.3	55.4	29.4	25.6	56.7	25.8	21.4
25-29	19.9	35.5	43.7	21.6	36.0	46.2	20.4	32.1	42.0
30-34	11.9	20.1	17.7	12.4	24.4	23.8	12.4	28.6	30.9
35-39	10.1	8.2	3.3	10.6	10.2	4.4	10.5	13.5	5.8
Country of birth									
Sweden	90.5	91.1	94.0	89.0	88.2	93.0	87.6	86.6	91.5
Other Scandinavian country	2.2	2.6	1.7	1.4	1.7	1.2	1.1	1.4	1.0
Other EU 25	1.6	1.3	0.8	1.5	1.3	0.8	1.6	1.5	1.0
Rest of the world	5.7	5.0	3.5	8.1	8.8	5.0	9.7	10.5	6.5
Type of living area									
Large cities	41.7	39.7	37.0	43.3	41.6	41.4	43.4	43.8	44.1
Medium-sized cities	34.9	34.9	35.4	35.1	34.5	34.2	35.7	33.7	34.2
Small cities/village	23.4	25.4	27.6	21.7	23.9	24.4	20.9	22.5	21.8
Educational level									
Elementary school (≤9 years)	19.4	15.3	9.2	21.9	18.5	9.6	20.0	12.7	7.1
High school (10-12 years)	57.2	60.0	57.3	49.5	52.7	48.1	45.9	47.2	38.6
University/college (≥13 years)	23.4	24.7	33.5	28.6	28.8	42.3	34.1	40.1	54.3
Family situation									
Married or cohabitant	6.0	22.0	28.7	5.1	22.3	29.2	4.5	22.5	27.7
Single	94.0	78.0	71.3	94.9	77.7	70.8	95.5	77.5	72.3

[1]B0=No childbirth during follow-up, B1=First childbirth during index year (at date T_0) of each cohort and no more children during follow-up, B1+=First childbirth at T_0 and at least one more during follow-up.

Table 2. Proportion of women with a sickness absence spell >14 days and disability pension during the six different years before and after childbirth, for Cohort2005, by childbirth group

Year	Childbirth group	Total study population				Of DP recipients, received DP		Of SA recipients, received SA for a period of			
		N	SA/DP[1] (%)	DP[1] (%)	SA[2] (%)	Part of the year (%)	All year (%)	>0-30 days (%)	>30-90 days (%)	>90-180 days (%)	>180 days (%)
Y_{-3}	B0	453532	9.5	3.4	6.6	26.8	73.2	40.0	22.8	13.6	23.6
	B1	14299	12.6	1.4	11.6	53.8	46.2	43.1	22.6	14.9	19.4
	B1+	24673	8.9	0.5	8.6	63.4	36.6	51.0	24.0	12.7	12.3
Y_{-2}	B0	453532	9.5	3.9	6.2	24.3	75.7	34.2	23.3	14.8	27.7
	B1	14299	12.7	2.0	11.4	52.8	47.2	40.8	22.3	14.1	22.8
	B1+	24673	8.6	0.7	8.1	60.9	39.1	45.7	25.5	13.8	14.9
Y_{-1}	B0	453532	10.3	4.5	6.5	25.5	74.5	36.3	23.6	15.3	24.8
	B1	14299	36.2	2.4	35.0	44.7	55.3	37.8	36.9	15.8	9.5
	B1+	24673	30.6	0.8	30.2	50.8	49.2	45.4	35.8	13.3	5.6
Y_{+1}	B0	453532	11.1	5.0	6.9	25.5	74.5	41.1	23.2	13.9	21.9
	B1	14299	10.7	2.4	8.7	36.2	63.8	61.5	22.5	8.4	7.7
	B1+	24673	6.8	0.8	6.1	49.7	50.3	67.9	20.2	6.5	5.4
Y_{+2}[3]	B0	448921	11.8	5.4	7.3	26.5	73.5	43.1	22.6	13.7	20.6
	B1	14270	10.7	2.6	8.7	37.1	62.9	44.1	21.5	14.1	20.3
	B1+	24671	15.1	0.8	14.5	45.4	54.6	50.4	33.4	11.7	4.6
Y_{+3}[3]	B0	443320	12.0	5.8	7.1	27.1	72.9	43.7	23.1	13.2	20.0
	B1	14183	12.7	2.9	10.6	43.0	57.0	44.7	20.9	13.2	21.1
	B1+	24667	19.1	0.8	18.5	47.5	52.5	50.8	34.7	11.0	3.5

SA=sickness absence, DP=disability pension.

[1]Having DP was defined as 1≤DP net annual days≤364. [2]SA spell>14 days after excluding those with full-time DP. [3]Numbers of women in Y_{+2} and Y_{+3} are lower due to the fact that some died or emigrated during these years.

Comparing crude annual mean net SA and DP days, we found a similar pattern regardless of cohort (Figure 1). Group B0 had the highest mean SA/DP days combined, followed by group B1 and group B1+. The only exception to this was year Y_{-1}, that is the year of the first pregnancy for B1 and B1+, when group B0 had the lowest crude number of combined SA and DP days. During all years, the largest difference was found in DP days, where women with no childbirths had up to 10 times the number of DP days as compared to women in group B1+.

The standardized mean number of combined SA/DP days showed similar patterns for the three different cohorts (Figure 2). Women with no childbirths (B0) had the highest number of SA/DP days at all years except at Y_{-1}, when B1 had the highest number of SA/DP days, followed by group B1+. Also for standardized number of days, the largest differences were seen for DP. Regardless of year, women in B0 had three to ten times more DP days than did the other groups. SA days were more evenly spread. In Cohort2005 during Y_{-3} and Y_{-2} group B0 and group B1 had similar number of mean SA days (11.3; 10.9 and 11.6; 11.6, respectively). Women with at least one additional childbirth had fewer mean SA days, 7.0 and 7.5 SA days at Y_{-3} and Y_{-2}. The pattern for the association between childbirth and SA/DP was largely similar across cohorts. There was also an increase in SA and DP over time in all groups.

In the age-stratified analyses for Cohort2005, we found that the youngest women (18-24 years) in B1 had the highest mean SA and DP days, whereas B0 women had the lowest mean number of corresponding days (Figure 3). Still, B0 women had slightly more DP days, regardless of year. In the other age groups, B0 women had most DP days during all years, as compared with B1 and B1+, while women in B1+ had lowest number of SA days during all years, except during Y_{-1}. Women aged 30-39 in B0 had the highest mean SA and DP days, regardless of year. Their combined mean number of SA/DP days varied between 50 and 60, whereas the range was 30-40 in group B1 and 8-25 in B1+.

DISCUSSION

In this exploratory population-based study using three cohorts from different time periods, we found that women who had no childbirths had up to ten times higher rates of DP than their counterparts who gave at least one birth, regardless of cohort and year studied. Women

having one additional, subsequent childbirth during follow-up, tended to have fewer days of combined SA and DP, than women having no childbirths. The findings suggest no period effects regarding the linkages between childbirth and the investigated outcomes.

Our finding that women with no childbirths had higher levels of DP is in line with those of a Swedish study of twins up to ten years after childbirth, which reported that the number of DP days was significantly higher in women not giving birth than in their twin sisters who did.[10] Further, this twin study found that except for the year of childbirth, the number of mean annual SA days (for SA spells >14 days) was similar among women giving birth and those who did not. Our study showed similar results, except that women who had more than one childbirth had slightly fewer mean SA days, than the other two groups of women.

Women with poor health or other characteristics associated with adverse health may decide against going through a pregnancy.[19 21] This may be part of the explanation for the substantially higher levels of DP among women with no childbirths in our study, i.e., a positive health selection into giving birth, or into having more than one birth is likely, as has been suggested by others.[10] However, with improvements in medical care, more women with severe diseases who earlier had to refrain from pregnancy due to disease, might now choose otherwise. In line with the above mentioned results, a Swedish twin study also indicated a health selection into giving birth.[11] It also emphasized their findings regarding multiple hospitalizations before subsequent DP. Future studies with good measures of morbidities (e.g., in terms of specific medical diagnoses) are needed to more closely investigate the health selection mechanisms into childbirth.

In our study, women aged 30 years or more, with no childbirths, had higher mean SA days than those with one or more childbirths. Mean number of DP days were higher in all age groups among women with no childbirths. These findings indicate that the hypothesis of that

childbirth leads to more SA[25] strongly can be questioned and that information of DP is also warranted in studies of SA in women with and without children.

We found that women having a subsequent childbirth during the follow-up (B1+), had – except for the year before delivery – fewer days of both SA and DP up until Y_{+1} than B0 or B1 did, but from Y_{+2} the levels were closer to those in B1, an increase possibly due to a new pregnancy. This is in accordance with a Norwegian study reporting that the higher SA risk in women in the years after pregnancy disappeared, when SA during subsequent pregnancies were accounted for.[15]

When we analysed period effects, our results indicated similar patterns between the three exposure groups regardless of cohort. Nevertheless, the levels of SA/DP combined increased in a graded manner from Cohort1995 to Cohort2000 and was highest in Cohort2005. Our data did not allow to investigate the reasons for the increasing SA/DP time trends, but we speculate that among childbearing women potential explanations may be related to the increase in age at first childbirth, the better medical care thanks to which women with severe conditions who earlier refrained from now can engage in pregnancy, as well as better possibilities to remain in paid work during pregnancy. Nevertheless, the fact that the SA/DP levels increased over time also among women not giving birth may suggest that factors not related to childbearing and childrearing may also be important, e.g., changes in mental disorder rates at the population-level, in possibilities to combine paid and unpaid work and to remain in employment with certain medical conditions, in physicians' sick-listing practices and in rules or practices concerning SA and DP at the Social Insurance Agency. Furthermore, there have been extensive changes in Swedish work life since the 1990s, as in other Western countries. More organisational instability and downsizing accompanied by a higher prevalence of adverse psychosocial work situations, have increased the work demands in

ways that can interfere with work and family life balance, potentially increasing SA/DP over time.[28-30]

The strengths of this study include its population-based and longitudinal design, and the use of high-quality and nationwide register data with high completeness, validity and no drop-outs.[24] The use of National Patient Register data in addition to the MBR allowed us to include childbirths not captured by the MBR. Furthermore, we were able to account for factors related both to the occurrence of SA/DP and childbirth such as maternal age, educational level, and type of living area, by means of a standardized analysis taking these variables into account. Another strength is related to characteristics of the Swedish labour market and public insurance system, i.e., high employment rates among women[31] (that is, low health selection bias) and a public sickness insurance covering basically the whole population. However, two study limitations warrant consideration in contextualizing the present results. First, women who had only given birth outside of Sweden would not appear in the registers and may thus, be incorrectly categorized as not having had any childbirth. This may result in differential misclassification of exposure, and biased levels of SA/DP in women having no childbirths. To mitigate this, and to make sure we had information on their possible SA/DP, residency in Sweden for at least three years prior to childbirth was an inclusion criterion. We had no information on SA spells <15 days, this can be considered both a limitation and a strength. The shorter SA spells only represent a limited number of all SA days, and most are self-reported and not verified by any physician certificate.[32] The underestimation of the mean yearly SAs is more likely to affect women who gave birth than those who did not since small children are vulnerable to infections and their parents are likely to catch these; nevertheless, parents probably choose the social benefits for caring for sick children if they are sick at the same time as the child.

In conclusion, women who had more than one childbirth had – except for the year before delivery – lower rates and fewer days of both SA and DP, than women with one childbirth only and women not giving birth. Further, women not giving birth had markedly more DP days than women who gave birth. These findings are suggestive of a health selection into childbirth. No period effects in the association between childbirth and these outcomes were detected. High levels of SA and DP among parous women appear to be mainly restricted to pregnancy. DP should also be included in studies of SA in relation to childbirth.

Contributors CB conducted the analyses, wrote the first draft and revised the paper; CO contributed to analyses and revised the paper; KL contributed to writing, interpretation of the findings and revised the paper; PS and KA contributed to the conception and design of the study, interpretation of the findings and revised the paper; MV, UL and PL contributed to the design of the study, interpretation of the findings and revised the paper. All authors have read and approved the final version of the manuscript.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The project was approved by the Regional Ethical Review Board of Stockholm. The Ethical Review Board waived the requirement that informed consent of research subjects should be obtained.

Data sharing statement The data used in this study is administered by the Division of Insurance Medicine, Karolinska Institutet, and cannot be made public. According to the General Data Protection Regulation, the Swedish law SFS 2018:218, the Swedish Data Protection Act, the Swedish Ethical Review Act, and the Public Access to Information and Secrecy Act, these type of sensitive data can only be made available, after legal review, for researchers who meet the criteria for access to this type of sensitive and confidential data. Readers may contact Professor Kristina Alexanderson (kristina.alexanderson@ki.se) regarding the data.

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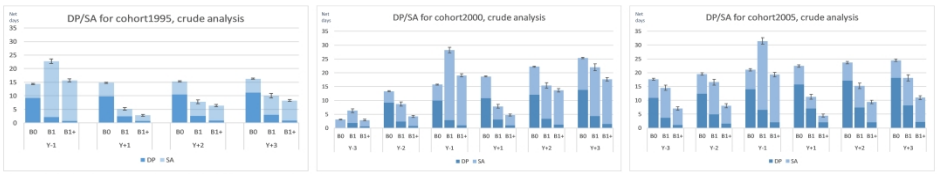
FIGURE LEGENDS

Figure 1. Crude mean annual net days of sickness absence (SA) and disability pension (DP) from Y_{-3} to Y_{+3}, in Cohort1995, Cohort2000, and Cohort2005, respectively, by childbirth group.

Figure 2. Standardized mean annual net days of sickness absence (SA) and disability pension (DP) from Y_{-3} to Y_{+3} in Cohort1995, Cohort2000, and Cohort2005, respectively, by childbirth group.

Figure 3. Crude mean annual net days of sickness absence (SA) and disability pension (DP) from Y_{-3} to Y_{+3} in Cohort2005, by age group and childbirth group.



*The vertical lines represent the confidence interval for the sum of SA and DP net days

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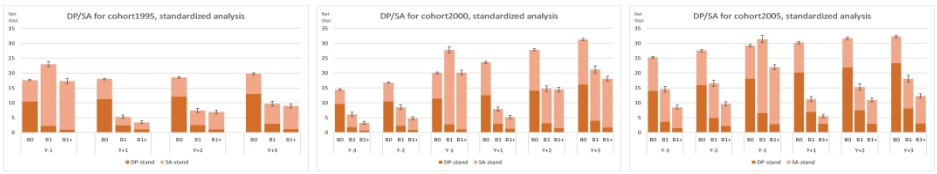

*The vertical lines represent the confidence interval for the sum of SA and DP net days

929x190mm (300 x 300 DPI)

*The vertical lines represent the confidence interval for the sum of SA and DP net days

603x400mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	p. 1, 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	p. 2, 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	p. 4-6
Objectives	3	State specific objectives, including any prespecified hypotheses	p. 5-6
Methods			
Study design	4	Present key elements of study design early in the paper	p. 6-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	p. 6-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	p. 6-8
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	-
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	p. 7, 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	p. 6-8
Bias	9	Describe any efforts to address potential sources of bias	p. 8, 9
Study size	10	Explain how the study size was arrived at	p. 7, 8, 11
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	p. 7-9, 11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	p. 8, 9
		(*b*) Describe any methods used to examine subgroups and interactions	p. 9
		(*c*) Explain how missing data were addressed	-
		(*d*) If applicable, explain how loss to follow-up was addressed	p. 11
		(*e*) Describe any sensitivity analyses	p. 9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	p. 11, 12
		(b) Give reasons for non-participation at each stage	p. 7, 8, 12
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	p. 11
		(b) Indicate number of participants with missing data for each variable of interest	p. 11
		(c) Summarise follow-up time (eg, average and total amount)	-
Outcome data	15*	Report numbers of outcome events or summary measures over time	p. 12, Figures 1-3
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted	Figures 1-3

		estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	p. 8, 11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	p. 12-13
Discussion			
Key results	18	Summarise key results with reference to study objectives	p. 13-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	p. 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	p. 13-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	p. 16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	p. 18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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Sickness absence and disability pension before and after first childbirth and in nulliparous women: longitudinal analyses of three cohorts in Sweden

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Sickness absence and disability pension before and after first childbirth and in nulliparous women: longitudinal analyses of three cohorts in Sweden

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ABSTRACT

Objective Childbirth is suggested to be associated with elevated levels of sickness absence (SA) and disability pension (DP). However, detailed knowledge about SA/DP patterns around childbirth is lacking. We aimed to compare SA/DP across different time periods among women according to their childbirth status.

Design Register-based longitudinal cohort study.

Setting Sweden.

Participants Three population-based cohorts of nulliparous women aged 18-39 years, living in Sweden 31 December 1994, 1999, or 2004 (nearly 500,000/cohort).

Primary and secondary outcome measures Sum of SA>14 and DP net days/year.

Methods We compared crude and standardized mean SA and DP days/year during the three years preceding and the three years after first childbirth date (Y_{-3} to Y_{+3}), among women having (1) their first and only birth during the subsequent three years (B1), (2) their first birth and at least another delivery (B1+), and (3) no childbirths during follow-up (B0).

Results Despite an increase in SA in the year preceding the first childbirth, women in the B1 group, and especially in B1+, tended to have fewer SA/DP days throughout the years than women in the B0 group. For cohort 2005, the mean SA/DP days/year (95% confidence intervals) in the B0, B1, and B1+ groups were for Y_{-3}: 25.3 (24.9-25.7), 14.5 (13.6-15.5), and 8.5 (7.9-9.2); Y_{-2}: 27.5 (27.1-27.9), 16.6 (15.5-17.6), and 9.6 (8.9-10.4); Y_{-1}: 29.2 (28.8-29.6), 31.4 (30.2-32.6) and 22.0 (21.2-22.9); Y_{+1}: 30.2 (29.8-30.7), 11.2 (10.4-12.1), and 5.5 (5.0-6.1); Y_{+2}: 31.7 (31.3-32.1), 15.3 (14.2-16.3), and 10.9 (10.3-11.6); Y_{+3}: 32.3 (31.9-32.7), 18.1 (17.0-19.3), and 12.4 (11.7-13.0), respectively. These patterns were the same in all three cohorts.

Conclusions Women with more than one childbirth had fewer SA/DP days/year compared to women with one childbirth or with no births. Women who did not give birth had markedly more DP days than those giving birth, suggesting a health selection into childbirth.

Key words Sick leave, disability pension, childbirth, cohort study, postpartum, pregnancy, child delivery

Strengths and limitations of this study

- The study involved longitudinal analyses of both sickness absence and disability pension.
- It was population-based, we included virtually all nulliparous women in Sweden during the study periods.
- By analysing three cohorts of women five years apart we explored potential time-period effects.
- Since we used large, nationwide data, statistical precision in our analyses was high.
- We had no information on sickness absence spells ≤14 days.

BACKGROUND

In many countries with high labour force participation of women, women have higher levels of sickness absence (SA) and disability pension (DP) than men.[1-4] One suggestion to explain this gender difference focuses on SA during pregnancy and after childbirth.[5-8] Also for DP, pregnancy has been suspected to be a factor behind this gender gap, although findings are less consistent than for SA.[8] Swedish studies have shown that women have higher SA during pregnancy, as well as during the years following childbirth, as compared to other years.[5 6 9 10] Yet, it is unclear whether women have elevated rates of SA also during the years preceding their first childbirth. Findings from twin studies, have shown that women who gave birth had lower average number of SA days compared with their nulliparous twin sisters.[5 10 11] After delivery the average number of SA days were similar in both groups. However, few studies have focused on SA and DP in different groups of women; most have focused on gender differences.

Pregnancy and the postpartum period are characterized by important alterations in endocrine, metabolic, immune, and cardiovascular function.[12 13] Changes in immunity in pregnancy may result in higher maternal susceptibility to certain common infectious diseases and in diminished immune responses. This could lead to more severe disease courses in pregnancy, than in the non-pregnant state and consequently to longer SA spells. Similarly, while women's conditions with certain autoimmune diseases improve during pregnancy and may deteriorate after delivery, for others there is a deterioration or no change during gestation.[14] Also, women with a genetic vulnerability or certain risk factors, may experience pregnancy-induced hypertension/preeclampsia, gestational diabetes, peri- and postpartum thrombotic events, or peri- and postpartum psychiatric disorders. Several of these conditions reverse shortly after delivery/the postpartum period, but may reappear later in vulnerable women and

result in SA or DP.[13] Women with in vitro fertilization may have increased SA also in the time preceding conception.

Regarding SA, a Norwegian study found that the higher SA risk in women in the years after pregnancy disappeared when SA during subsequent pregnancies were accounted for.[15] However, this study included mothers only and no information on DP was included, which means that long-term or permanent reductions in work capacity was not accounted for.

The mean age for first childbirth, and the prevalence of several maternal chronic diseases, of obesity, and in vitro fertilization has increased over the past decades, which may contribute to an increase in rates over time of certain complications related to pregnancy and childbirth [6 16 17] and subsequently higher SA rates during and shortly after pregnancy.

It has also been argued that the combination of paid and unpaid work could be one reason for women having higher levels of SA and DP than men.[18-20] However, other findings have reported a positive association between multiple roles and health and well-being, respectively.[21 22] One exception is single mothers, for whom DP levels according to a Swedish study are higher than for married or cohabiting mothers, a difference that increases with the number of children.[23]

There might also be a positive health selection into giving birth, where women not giving birth may have poorer health and thus are unable to, or choose not to give birth.[5 10 11] However, with these three studies having included twins only, the generalizability to the general population is unclear.

Our aim was to gain knowledge on SA and DP over time in women, in relation to childbirth while accounting for period effects. Specifically, we wanted to compare annual mean net days of SA and DP among women giving and not giving birth, covering a period of three years before and after childbirth. As both childbirth and age are associated with socioeconomic

position, another aim was to examine if the association between childbirth and SA/DP varied between age groups.

METHODS

Longitudinal population-based cohort studies were conducted. We created three different population-based cohorts, using the unique personal identity number assigned to all residents in Sweden for linkage of microdata from five Swedish nationwide registers, from the following three authorities:[24]

-From Statistics Sweden: The Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA) regarding sociodemographic information, year of immigration, and emigration.[25]

-From the National Board of Health and Welfare: 1) The Medical Birth Register (MBR) for dates of childbirth and parity. This register covers 97-99% of all births in Sweden since 1973 [17]; 2) the National In-Patient Register for information since 1964 on childbirths not found in the MBR.[26] We used main or secondary diagnoses related to childbirth (as defined by the International Classification of Disease (ICD): ICD-7: 660, 670-678; ICD-8: 650-662; ICD-9: 650, 651, 652, 659X, W/659.W-659.X, 669.E,F,G,H,W,X; ICD-10:O75.7-O75.9, O80-84). If a delivery appeared in both registers, the date from the MBR was used. 3) The Causes of Death Register for date of death.

-From the Swedish Social Insurance Agency, information from their register Micro Data for Analysis of Social Insurance (MiDAS) on SA and DP (start and end dates and extent) for the period 1994-2008 [27]. Only SA spells >14 days were included.

In Sweden, all individuals aged 16 years or older with income from work, unemployment benefits, or parental leave benefits, as well as students are entitled to SA benefits from the

public sickness insurance system, if their disease or injury is so severe that it has led to work incapacity in relation to ordinary work duties. There is one waiting day and a physician certificate is needed from day 8. For employees, sick pay is paid by the employer during the first 14 days of a SA spell. People aged 19-64 who, due to disease or injury have a long-term or permanently reduced work capacity can be granted DP. Both SA and DP can be granted for full- or part-time (25%, 50% or 75%) of ordinary work hours. Approximately 80% of the lost income, up to a certain limit, is covered by SA benefits, while DP covers up to 65%. If on parental leave at the time of disease or injury, the parent may receive SA benefits (instead of parental leave benefits) in circumstances that involve hospital care or if due to the morbidity he/she cannot take care of the child. Women on full or partial DP before giving birth remain on DP also after giving birth. Parents can stay home to care for a sick child for 60 days/year/child, with benefits at the same level as SA. There is no waiting day. The number of days can be prolonged in the case of severe disease of the child (e.g., cancer).

Cohorts

We created three cohorts (Cohort1995, Cohort2000, Cohort2005) of all women living in Sweden and aged 18-39 years on 31 December 1994, 1999, or 2004, respectively, using the LISA register. To study SA and DP during the three years prior to three years after first child delivery date (T_0), and to allow comparisons with women not having any births during this period, we only included women who resided in Sweden during the three years prior to the respective inclusion year. To handle that the outcome (SA/DP) might be influenced by a new pregnancy, all women were followed up also for a new childbirth in the 43 weeks after Y_{+3}. For each cohort, we identified three groups of women:

- B0: Women having no childbirths registered neither before nor during the follow-up.

- B1: Women having their first childbirth during the index year and no additional births registered during the follow-up.
- B1+: Women having their first childbirth during the index year and at least one more birth during the follow-up.

Thus, all women with a childbirth prior to the index year (1995, 2000, or 2005) were excluded. For the women in B0, T_0 was set to 2 July of each index year.

Outcome

We calculated the number of annual mean net SA and DP days for each of the three years preceding T_0 and the three years after, for each cohort, respectively. However, as data on SA and DP was only available from 1994, only one year prior to T_0 was considered for Cohort1995. Part-time SA/DP days were combined, e.g., two days of half-time SA or DP was counted as one net day.

Sociodemographics

The following covariates were included: age (categorized into four groups: 18-24, 25-29, 30-34, and 35-39 years), country of birth (Sweden, other Scandinavian country, other EU 25, and rest of the world), type of living area (based on the H-classification scheme[20]), categorized as: large city (Stockholm, Gothenburg, Malmö); medium-sized city (≥90,000 inhabitants); and small city/village (<90,000 inhabitants)), family situation (married/cohabitant and single), and educational level (categorized as elementary (≤9 years), high school (10–12 years), and university/college (>12 years)). These variables were obtained from the LISA register and were measured on 31 December 1994, 1999, and 2004, respectively.

Statistical analyses

We calculated annual mean numbers of net SA and DP days, starting three years preceding the date of the first childbirth (Y_{-3}) until three years after (Y_{+3}) for the three comparisons groups (B0, B1, B1+) within each cohort. Both crude and standardized mean numbers of net days were calculated. We used a direct standardization using Cohort2005 as the standard population. In the standardization, all sociodemographic variables were taken into account; age (in four categories), country of birth, place of residence, educational level, and family status (as binary). Women who died or emigrated within three years after child delivery were excluded from the analyses from the year after death or emigration.

Further, for Cohort2005, we calculated the proportion of all women who had DP or at least one SA spell >14 days, respectively, and also the proportion of women with SA among those who had no DP.

As age is strongly associated with both SA/DP and childbirth,[6] we also performed analyses stratified by age for Cohort2005, calculating 95% confidence intervals (CI) for the means of the sums of SA and DP net days. All analyses were conducted using SAS 9.4.

The project was approved by the Regional Ethical Review Board in Stockholm, Sweden.

Patient and public involvement

The study participants or the general public were not involved in decisions about the research question, the design of the study, the outcomes, the conduct of the study, the drafting of the paper, nor in the dissemination of the study results.

RESULTS

In all three cohorts, 92-93% of the women had no childbirths, that is, they belonged to the group B0 (Table 1). Around 13,000 to 15,000 women had had their first childbirth during the index year (3%) but no more births during the study period, i.e., belonged to group B1. About 21,000 to 25,000 women belonged to B1+, i.e., had their first delivery during the index year and at least one additional childbirth during follow-up (4-5%). Women in B0 were younger (18-24 years), had lower educational level, and were to a higher extent single. A lower rate of women in B1+ were in the oldest age group (i.e., 35-39 years), as compared to women in B0 and B1. Furthermore, women in group B1+ were more likely to have higher education and to be married or cohabiting, than those in B0 and B1.

For Cohort2005, women in B1 had the highest proportion of SA/DP combined during Y_{-3} to Y_{-1}, as well as the highest proportion of SA between Y_{-3} to Y_{+1}, while B1+ had both highest proportion of SA/DP combined and SA the other years (Table 2). The highest proportions of women on DP were found for B0 during all years, ranging from 3.4% to 5.8%. Among DP recipients, the proportion on part-time DP was lowest in B0 and highest in B1+ (Table 2). Among SA recipients, women in B1+ were more likely to have shorter SA spells than women in B0 or B1+ (Table 2).

Table 1. Characteristics of the three cohorts of women, by cohort and childbirth group[1].

	Cohort 1995 (N=486,628) (%)			Cohort 2000 (N=490,878) (%)			Cohort 2005 (N=492,504) (%)		
	B0[1]	B1[1]	B1+[1]	B0	B1	B1+	B0	B1	B1+
N	450630	15096	20902	455962	13569	21347	453532	14299	24673
Age (years)									
18-24	58.1	36.2	35.3	55.4	29.4	25.6	56.7	25.8	21.4
25-29	19.9	35.5	43.7	21.6	36.0	46.2	20.4	32.1	42.0
30-34	11.9	20.1	17.7	12.4	24.4	23.8	12.4	28.6	30.9
35-39	10.1	8.2	3.3	10.6	10.2	4.4	10.5	13.5	5.8
Country of birth									
Sweden	90.5	91.1	94.0	89.0	88.2	93.0	87.6	86.6	91.5
Other Scandinavian country	2.2	2.6	1.7	1.4	1.7	1.2	1.1	1.4	1.0
Other EU 25	1.6	1.3	0.8	1.5	1.3	0.8	1.6	1.5	1.0
Rest of the world	5.7	5.0	3.5	8.1	8.8	5.0	9.7	10.5	6.5
Type of living area									
Large cities	41.7	39.7	37.0	43.3	41.6	41.4	43.4	43.8	44.1
Medium-sized cities	34.9	34.9	35.4	35.1	34.5	34.2	35.7	33.7	34.2
Small cities/village	23.4	25.4	27.6	21.7	23.9	24.4	20.9	22.5	21.8
Educational level									
Elementary school (≤9 years)	19.4	15.3	9.2	21.9	18.5	9.6	20.0	12.7	7.1
High school (10-12 years)	57.2	60.0	57.3	49.5	52.7	48.1	45.9	47.2	38.6
University/college (≥13 years)	23.4	24.7	33.5	28.6	28.8	42.3	34.1	40.1	54.3
Family situation									
Married or cohabitant	6.0	22.0	28.7	5.1	22.3	29.2	4.5	22.5	27.7
Single	94.0	78.0	71.3	94.9	77.7	70.8	95.5	77.5	72.3

[1]B0=No childbirth during follow-up, B1=First childbirth during index year (at date T_0) of each cohort and no more children during follow-up, B1+=First childbirth at T_0 and at least one more during follow-up.

Table 2. Proportion of women with a sickness absence spell >14 days and disability pension during the six different years before and after childbirth, for Cohort2005, by childbirth group

Year	Childbirth group	Total study population				Of DP recipients, received DP		Of SA recipients, received SA for a period of			
		N	SA/DP[1] (%)	DP[1] (%)	SA[2] (%)	Part of the year (%)	All year (%)	>0-30 days (%)	>30-90 days (%)	>90-180 days (%)	>180 days (%)
Y_{-3}	B0	453532	9.5	3.4	6.6	26.8	73.2	40.0	22.8	13.6	23.6
	B1	14299	12.6	1.4	11.6	53.8	46.2	43.1	22.6	14.9	19.4
	B1+	24673	8.9	0.5	8.6	63.4	36.6	51.0	24.0	12.7	12.3
Y_{-2}	B0	453532	9.5	3.9	6.2	24.3	75.7	34.2	23.3	14.8	27.7
	B1	14299	12.7	2.0	11.4	52.8	47.2	40.8	22.3	14.1	22.8
	B1+	24673	8.6	0.7	8.1	60.9	39.1	45.7	25.5	13.8	14.9
Y_{-1}	B0	453532	10.3	4.5	6.5	25.5	74.5	36.3	23.6	15.3	24.8
	B1	14299	36.2	2.4	35.0	44.7	55.3	37.8	36.9	15.8	9.5
	B1+	24673	30.6	0.8	30.2	50.8	49.2	45.4	35.8	13.3	5.6
Y_{+1}	B0	453532	11.1	5.0	6.9	25.5	74.5	41.1	23.2	13.9	21.9
	B1	14299	10.7	2.4	8.7	36.2	63.8	61.5	22.5	8.4	7.7
	B1+	24673	6.8	0.8	6.1	49.7	50.3	67.9	20.2	6.5	5.4
Y_{+2}[3]	B0	448921	11.8	5.4	7.3	26.5	73.5	43.1	22.6	13.7	20.6
	B1	14270	10.7	2.6	8.7	37.1	62.9	44.1	21.5	14.1	20.3
	B1+	24671	15.1	0.8	14.5	45.4	54.6	50.4	33.4	11.7	4.6
Y_{+3}[3]	B0	443320	12.0	5.8	7.1	27.1	72.9	43.7	23.1	13.2	20.0
	B1	14183	12.7	2.9	10.6	43.0	57.0	44.7	20.9	13.2	21.1
	B1+	24667	19.1	0.8	18.5	47.5	52.5	50.8	34.7	11.0	3.5

SA=sickness absence, DP=disability pension.

[1]Having DP was defined as 1≤DP net annual days≤364. [2]SA spell>14 days after excluding those with full-time DP. [3]Numbers of women in Y_{+2} and Y_{+3} are lower due to the fact that some died or emigrated during these years.

Comparing crude annual mean net SA and DP days, we found a similar pattern regardless of cohort (Figure 1). Group B0 had the highest mean SA/DP days combined, followed by group B1 and group B1+. The only exception to this was year Y_{-1}, that is the year of the first pregnancy for B1 and B1+, when group B0 had the lowest crude number of combined SA and DP days. During all years, the largest difference was found in DP days, where women with no childbirths had up to 10 times the number of DP days as compared to women in group B1+.

The standardized mean number of combined SA/DP days showed similar patterns for the three different cohorts (Figure 2). Women with no childbirths (B0) had the highest number of SA/DP days at all years except at Y_{-1}, when B1 had the highest number of SA/DP days, followed by group B1+. Also for standardized number of days, the largest differences were seen for DP. Regardless of year, women in B0 had three to ten times more DP days than did the other groups. SA days were more evenly spread. In Cohort2005 during Y_{-3} and Y_{-2} group B0 and group B1 had similar number of mean SA days (11.3; 10.9 and 11.6; 11.6, respectively). Women with at least one additional childbirth had fewer mean SA days, 7.0 and 7.5 SA days at Y_{-3} and Y_{-2}. The pattern for the association between childbirth and SA/DP was largely similar across cohorts. There was also an increase in SA and DP over time in all groups.

In the age-stratified analyses for Cohort2005, we found that the youngest women (18-24 years) in B1 had the highest mean SA and DP days, whereas B0 women had the lowest mean number of corresponding days (Figure 3). Still, B0 women had slightly more DP days, regardless of year. In the other age groups, B0 women had most DP days during all years, as compared with B1 and B1+, while women in B1+ had lowest number of SA days during all years, except during Y_{-1}. Women aged 30-39 in B0 had the highest mean SA and DP days, regardless of year. Their combined mean number of SA/DP days varied between 50 and 60, whereas the range was 30-40 in group B1 and 8-25 in B1+.

DISCUSSION

In this exploratory population-based study using three cohorts from different time periods, we found that women who had no childbirths had up to ten times higher rates of DP than their counterparts who gave at least one birth, regardless of cohort and year studied. Women

having one additional, subsequent childbirth during follow-up, tended to have fewer days of combined SA and DP, than women having no childbirths. The findings suggest no period effects regarding the linkages between childbirth and the investigated outcomes.

Our finding that women with no childbirths had higher levels of DP is in line with those of a Swedish study of twins up to ten years after childbirth, which reported that the number of DP days was significantly higher in women not giving birth than in their twin sisters who did.[10] Further, that twin study found that except for the year of childbirth, the number of mean annual SA days (for SA spells >14 days) was similar among women giving birth and those who did not. Our study showed similar results, except that women who had more than one childbirth had slightly fewer mean SA days, than the other two groups of women.

Women with poor health or other characteristics associated with adverse health may decide against going through a pregnancy.[19 21] This may be part of the explanation for the substantially higher levels of DP among women with no childbirths in our study, i.e., a positive health selection into giving birth or into having more than one birth is likely, as has been suggested by others.[10] However, with improvements in medical care, more women with severe diseases who earlier had to refrain from pregnancy due to disease, might now choose otherwise. In line with the above mentioned results, a Swedish twin study also indicated a health selection into giving birth.[11] It also emphasized their findings regarding multiple hospitalizations before subsequent DP. Future studies with good measures of morbidities (e.g., in terms of specific medical diagnoses) are needed to more closely investigate the health selection mechanisms into childbirth.

In our study, women aged 30 years or more, with no childbirths, had higher mean SA days than those with one or more childbirths. Mean number of DP days were higher in all age groups among women with no childbirths. These findings indicate that the hypothesis of that

childbirth leads to more SA [28] strongly can be questioned and that information of DP is also warranted in studies of SA in women with and without children.

We found that women having a subsequent childbirth during the follow-up (B1+), had – except for the year before delivery – fewer days of both SA and DP up until Y_{+1} than B0 or B1 did, but from Y_{+2} the levels were closer to those in B1, an increase possibly due to a new pregnancy. This is in accordance with a Norwegian study reporting that the higher SA risk in women in the years after pregnancy disappeared, when SA during subsequent pregnancies were accounted for.[15] As expected, those who gave birth had lower SA in the year after childbirth (Y_{+1}) as most women are on parental leave for at least some months in that year.[28] Even if it is possible to claim SA benefits also when on parental leave, this is not usual, unless the morbidity leads to not being able to care for the child.

When we analysed period effects, our results indicated similar patterns between the three exposure groups regardless of cohort. Nevertheless, the levels of SA/DP combined increased in a graded manner from Cohort1995 to Cohort2000 and was highest in Cohort2005. Our data did not allow to investigate the reasons for the increasing SA/DP time trends, but we speculate that among childbearing women potential explanations may be related to the increase in age at first childbirth, the better medical care thanks to which women with severe conditions who earlier refrained from now can engage in pregnancy, as well as better possibilities to remain in paid work during pregnancy. Nevertheless, the fact that the SA/DP levels increased over time also among women not giving birth may suggest that factors not related to childbearing and childrearing may also be important, e.g., changes in mental disorder rates at the population-level, in possibilities to combine paid and unpaid work and to remain in employment with certain medical conditions, in physicians' sick-listing practices, and in rules or practices concerning SA and DP at the Social Insurance Agency. Furthermore, there have been extensive changes in Swedish work life since the 1990s, as in other Western

countries. More organisational instability and downsizing accompanied by a higher prevalence of adverse psychosocial work situations, have increased the work demands in ways that can interfere with work and family life balance, potentially increasing SA/DP over time.[29-31]

The strengths of this study include its population-based and longitudinal design, and the use of high-quality and nationwide register data with high completeness, validity and no drop-outs.[24] The use of National Patient Register data in addition to the MBR allowed us to include childbirths not captured by the MBR. Furthermore, we were able to account for factors related both to the occurrence of SA/DP and childbirth such as maternal age, educational level, and type of living area, by means of a standardized analysis taking these variables into account. Another strength is related to characteristics of the Swedish labour market and public insurance system, i.e., high employment rates among women [32] (that is, low health selection bias) and a public sickness insurance covering basically the whole population. However, two study limitations warrant consideration in contextualizing the present results. First, women who had only given birth outside of Sweden would not appear in the registers and may thus, be incorrectly categorized as not having had any childbirth. This may result in differential misclassification of exposure, and biased levels of SA/DP in women having no childbirths. To mitigate this, and to make sure we had information on their possible SA/DP, residency in Sweden for at least three years prior to childbirth was an inclusion criterion. We had no information on SA spells <15 days, this can be considered both a limitation and a strength. The shorter SA spells only represent a limited number of all SA days, and most are self-reported and not verified by any physician certificate.[33] The underestimation of the mean yearly SAs is more likely to affect women who gave birth than those who did not since small children are vulnerable to infections and their parents are likely to catch these; nevertheless, parents probably choose the very generous social benefits for

caring for sick children if they were sick at the same time as the child. We had no information on if and in that case how much the women in the three groups were in paid work, studying, or on different types of parental leave during the studied years.

In conclusion, women who had more than one childbirth had – except for the year before delivery – lower rates and fewer days of both SA and DP, than women with one childbirth only and women not giving birth. Further, women not giving birth had markedly more DP days than women who gave birth. These findings are suggestive of a health selection into childbirth. No period effects in the association between childbirth and these outcomes were detected. High levels of SA and DP among parous women appear to be mainly restricted to pregnancy. DP should also be included in studies of SA in relation to childbirth.

Contributors CB conducted the analyses, wrote the first draft and revised the paper; CO contributed to analyses and revised the paper; KL contributed to writing, interpretation of the findings and revised the paper; PS and KA contributed to the conception and design of the study, interpretation of the findings and revised the paper; MV, UL and PL contributed to the design of the study, interpretation of the findings and revised the paper. All authors have read and approved the final version of the manuscript.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The project was approved by the Regional Ethical Review Board of Stockholm. The Ethical Review Board waived the requirement that informed consent of research subjects should be obtained.

Data sharing statement The data used in this study is administered by the Division of Insurance Medicine, Karolinska Institutet, and cannot be made public. According to the General Data Protection Regulation, the Swedish law SFS 2018:218, the Swedish Data Protection Act, the Swedish Ethical Review Act, and the Public Access to Information and Secrecy Act, these type of sensitive data can only be made available, after legal review, for researchers who meet the criteria for access to this type of sensitive and confidential data. Readers may contact Professor Kristina Alexanderson (kristina.alexanderson@ki.se) regarding the data.

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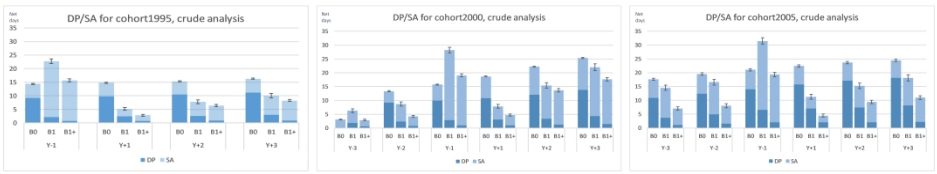
FIGURE LEGENDS

Figure 1. Crude mean annual net days of sickness absence (SA) and disability pension (DP) from Y_{-3} to Y_{+3}, in Cohort1995, Cohort2000, and Cohort2005, respectively, by childbirth group.

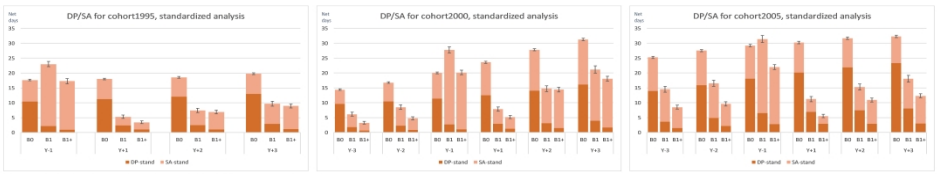
Figure 2. Standardized mean annual net days of sickness absence (SA) and disability pension (DP) from Y_{-3} to Y_{+3} in Cohort1995, Cohort2000, and Cohort2005, respectively, by childbirth group.

Figure 3. Crude mean annual net days of sickness absence (SA) and disability pension (DP) from Y_{-3} to Y_{+3} in Cohort2005, by age group and childbirth group.



*The vertical lines represent the confidence interval for the sum of SA and DP net days

929x190mm (300 x 300 DPI)



*The vertical lines represent the confidence interval for the sum of SA and DP net days

929x190mm (300 x 300 DPI)

*The vertical lines represent the confidence interval for the sum of SA and DP net days

603x400mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	p. 1, 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	p. 2, 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	p. 4-6
Objectives	3	State specific objectives, including any prespecified hypotheses	p. 5-6
Methods			
Study design	4	Present key elements of study design early in the paper	p. 6-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	p. 6-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	p. 6-8
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	-
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	p. 7, 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	p. 6-8
Bias	9	Describe any efforts to address potential sources of bias	p. 8, 9
Study size	10	Explain how the study size was arrived at	p. 7, 8, 11
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	p. 7-9, 11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	p. 8, 9
		(*b*) Describe any methods used to examine subgroups and interactions	p. 9
		(*c*) Explain how missing data were addressed	-
		(*d*) If applicable, explain how loss to follow-up was addressed	p. 11
		(*e*) Describe any sensitivity analyses	p. 9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	p. 11, 12
		(b) Give reasons for non-participation at each stage	p. 7, 8, 12
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	p. 11
		(b) Indicate number of participants with missing data for each variable of interest	p. 11
		(c) Summarise follow-up time (eg, average and total amount)	-
Outcome data	15*	Report numbers of outcome events or summary measures over time	p. 12, Figures 1-3
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted	Figures 1-3

		estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	p. 8, 11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	p. 13
Discussion			
Key results	18	Summarise key results with reference to study objectives	p. 13-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	p. 16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	p. 13-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	p. 16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	p. 18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.