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Age, occupational class, and sickness absence during pregnancy: A retrospective analysis study of the Norwegian population registry

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Abstract

Objective:

Western women increasingly delay having children to advance their career, and pregnancy is considered to be riskier among older women. In Norway, this development somewhat surprisingly coincides with increased sickness absence among young pregnant women, rather than their older counterparts. This paper tests the hypothesis that the negative association between age and sickness absence is due to class differentials in the timing of pregnancy.

Design:

A zero-inflated Poisson regression was conducted on the Norwegian population registry.

Participants:

All pregnant employees giving birth in 2004-2008 were included in the study. A total number of 216 541 pregnancies were observed among 180 483 women.

Outcome measure:

Days of sickness absence

Results:

Among women undergoing their first pregnancy, the negative association between age and sickness absence became statistically insignificant when occupational class was controlled for

(p>0.05, 95% CI -0.001 to 0.001). This was not the case for women with previous deliveries, who still had a significant, negative effect of age after control for class (p<0.001, 95% CI -0.006 to -0.004).

Conclusion:

The higher frequency of sickness absence among young pregnant women is partly due to class differentials in timing of pregnancy. Young pregnant women's needs for job adjustments should not be underestimated.

Strengths and limitations of the study

- Retrospective analyses of a population registry reveal that heightened sickness absence among young, pregnant women in Norway is partly due to class differentials in timing of pregnancy.
- The data employed include information about all employees giving birth in 2004-2008, thus the risks of Type I and Type II errors are eliminated.
- The data consist of official recordings, which make sure that the estimates do not suffer from bias due to self-reporting or non-response.
- Although occupational class has a major impact on sickness absence among pregnant women in this study, the data do not allow for assessing the relative contribution of working conditions.
- Age differentials among pregnant women with previous deliveries remain unexplained.

Objective

Western women increasingly delay having children to advance their career [1], and pregnancy is normally regarded as being riskier among older women [2]. In Norway, this development coincides with increased sickness absence during pregnancy. Somewhat surprisingly, the increased sickness absence primarily applies to young pregnant women rather than their older counterparts [3].

Previous research has revealed that sickness absence during pregnancy is influenced by the pregnant women's work place, both through adjustments and social interaction with colleagues [4 5]. This paper broadens the scope of this literature by emphasising how the women's work place is also influenced by recent shifts in fertility and employment patterns. Age during pregnancy has become increasingly linked to education and occupation [1]. The aim of this paper is to examine if the heightened sickness absence among young pregnant women in Norway is due to a preponderance of working class women in this group.

Background and significance

Because the Norwegian sickness benefit is very generous, growing levels of sickness absence have created concern about future public costs [6]. In this context, more frequent sickness absence among young pregnant women may easily be seen as a reflection of unsustainable welfare consumption in younger generations. Such speculation is problematic, because pregnant women may respond to other's negative views on them with risky behavior [7]. This highlights the importance of ensuring that heightened sickness absence among young pregnant women is addressed through empirical investigation rather than unsound generalisations.

Although female employment is facilitated by most welfare states, Norway has been in the forefront of this development [8]. If heightened sickness absence among young pregnant women in Norway is an unintended side effect of women's growing engagement with career building, other western welfare states may expect similar patterns of inequality in the future.

Shift work and physical strain in terms of lifting or standing is associated with preterm birth [9 10]. Heavy lifting, as well as exposure to certain chemicals, also increases the risk for miscarriage and decreased birth weight [11-13]. The importance of working conditions has also been emphasised in previous research on sickness absence among pregnant women. Physical strain increases sickness absence [14 15], while the opportunity for job adjustments reduces sickness absence [5 16].

Moreover, pregnant employees express that they strive to meet those standards of bodily control and appearance that are expected at their workplace [4 17]. These accounts highlight the need for adjustments such as breaks and permission to work from home. The "illness flexibility model," emphasises how working conditions such as adjustment opportunities and reduced requirement for physical presence enhance the possibility of continuing to work in spite of health problems. A Swedish study explained lower rates of sickness absence among higher-ranking employees in terms of such adjustment opportunities [18]. Other studies have also found that working conditions explain some of the class differentials in sickness absence [19 20].

Class is also related to both sickness absence and pregnancy through norms and values. A study from Finland suggests that differences in sickness absence were due to a "working class culture" in which sickness absence is regarded as more legitimate [21: 1227]. Working in a female-dominated work-place tend to slightly increase women's sickness absence in Norway, which might be due to gender specific norms [22]. As gender segregation is stronger in the working classes [23], such norms might enhance class differentials in sickness absence among women.

Working-class women are more likely to express family-oriented values, while middle-class women are more often characterised by occupational dedication [24]. Accordingly, part-time work and housewifery are more widespread among working-class people [25]. However, an apparent association between family orientations and sickness absence may also be health related, because housewives tend to have more health problems than employed women [26]. To the extent that early pregnancy indicates future housewifery, this could thus be a choice born of necessity rather than a preference for women with health problems.

Finally, postponed first birth is associated with a shorter duration between the first and second birth [27: 157], suggesting that the age differentials among women of different classes may be larger among first-time mothers than among women who have previously given birth. This leads to the following hypotheses:

H1: The negative association between age and sickness absence among pregnant women is more pronounced among pregnant women undergoing their first pregnancies than among pregnant women who have previously given birth.

H2: The negative association between age and sickness absence becomes statistically insignificant when occupational class is controlled for, both among first-time pregnant women and those who have previously given birth.

Materials and Methods

The following analyses are based on data collected by the Norwegian Labour and Welfare Administration, the Norwegian Tax Administration and the Ministry of Health and Care Services. The national agency Statistics Norway of the Ministry of Finance has adapted the data for research. The collected data include information about each individual of the entire Norwegian population. Use of population data from public records ensures that our estimates are not biased by non-response or self-reporting. Furthermore, the risk of type I or type II errors is eliminated because the analyses are based on data from the population rather than from a random sample.

The generous sickness benefit provisions in Norway ensure that most employees listed as sick receive full wage compensation for an entire calendar year. The pay-out has an upper limit which in 2008 amounted to NOK 414 648, or about EUR 52 799. Separate rules for sickness absence apply to self-employed, which makes comparison with employees difficult. For this reason self-employed women were excluded from our analyses.

For non-pregnant employees, the employer covers the first 16 calendar days of sickness absence, whereas National Insurance covers the rest of the period. This was also the rule for pregnant employees until 2001. Since 2002, employers can request reimbursement from National Insurance for expenditure on sickness absence among pregnant employees suffering periods of illness with a pregnancy-related diagnosis. This implies that the first 16 days are left censored for some spells, while other spells are complete. For women in general, approximately 32% of sickness absence is covered by the employer [28], but given the abovementioned amendment, the corresponding figure for pregnant women is probably smaller.

Each woman's value of the dependent variable *Sickness absence* equals the total number of days of absence covered for which she received the National Insurance sickness benefit in the 282 days preceding birth. The variable also includes spells of absence covered by the pregnancy benefit, which are certified by physicians if they consider the pregnant woman's tasks or working environment to threaten the foetus. In order to prevent registration errors from turning into influential outliers, the variable *Sickness absence* was limited to an upper value. When weekends and holidays are taken into account, 248 is the maximum number of days for which compensation may be received during one calendar year for full-time employees, which equals 68% of all calendar days in this period. The maximum value of days of sickness absence during pregnancy is correspondingly limited to 68% of the total pregnancy period of 282 days, or a maximum value of 192 days of sickness absence during pregnancy.

A pregnancy period of 282 days is equal to the expected gestational age, which is counted from the first day of the last menstrual period prior to conception, and extends the period from conception to birth by 14 days. Norwegian health professionals frequently refer to gestational age as a measure of pregnancy duration when consulting women who are or plan to become pregnant, possibly increasing their awareness of symptoms even prior to conception. Because this awareness may influence sickness absence behaviour, the categorisation of sickness absence during pregnancy was based on expected gestational age.

From 2003 and onwards, registration of employment in the population data was improved because variables containing occupational codes and contracted working hours were included. Most of the women who gave birth in 2003 became pregnant in 2002, and thus lack relevant information from the first part of their pregnancy. For this reason the statistical analyses are limited to the years 2004-2008, as data for the years after 2008 are not yet accessible for research.

In the data, registration of occupation follows the four-digit occupational code scheme “Standard for yrkesklassifisering” (STYRK), which is a Norwegian version of the International Standard Classification of Occupations (ISCO-88). The occupational codes in the registry data were grouped according to the class scheme of Eriksson, Goldthorpe and Portocarero (EGP). On direct request, a detailed manual for this categorisation was most kindly provided by Magne Flemmen [29]. Utilisation of the EGP class scheme ensures international comparability [30 31] and the class scheme has also shown a consistent association with health inequality [32 33], which makes it suited when investigating sickness absence.

The class scheme is described by Erikson, Goldthorpe and Portocarero as clusters of occupations with similar relations to the labour market. The separation of occupations into different occupation does not necessarily imply hierarchical differences between them [34: 420]. The analyses presented in this article employs a later version of the EGP-class scheme [35, p. 38-39], which soon will be outlined in the variable list. The classes which only contain self-employed were omitted from the analyses, because a separate sickness benefit scheme applies to this group, which makes comparison with employees difficult.

The variable *Previous deliveries* indicates whether a woman is registered as having given birth since 1 January 1992. This categorisation is because the registration of births does not start until that date, and necessarily implies an underestimation of the number of previous births for women who first delivered prior to 1992. However, even for women giving birth in 2004 this difference of more than 12 years between subsequent births of the same mother is rare. Thus, the bias resulting from any misclassifications is limited.

Previous research indicates that the association between pregnant women's age and their occupation may be more pronounced during first pregnancies than subsequent ones [36]. The product of the variables *Age* and *Previous deliveries* is included in the regression analyses to account for such interactions.

All estimates are adjusted for possible confounders in terms of calendar year, weekly working hours, timing of transition to parental leave, and marital status, but for simplicity these control variables were left out of the analysis.

The variable *Calendar year* consists of a set of dummy variables, and was included to ensure that the estimated associations between age and occupational class do not reflect annual fluctuations in the work stock.

The control variables *Working hours* and *Leave* were included to ensure that the association between pregnant women's age and their sickness absence do not simply reflect differences in working hours and/or timing of maternal leave among women different age groups. The value of the variable *Working hours* corresponds to the registered average number of hours worked by a woman in each week of employment during pregnancy. According to Norwegian Law, 40 weekly working hours is the standard for full-time employees, but due to collective bargaining agreements most full-time employees rather have 37.5 weekly working hours. Although contracts may include overtime, the variable was constructed so that 40 is the upper limit in order to prevent outliers in cases where incomplete registration of previous employment entailed artificially high numbers of working hours. The *Leave* variable indicates the number of days between onset of pregnancy and either transition to maternity leave or date of delivery.

The control variable *Marital status* was included to ensure that the association between age and sickness absence does not stem from differences in marital status. *Marital status* is measured at the end of the calendar year that the woman became pregnant and consists of a set of dummy variables. Over recent decades, cohabitation has become more widespread in Norway, even among couples with children [37]. However, registration of marital status does not distinguish cohabiting from single pregnant women.

Thus, the following variables are included in the Results section:

- *Sickness absence*. Continuous dependent variable, the natural logarithm of the pregnant woman's number of sickness absence days covered by the National Insurance scheme;
- *Age.* Continuous independent variable. The age of the pregnant woman;
- *Occupational class.* Dummy set of independent variables. Reference group: *I Higher professionals*. Other categories: *II Lower professionals*, *IIIa Higher routine*, *IIIb Lower routine*, *V Technicians*, *VI Skilled*, *VII Semi- and unskilled*, *VIIb Agricultural*, *Missing*;
- *Previous deliveries.* Independent dummy variable. Women with previous deliveries take the value of 1. Women who undergo their first pregnancy take the value of 0;
- *Age × Previous deliveries.* Independent interaction variable equaling the value of *Age* multiplied by the value of *Previous deliveries;*
- *Year*. Dummy set of control variables. Reference group: Women giving birth in 2004. Other categories: *Year 2005*, *Year 2006*, *Year 2007*, *Year 2008*;
- *Working hours.* Continuous control variable. Average number of hours of paid work per week;

- *Leave.* Continuous control variable. Total number of days between pregnancy onset and either transition to parental leave or date of delivery;

- *Marital status.* Dummy set of independent variables. Reference group: *Unmarried.* Other categories: *Married, Divorced, Widowed.*

Methods

After deleting 2537 deliveries with unknown mothers, a total number of 286 104 deliveries were registered during the observed period 2004-2008. The aim of the paper is to address the occupational challenges among young pregnant women rather than the particular difficulties associated with teen age pregnancies, thus 1473 teenage pregnancies were excluded from the analyses. Further 30 of the registered deliveries were excluded due to missing value on the variable *Age*, and 168 554 due to lack of registration of the woman's marital status. Of the remaining pregnancies, a total number of 216 541 met the inclusion criteria that the pregnant woman had registered earnings the year of delivery, and had worked at least 1 hour per week on average during the employed period of pregnancy. Of these, 16 286 have missing values on the variable of occupational class. A separate dummy variable for these observations was added to the set of dummy variables which occupational class consists of. About 0.6% of the registered sickness absence spells were excluded from the analyses due to missing value on the variable of compensated days of sickness absence.

As some women underwent more than one of the registered pregnancies, a total number of 180 483 individuals are included in the analyses. Pregnancies applying to the same woman are treated as different observations in the analysis, thus the total number of observations is 216 541. However, robust standard errors are utilized in the calculations of confidence intervals and p-values, to account for correlation of observations in cases where one woman has undergone more than one of the observed pregnancies.

The dependent variable in the following analyses can be characterised as count data, because it represents the total number of sickness absence days and thus only contains positive integer values. Furthermore, the dependent variable indicates a large proportion of women with the value of 0, which supports the use of a zero-inflated Poisson regression model (zip model). A significant Vuong test also indicates that the zip model fits the data better than the standard Poisson model.

The zip model consists of two components, because the predicted value of *Sickness absence* is combined with a prediction of the probability of achieving a value of zero. The coefficients for the first prediction indicate the change in the log of the expected days of sickness absence, rather than expected days of sickness absence directly. Consequently, each regression coefficient reveals changes in the log of the expected value of sickness absence produced by a one-unit increase in a given variable when other independent variables are held constant. Because the substantial meaning of the coefficients is not readily apparent, marginal plots will be provided for the core findings.

In the second component of the zip model, the variables *Working hours* and *Leave* are used as predictors of values exceeding zero in all four regression models. This indicates that the inflation of 0 days of sickness absence is partly due to inclusion of employees with few contracted working hours and/or early transition to parental leave, which reduces the possible number of sick days.

In analyses of samples drawn from a population, the purpose of significance testing is to assess the likelihood that the estimates that apply to the sample also apply to the population as a whole. For analyses based on a population rather than a sample drawn from it, this condition is already satisfied. Nevertheless, use of significance testing may be appropriate to distinguish between correlations that reflect actual conditions in the population and those that simply reflect the possible occurrence of small natural variations across time and space despite support for a true null hypothesis [38]. For this reason, significance testing is included in the following regression models.

Results

Table 1 shows that the pregnant women included in the analyses on average have 46.8 days of sickness absence compensated from the National Insurance during pregnancy, although the large standard deviation indicates that the variation is large. The average pregnant employee is about 30 years old, works almost 30 working hours per week, and goes on maternal leave about 18 days prior to delivery. More than half of the pregnancies occur among women who have had previous deliveries, and more than half of the pregnant women belong to one of the two occupational classes *IIIa Higher Routine* and *II Lower professionals*. Most of the pregnant women are either unmarried or married. The number of pregnant employees increases slightly each year throughout the observed period.

Table 1. Descriptive statistics.

Continuous variables	Mean	St. Dev.
Sickness absence	46.8	48.46
Age	30.6	4.8

Working hours	29.5	10.8
Leave	17.9	10.9
Categorical variables	**Category**	**Percentage**
Previous births	First pregnancy	46.0
	Previous births	54.0
Occupational class	I Higher professionals	8.9
	II Lower professionals	21.4
	IIIa Higher routine	33.6
	IIIb Lower routine	16.5
	V Technicians	0.2
	VI Skilled	2.9
	VII Semi- and unskilled	8.7
	VIIb Agricultural	0.4
	Missing	7.5
Marital status	Unmarried	51.05
	Married	44.42
	Divorced	4.44
	Widowed	0.09
Year	2004	19.4
	2005	19.1
	2006	19.8
	2007	20.3
	2008	21.3
Total number of observations		216 541

Table 2 shows a zero-inflated Poisson regression, which includes two components. The Count component is a prediction of Sickness absence, and Models 1-4 show the varying associations that follow from different sets of independent variables. The Zero excess component predicts the probability of taking no sick days after control for *Working hours* and *Leave*, and remains unchanged in all four models. Table 2 lists a high number of coefficients which are statistically significant at the predefined significance level of 1%, a situation that is quite common when analysing population data. The Count component of Model 1 shows the unadjusted association between *Age* and *Sickness absence*, while Models 2-4 are adjusted for confounders.

Table 2. Zero-inflated Poisson regression with days of sickness absence as the dependent variable. The coefficients in the Count component are adjusted for Working hours, Leave, Year

and Marital status in Models 2-4. The coefficients of the Excess zero component are adjusted for *Working hours* and *Leave* in all four models.

	Model 1	Model 2	Model 3	Model 4
Count component				
Age	-0.001*** (-0.002 - -0.001)	-0.004*** (-0.005 - -0.003)	-0.005*** (-0.006 - -0.003)	-0.00002 (-0.001 - 0.001)
Previous deliveries			0.276*** (0.228 - 0.323)	0.261*** (0.214 - 0.307)
Age x Previous deliveries			-0.005*** (-0.007 - -0.004)	-0.005*** (-0.007 - -0.004)
II Lower professionals				0.054*** (0.038 - 0.071)
IIIa Higher routine				0.184*** (0.169 - 0.200)
IIIb Lower routine				0.243*** (0.226 - 0.259)
V Technicians				0.069 (-0.015 - 0.153)
VI Skilled				0.215*** (0.191 - 0.240)
VIIa Semi- and unskilled				0.287*** (0.268 - 0.306)
VIIb Agricultural				0.203*** (0.143 - 0.263)
Missing				0.107*** (0.088 - 0.127)
Constant	4.227*** (4.204 - 4.250)	3.148*** (3.052 - 3.244)	3.102*** (3.002 - 3.201)	2.768*** (2.668 - 2.868)
Excess zero component				
Constant	-1.341*** (-1.593 - -1.088)	-1.341*** (-1.593 - -1.088)	-1.341*** (-1.593 - -1.088)	-1.341*** (-1.593 - -1.088)
Observations	216 541	216 541	216 541	216 541
Cragg & Uhler's R2:	0.021	0.178	0.278	0.457

Robust confidence intervals in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Model 1 reveals a significant negative coefficient for *Age*. This implies that the average level of sickness absence is higher among young women than among those of higher age before control for confounders. The negative association between age and sickness absence is further enhanced by control for the confounders *Year*, *Working hours*, *Leave*, and *Marital status*, as shown in Model 2.

In Model 3, the variable *Previous deliveries* and the product of *Age* and *Previous deliveries* is included to measure interaction effects. The significant coefficient confirms that different associations between age and sickness absence applies to women with and without previous birth(s). Since the interpretation of the interaction coefficients is complicated, the interaction effect is illustrated in Figure 1. However, it is worth noticing that in Model 3, the negative *Age* coefficient is still statistically significant. As age is one of the variables included in the interaction term, a negative coefficient for age implies a negative association between age and sickness absence among women who have the value 0 on the other variable included in the interaction term, which in this case means pregnancies of women undergoing their first pregnancy.

The coefficient of *Age* is no longer statistically significant when occupational class is controlled for, as shown in Model 4. Among women undergoing their first pregnancy, there is thus no significant association between age and sickness absence after control for class. However, the significant interaction term suggest that this is not the case for women with previous deliveries. The implications of this change are illustrated in Figure 1. Except from *V Technicians*, all the occupational classes have positive and statistically significant coefficients, indicating that each class has a higher level of sickness absence than the reference category, which is *I Higher professionals*.

Cragg and Uhler's R2, also referred to as Nagelkerke's R2, is a measure of model fit that varies between 0 and 1 [39]. High values indicate better prediction of counts in the current model than in the intercept model, which equals a model without independent variables. In Model 1, the value of Cragg and Uhler's R2 is 0.021, which implies that controlling only for Age has a limited improvement of prediction of days of sickness absence. In Model 2 and Model 3 the values of

Cragg and Uhler's R2 have increased to 0.178 and 0.278, which suggest that the prediction of sickness absence is substantially improved after controlling for the confounders, and further improved by control for previous births and the interactions of age and previous births. By control for occupational class in Model 4, the value increases to 0.457, thus prediction of sickness absence is considerably improved when occupational class is included in the model.

Figure 1 displays the various associations between age and days of sickness absence in the preceding regression models. As the graph for Model 1 indicates, sickness absence is negatively associated with age. Before control for any covariates, pregnant women aged 20 on average have 47,78 days of sickness absence during pregnancy, while the corresponding number for pregnant women aged 45 is 46,06. The former group thus have 1.72 more days of sickness absence than the latter. This difference increases to 4.42 after control for the relevant confounders Calendar year, Working hours, Leave and Marital status, as revealed in the second graph, Model 2.

The interaction of previous deliveries and age is illustrated in the third graph, Model 3. The negative association between age and sickness absence is most pronounced among pregnant women with previous deliveries. Among first-time pregnant women, 20 year-olds have 46.46 days of absence while 45 year-olds have 41.37. Among pregnant women with previous births, the corresponding numbers are 54.95 and 42.76.

Finally, the last graph shows that among first-time pregnant women, the negative association between age and sickness absence levels out after control for occupational class. Although first-time pregnant women aged 20 have on average 43.99 days of sickness absence, while those aged 45 have 43.96, these differences are not statistically significant. Among pregnant women with previous births, the association is weakened but still negative after control for class. In this category, 20 year-old women have on average 51.48 days of sickness absence and 45 year-olds have 45.20.

Discussion

The preceding analyses have shown that among women undergoing their first pregnancies, the higher sickness absence among employees of young age is due to a preponderance of working class occupations in this group. Among first-time mothers, the initial association between age and sickness absence is thus due to class differentials in timing of pregnancy. Among pregnant women with previous births, young employees still have higher sickness absence after control for class, although the association between age and sickness absence is slightly weakened. A majority of the heightened sickness absence among young pregnant women in this group is thus not explained by class differentials in timing of pregnancy. Since the analyses are conducted on data from a population rather than a sample, the results necessarily apply to the population as well.

Since controlling for occupational class implies a weakening of the negative association between age and sickness absence both among first-time pregnant women and women who have previously given birth, the initial association is partly due to aspects of occupational class which these two groups have in common. Unfortunately, the data set does not allow for a more detailed causal analysis of class differentials, but previous research may hint at possible explanations of the association between class, pregnancy and sickness absence which apply to both groups. Manual work and night shifts are less compatible with pregnancy than are working conditions in most middle-class occupations. The importance of flexible working conditions is also highlighted among pregnant employees themselves and empirically verified by analyses of the "illness flexibility model". Employees in working-class occupations are also less often rewarded with promotions for faithful service. Sickness absence may be more legitimate among workers than among middle-class employees, and working-class women are often more oriented toward family building than employment. In summary, several aspects of the working environment and the employees shape pregnant women's opportunities for adjustments and probably also their motivation to work in spite of their symptoms.

However, class and family characteristics only explain a small proportion of the negative association between age and sickness absence among women who had previously delivered. In this group, higher levels of sickness absence apply to young pregnant women even after control for occupational class. This result calls for an explanation.

Pregnant employees' own accounts, termed *"Strategies of Secrecy, Silence and Supra-performance"* [4] may shed light on this picture. In short, these pregnant employees explain how they strive to adapt to workplace norms of occupational performance by delaying the announcement of their pregnancy, avoiding discussing it and compensating through increased flexibility and longer working hours, to demonstrate to their employer that the pregnancy does not make them less predictable or reliable as employees. Keeping sickness absence at an absolute minimum is also part of these strategies. Although these strategies seem quite hazardous, they also seem to reflect an important implicit assumption: employees do not want pregnancy to jeopardise their occupational attachment. Thus, their efforts to reduce their sickness absence during pregnancy probably reflect a general orientation toward future employment.

In contrast, early transition to second or third births may reflect weaker employment orientation, especially since Norwegian women less frequently return to full-time employment after second or third births [40]. Accordingly, the association between high levels of sickness absence and early transition to second or third births that we find in our analyses may indicate that the threshold for sickness absence is lower for women whose future prospects are oriented toward family building rather than employment. However, the well-known association between homemaking and health problems implies that the apparent family orientation indicated by early transition to second or third births may reflect health problems rather than preferences.

Finally, early transition to second or third births occurs much less frequently in Norway today than just a few decades ago. Sickness absence among women who undertake such transitions should thus be regarded in the light of the possible atypical situation of these women, because they may be affiliated with ethnic or religious groups that influence their sickness absence.

Conclusion

Young pregnant women have higher frequency of sickness absence than their older counterparts. Contrary to expectations, the age differentials in sickness absence are stronger among pregnant women with previous deliveries than among those undergoing their first pregnancies. Class differentials in timing of pregnancy only account for the age differentials in the latter group.

Author contributions

AMSA designed the study, conducted the analyses and wrote the paper.

Funding and ethics

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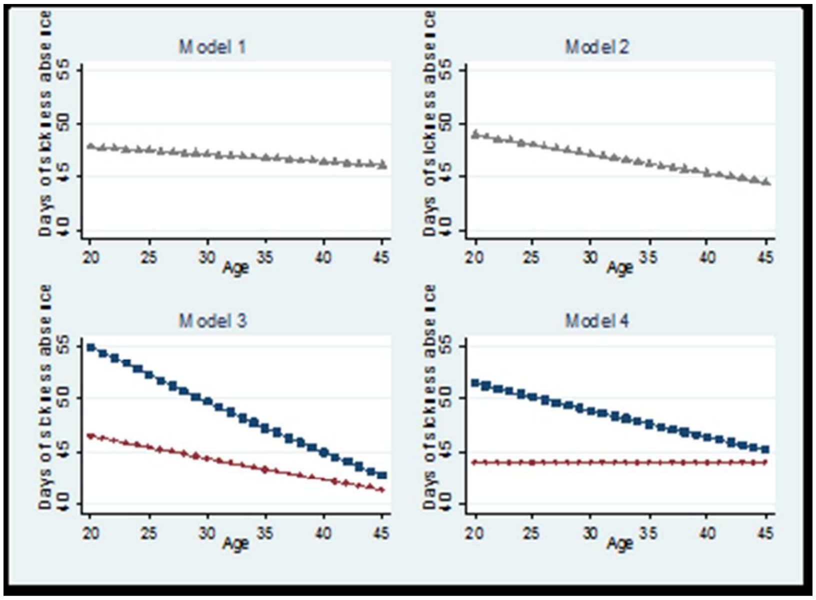
Figure legends

Figure 1. Marginal effect of age in Models 1 to 4 in the regression analysis.



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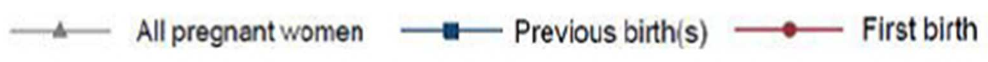

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	12
		(*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	8-11
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	*8-11*
Bias	9	Describe any efforts to address potential sources of bias	9-10
Study size	10	Explain how the study size was arrived at	12
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11-12
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	12-13
		(*b*) Describe any methods used to examine subgroups and interactions	10
		(*c*) Explain how missing data were addressed	12
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	12
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	12
		(b) Give reasons for non-participation at each stage	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	14-15
		(b) Indicate number of participants with missing data for each variable of interest	12
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	18
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10, 16
		(*b*) Report category boundaries when continuous variables were categorized	
		(*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	17-18
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
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	21

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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 www.strobe-statement.org.

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Age, occupational class, and sickness absence during pregnancy: A retrospective analysis study of the Norwegian population registry

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Age, occupational class, and sickness absence during pregnancy: A retrospective analysis study of the Norwegian population registry

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Abstract

Objective:

Western women increasingly delay having children to advance their career, and pregnancy is considered to be riskier among older women. In Norway, this development surprisingly coincides with increased sickness absence among young pregnant women, rather than their older counterparts. This paper tests the hypothesis that young pregnant women have a higher number of sick days because this age group includes a higher proportion of working class women, who are more prone to sickness absence.

Design:

A zero-inflated Poisson regression was conducted on the Norwegian population registry.

Participants:

All pregnant employees giving birth in 2004-2008 were included in the study. A total number of 216 541 pregnancies were observed among 180 483 women.

Outcome measure:

Number of sick days

Results:

Although the association between age and number of sick days was U-shaped, pregnant women in their early 20ies had a higher number of sick days than those in their mid 40ies. This was particularly the case for pregnant women with previous births. In this group, 20 year olds had 12.6 more sick days than 45 year olds; this age difference was reduced to 6.3 after control for class. Among women undergoing their first pregnancy, 20 year olds initially had 1.2 more sick days than 45 year olds, but control for class altered this age difference. After control for class, 45 year old first-time pregnant women had 2.9 more sick days than 20 year olds with corresponding characteristics.

Conclusion:

The negative association between age and sickness absence was partly due to younger age groups including more working class women, who were more prone to sickness absence. Young pregnant women's needs for job adjustments should not be underestimated.

Strengths and limitations of the study

- Retrospective analyses of a population registry reveal that heightened sickness absence among young, pregnant women in Norway is partly due to a preponderance of working class women in this age group.
- The data employed include information about all employees giving birth in 2004-2008, thus the risks of Type I and Type II errors are eliminated.
- The data consist of official recordings, which make sure that the estimates do not suffer from bias due to self-reporting or non-response.

- Because some absence spells are left censored, zero-inflated Poisson regression has been conducted.
- Although occupational class has a major impact on sickness absence among pregnant women in this study, the data do not allow for assessing the relative contribution of working conditions.
- Age differentials among pregnant women with previous deliveries remain largely unexplained.

Objective

Western women increasingly delay having children to advance their career [1], and pregnancy is normally regarded as being riskier among older women [2]. In Norway, this development coincides with increased sickness absence during pregnancy. Somewhat surprisingly, the increased sickness absence primarily applies to young pregnant women rather than their older counterparts [3 4].

Previous research has revealed that sickness absence during pregnancy is influenced by the pregnant women's work place, both through adjustments and social interaction with colleagues [5 6]. This paper broadens the scope of this literature by emphasising how the women's work place is also influenced by recent shifts in fertility and employment patterns. Age during pregnancy has become increasingly linked to socioeconomic factors such as education and occupation [1]. The aim of this paper is to examine if the heightened sickness absence among young pregnant women in Norway is due to a preponderance of working class women in this group.

Background and significance

Because the Norwegian sickness benefit is very generous, growing levels of sickness absence have created concern about future public costs [7]. In this context, more frequent sickness absence among young pregnant women may easily be seen as a reflection of unsustainable welfare consumption in younger generations. Such speculation is problematic, because pregnant women may respond to other's negative views on them with risky behavior [8].

The need for investigating sickness absence during pregnancy is further enhanced by studies suggesting that employers' or colleagues' negative expectations to the work performance or sickness absence of pregnant employees may challenge these women's career opportunities [5 9-12], even when the empirical basis for these assumptions is lacking [13-15]. These issues highlight the importance of ensuring that heightened sickness absence among young pregnant women is addressed through empirical investigation and evidence based policies rather than unsound generalisations and discrimination.

Sickness absence during pregnancy has increased substantially over the past two decades in Norway, and both the relative increase and the total level of sickness absence is highest among younger women [3 4 16]. However, the impact of occupational class on this age difference is unknown. Previous research on sickness absence during pregnancy has rarely focused on the impact of pregnant women's age and their class affiliation, except from three studies of Swedish data from the 1980ies, which reached different conclusions. The first study concluded that sickness absence during pregnancy in Sweden in the late 1980ies was characterised by class differentials, but only marginal age differentials [17]. However, the other two studies highlighted that a preceding increase in sickness absence during pregnancy particularly applied to young women [18], and that young age during pregnancy was associated with a higher frequency of sickness absence [19]. These findings indicate that high and increasing levels of sickness absence among young pregnant women is not a strictly Norwegian phenomenon.

Although the tight link between pregnant women's age and their class position has not received much attention in previous research on sickness absence, the issue has been highlighted in demographic research. "The second demographic transition", refers to growing female employment, postponement of pregnancy, and decreasing birth rates which has occurred in western countries [20]. However, these trends primarily characterize women with higher education and privileged class positions [21 22]. In Norway, postponed first birth is often followed by a shorter duration between the first and second birth [23]. This leads to the expectation that class differentials in timing of pregnancy are larger in the group of first-time pregnant women than among those with previous births.

As increased sickness absence among young pregnant women in Norway coincides with growing class differentials in timing of pregnancy, it seems relevant to question whether age differentials in sickness absence during pregnancy may be confounded by class. This concern is substantiated by a wide range of studies which emphasize the impact of occupational characteristics on pregnant women's health problems or sickness absence. Shift work and physical strain in terms of lifting or standing is associated with preterm birth [24 25]. Heavy lifting, as well as exposure to certain chemicals, increases the risk for miscarriage and decreased birth weight [26-28]. Physical strain increases sickness absence [29 30], while the opportunity for job adjustments reduces sickness absence [6 31]. Moreover, pregnant employees express that they strive to meet those standards of bodily control and appearance that are expected at their workplace [5 32]. These accounts highlight the need for adjustments, such as breaks and permission to work from home, which are more common in higher ranking occupations [33]. Class is also related to both sickness absence and pregnancy through norms and values. Sickness absence may be regarded more legitimate in a "working class culture" [34]. Working class occupations are also more gender segregated [35], and female-dominated work-places have somewhat higher levels of sickness absence in Norway, possibly because of gender specific norms [36]. Working-class women are more likely to express family-oriented values, while middle-class women more often are characterised by occupational dedication [37]. However, housewives tend to have more health problems than employed women [38]. To the extent that early pregnancy indicates future housewifery, this could thus be a choice born of necessity rather than a preference for women with health problems.

To summarize, women's age at first pregnancy varies according to occupational class, and occupational class may influence sickness absence during pregnancy in several ways. This leads to the following hypotheses:

H1: The negative association between age and sickness absence among pregnant women is more pronounced among pregnant women undergoing their first pregnancies than among pregnant women who have previously given birth.

H2: The negative association between age and sickness absence levels out when occupational class is controlled for, both among first-time pregnant women and those who have previously given birth.

Materials and Methods

The following analyses are based on data collected by the Norwegian Labour and Welfare Administration, the Norwegian Tax Administration and the Ministry of Health and Care Services. The national agency Statistics Norway of the Ministry of Finance has adapted the data for research. The collected data include information about each individual of the entire Norwegian population. Use of population data from public records ensures that our estimates are not biased by non-response or self-reporting. Furthermore, the risk of type I or type II errors is eliminated because the analyses are based on data from the population rather than from a random sample.

The data contain all women in the Norwegian population giving birth during the years 2004-2008. After deleting 2537 deliveries with unknown mothers, a total number of 286 104 deliveries were registered during the observed period. Further 30 of the registered deliveries were excluded due to missing value on the variable *Age*. Because the aim of the paper is to address the occupational challenges among young pregnant women rather than the particular difficulties associated with teen age pregnancies, 1473 teenage pregnancies were excluded from the analyses. Subsequently, the age span of the study population varied from 20 to 54, although less than 2% of the women were older than 40 at the year of delivery. Finally, 168 women were excluded due to lack of registration of the woman's marital status.

Of the remaining pregnancies, a total number of 216 541 met the inclusion criteria that the pregnant woman had registered earnings the year of delivery, and had worked at least 1 hour per week on average during the employed period of pregnancy. Of these, 16 286 had missing values on the variable of occupational class. A separate dummy variable for these observations was added to the set of dummy variables which occupational class consists of. About 0.6% of the registered sickness absence spells were excluded from the analyses due to missing value on the variable of compensated sick days. As some women underwent more than one of the registered pregnancies, a total number of 180 483 individuals are included in the analyses. Pregnancies applying to the same woman are treated as different observations in the analysis, thus the total number of observations is 216 541.

The generous sickness benefit provisions in Norway ensure that most employees listed as sick receive full wage compensation for an entire calendar year. The pay-out has an upper limit which in 2008 amounted to NOK 414 648, or about EUR 52 799. Separate rules for sickness absence apply to self-employed, which makes comparison with employees difficult. For this reason self-employed women were excluded from our analyses.

The registry only provides consistent recording of all spells of sickness absence from the 17th calendar day, while recording of spells prior to this day depends on the woman's diagnosis and her employers' request for imbursement. Each woman's value of the dependent variable *Sick days* equals the total number of sick days for which she received the National Insurance sickness benefit in the 282 days preceding birth. The variable also includes spells of absence covered by the pregnancy benefit, which are certified by physicians if they consider the pregnant woman's tasks or working environment to threaten the foetus. In order to prevent registration errors from turning into influential outliers, the variable *Sick days* was limited to an upper value of 192. This number amounts to 68% of the total number of calendar days of the total pregnancy period of 282 days, and is equivalent with the maximum percentage of calendar days compensated by the National Insurance for non-pregnant employees during one year.

A pregnancy period of 282 days is equal to the expected gestational age, which is counted from the first day of the last menstrual period prior to conception, and extends the period from conception to birth by 14 days. Norwegian health professionals frequently refer to gestational age as a measure of pregnancy duration when consulting women who are or plan to become pregnant, possibly increasing their awareness of symptoms even prior to conception. Because this awareness may influence sickness absence behaviour, the categorisation of sickness absence during pregnancy was based on expected gestational age.

The occupational codes in the registry data were grouped according to the class scheme of Eriksson, Goldthorpe and Portocarero (EGP) [39], by means of a detailed manual provided by Flemmen [40]. Utilisation of the EGP class scheme ensures international comparability [41 42], and the class scheme has shown a consistent association with health inequality [43 44], which makes it suited when investigating sickness absence. As mentioned earlier, self-employed women were excluded from the study population, and accordingly the class of self-employed was omitted from the analyses.

The variable *Previous deliveries* indicates whether a woman is registered as having given birth since 1 January 1992. The variables *Age* equals the age of the pregnant woman at the year of the delivery. The variable *Age squared* was added to account for the possibility of a curved association between age and sickness absence.

Previous research indicates that the association between pregnant women's age and their occupation may be more pronounced during first pregnancies than subsequent ones [45]. The product of the variables *Age* and *Previous deliveries* is included in the regression analyses to account for such interactions.

All estimates are adjusted for possible confounders in terms of calendar year, weekly working hours, timing of transition to parental leave, and marital status, but for simplicity these control variables were left out of the analysis.

Thus, the following variables are included in the Results section:

- *Sick days*. Continuous dependent variable, the natural logarithm of the pregnant woman's number of sick days covered by the National Insurance scheme;
- *Age.* Continuous independent variable. The age of the pregnant woman;
- *Age squared.* Continuous independent variable. The squared age of the pregnant woman;

- *Occupational class*. Dummy set of independent variables. Reference group: *I Higher professionals*. Other categories: *II Lower professionals*, *IIIa Higher routine*, *IIIb Lower routine*, *V Technicians*, *VI Skilled*, *VII Semi- and unskilled*, *VIIb Agricultural*, *Missing*;

- *Previous deliveries.* Independent dummy variable. Women with previous deliveries take the value of 1. Women who undergo their first pregnancy take the value of 0;

- *Age × Previous deliveries.* Independent interaction variable equaling the value of *Age* multiplied by the value of *Previous deliveries;*

- *Year*. Dummy set of control variables. Reference group: Women giving birth in 2004. Other categories: *Year 2005*, *Year 2006*, *Year 2007*, *Year 2008*;

- *Working hours.* Continuous control variable. Average number of hours of paid work per week;

- *Leave.* Continuous control variable. Total number of days between pregnancy onset and either transition to parental leave or date of delivery;

- *Marital status.* Dummy set of independent variables. Reference group: *Unmarried.* Other categories: *Married, Divorced, Widowed.*

Methods

The dependent variable in the following analyses can be characterised as count data, because it represents the total number of sick days and thus only contains positive integer values. The large proportion of women with the value of 0 on this variable indicates that the distribution may be characterised by inflated zero, which means that both the value of the variable and the likelihood of this value being zero is influenced by external factors [46]. For example, the value of zero sick days can be influenced by working hours in two different ways. Because part-time employees have a lower maximum number of sick days than do full-time employees, a larger proportion of part-timers probably have no actual sick days. However, they are probably also more likely to have shorter spells, which in turn are more likely to be left censored, and take the value of 0 for this reason. This also applies to women with early transition to maternity leave. To account for the excess of zero sick days among women with few working hours and/or early transition to maternity leave, a zero-inflated Poisson regression model was conducted. This choice of model was supported by a significant Vuong test, which indicates that the zip model fits the data better than the standard Poisson model,

The zip model consists of two components, because the predicted value of *Sick days* is combined with a prediction of the probability of achieving a value of zero. In the count component, each regression coefficient reveals changes in the log of the expected value of number of sick days produced by a one-unit increase in a given variable when other independent variables are held constant. Because the substantial meaning of the coefficients is not readily apparent, marginal plots will be provided for the core findings.

In excess zero component, the variables *Working hours* and *Leave* are used as predictors of values exceeding zero in all four regression models. This indicates that the inflation of 0 sick days is partly due to inclusion of employees with few contracted working hours and/or early transition to parental leave, which reduces the possible number of sick days. In analyses of samples drawn from a population, the purpose of significance testing regression coefficients is to assess the likelihood that the estimates that apply to the sample also apply to the population as a whole. For analyses based on a population rather than a sample drawn from it, this condition is already satisfied. For this reason, significance testing is left out of the following regression models.

Results

Descriptive statistics of the study population is listed in Table 1, and confirms that higher and lower professionals are characterized by fewer sick days, higher age, and a higher number of working hours than the skilled and unskilled workers.

Table 1. Descriptive statistics of the study population. According to occupational class.

	Sick days		Age		Working hours		Leave		Married	Previous deliveries
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	%	%
I Higher professionals	34.2	43.5	33.3	3.9	34.3	7.6	263.2	10.3	55.8	55.5
II Lower professionals	39.8	45.5	32.5	3.9	33.8	7.6	263.2	10.2	50.7	53.6
IIIa Higher routine	50.4	48.8	30.1	4.6	29.0	10.4	264.1	10.8	42.8	55.0
IIIb Lower routine	54.6	50.0	29.0	5.0	25.9	11.6	264.8	11.1	35.5	53.0
V Technicians	43.8	47.7	32.1	4.4	33.0	8.0	264.5	10.8	41.6	60.5
VI Skilled	51.4	49.6	28.8	4.9	29.1	10.6	263.8	10.7	32.9	52.0
VII Semi- and unskilled	51.9	52.1	29.1	5.2	22.7	12.8	266.4	12.3	41.7	51.2
VIIb Agricultural	37.6	47.0	28.3	4.9	24.9	12.9	265.9	12.0	35.2	51.1
Missing	41.6	46.6	30.8	4.7	29.2	11.1	264.0	11.0	48.1	55.5
Total	46.8	48.5	30.6	4.8	29.5	10.8	264.1	10.9	44.4	54.0

The distribution of *Sick days* is characterised by inflated zero (Figure 1). Investigation of the association between Age and Sickness absence among full-time employees indicates that the association is curved rather than linear (Figure 2).

Table 2 shows a zero-inflated Poisson regression, which includes two components. The *Count component* is a prediction of *Sick days*, and Models 1-4 show the varying associations that follow from different sets of independent variables. The *Excess zero component* predicts the probability of taking no sick days after control for *Working hours* and *Leave*, and remains unchanged in all four models. The Count component of Model 1 shows the unadjusted association between *Age* and *Sick days*, while Models 2-4 are adjusted for confounders.

Table 2. Zero-inflated Poisson regression with number of sick days as the dependent variable. The coefficients in the Count component are adjusted for Working hours, Leave, Year and Marital status in Models 2-4. The coefficients of the Excess zero component are adjusted for *Working hours* and *Leave* in all four models.

	Model 1	Model 2	Model 3	Model 4
Count component				
Age	-0.016	-0.017	-0.049	-0.031
Age squared	0.0002	0.0002	0.0007	0.0005
Previous deliveries			0.374	0.330
Previous deliveries x Age			-0.008	-0.007
II Lower professionals				0.056
IIIa Higher routine				0.185
IIIb Lower routine				0.240
V Technicians				0.069
VI Skilled				0.212
VIIa Semi- and unskilled				0.285
VIIb Agricultural				0.200
Missing				0.107
Constant	4.448	3.350	3.749	3.231
Excess zero component				
Constant	-1.341	-1.341	-1.341	-1.341
Observations	216 541	216 541	216 541	216 541
Cragg's and Uhler's	0.023	0.179	0.290	0.462

Model 1 reveals a positive coefficient for *Age squared*, which confirms the U-shaped association between age and sickness absence revealed in Figure 2. The coefficient is still positive after control for *Year*, *Working hours*, *Leave*, and *Marital status* in Model 2.

In Model 3, the variable *Previous deliveries* and the product of *Age* and *Previous deliveries* is included to investigate if the associations between age and sickness absence differ between women with and without previous births. Since the interpretation of the interaction coefficients is complicated, the interaction effect is illustrated in Figure 3.

The values of the coefficients change by control for occupational class in Model 4. The implications of this change are also illustrated in Figure 3. All the occupational classes have positive coefficients, indicating that each class has a higher number of sick days than the baseline category, which is *I Higher professionals*.

Cragg and Uhler's R2, also referred to as Nagelkerke's R2, is a measure of model fit that varies between 0 and 1 [47]. High values indicate better prediction of counts in the current model than in the intercept model, which equals a model without independent variables. In Model 1, the value of Cragg and Uhler's R2 is 0.023, which implies that controlling only for *Age* and *Age squared* brings about a limited improvement of prediction of the number of sick days. In Model 2 and Model 3 the values of Cragg and Uhler's R2 have increased to 0.179 and 0.290, which suggest that the prediction of sick days is substantially improved after controlling for the confounders, and further improved by control for previous births and the interactions of age and previous births. By control for occupational class in Model 4, the value increases to 0.462, thus prediction of sick days is considerably improved when occupational class is included in the model.

Figure 3 displays the various associations between age and number of sick days in the preceding regression models. As the graph for Model 1 indicates, the youngest and oldest women have the highest numbers of sick days. Before control for any covariates, the numbers of sick days among pregnant women aged 20, 30, and 45 are 48.9, 46.8 and 48.1, respectively. After control for Calendar year, Working hours, Leave and Marital status, the corresponding numbers are 49.9, 46.9, and 46.2, as revealed in the second graph, Model 2.

The interaction of previous deliveries and age is illustrated in the third graph, Model 3. Young pregnant women with previous deliveries are characterised by a considerably higher number of sick days than equally aged women who are undergoing their first pregnancy. Pregnant women with previous births at the aged of 20, 30 and 45 have 60.3, 49.2, and 47.7 sick days, respectively. Among first-time pregnant women, the corresponding numbers are 49.1, 43.5, and 47.9.

Finally, the last graph shows that among pregnant women with previous births, the association between age and sick days is somewhat weakened after control for occupational class. However, 20 year old women in this group still have 55.1 sick days, which is a substantially higher number than the 48.5 and 48.8 sick days which apply to 30 and 45 year olds. In contrast, control for class alters the association between age and sickness absence among women undergoing their first pregnancy. In this group, 30 year olds still have the lowest number of sick days, 43.4, but 20 year olds now have a value of 45.8, which is considerably lower than the value of 48.7, which applies to 45 year olds.

Discussion

The preceding analyses have shown that among pregnant women with previous births, young employees still have higher numbers of sick days after control for class, although the association between age and sick days is slightly weakened. However, among women undergoing their first pregnancies, young pregnant women no longer have the highest level of sick days after control for class. This indicates that the high number of sick days among young first-time pregnant women is due to a preponderance of working class women in this group, who are more prone to sickness absence. In younger age groups, women with previous deliveries have a higher number of sick days than do first-time pregnant women, but the difference decreases with age and levels out in the mid 40ies. Regardless of previous pregnancies, pregnant women in their early 30ies have the lowest number of sick days, and this pattern remains largely unchanged after control for class.

Using data from the Norwegian population registry eliminates risks of Type I and II errors, thereby representing a strength of the study. Because the data are recorded by public entities, the empirical analyses do not suffer from non-response or self-reporting bias. Still, the registry has certain weaknesses. First, registration of births first started in 1992, which implies that the few number of women who gave birth prior to this year and had their next delivery during the observation period are misclassified as women undergoing their first pregnancy. However, this weakness only applies to women gave birth prior to 1992 and then had a birth interval of at least 12 years of duration, which is rare. Thus, any bias resulting from these misclassifications is limited. Second, only days of sickness absence covered by the National Insurance is included in the registry. For employees who do not suffer from pregnancy related conditions, this excludes the first 16 calendar days of the spell. Since 2002, employers can request reimbursement from National Insurance for expenditure on sickness absence among pregnant employees suffering periods of illness with a pregnancy-related diagnosis. In these cases, spells are registered from day one. This implies that the first 16 days are left censored for some spells, while other spells are complete. Although censoring may vary according to employer characteristics, such variation does not explain the high and increasing levels of sickness absence among young pregnant women, because this trend started before the amendment in 2002 [16].

The impact of excluding short term sickness absence is also limited, because only 32% of Norwegian women's sickness absence is covered by the employer [48], and the figure is probably lower for pregnant employees, considering the separate rules of employer imbursement which applies to absence spells caused by pregnancy related diagnoses. Still, censoring may have contributed to an excess zero in the distribution of sick days, although high numbers of zero often occur naturally in count data, which this variable in is an example of [46]. Zero-inflated Poisson regression was conducted to account for excess zero in the distribution of sick days.

Controlling for occupational class implies a weakening of the negative association between age and sickness absence both among women undergoing their first pregnancy and those who have previously given birth. This indicates that the initial association between age and sickness absence during pregnancy is partly due to aspects of occupational class which these two groups have in common, such as physical and social working environment. However, occupational class only explains a small proportion of the heightened number of sick days among young pregnant women who have previously delivered. In this group, higher numbers of sick days apply to young pregnant women even after control for occupational class. Unfortunately, the data set does not allow for a more detailed analysis of this group, but previous research may hint at possible explanations.

Early transition to second or third births may reflect weaker employment orientation, especially since Norwegian women less frequently return to full-time employment after second or third births [49]. Accordingly, the association between high numbers of sick days and early transition to second or third births that we find in our analyses may indicate that the threshold for sickness absence is lower for women whose future prospects are oriented toward family building rather than employment. However, the well-known association between homemaking and health problems implies that the apparent family orientation indicated by early transition to second or third births may reflect health problems rather than preferences. It is also worth noticing that early transition to second or third birth occurs much less frequently in Norway today than just a few decades ago. Sickness absence among women who undertake such transitions should thus be regarded in the light of the possible atypical situation of these women, because they may be affiliated with ethnic or religious groups that influence their sickness absence. Regardless of class and previous pregnancies, pregnant employees in their early 30ies are least prone to sickness absence. This may reflect a stronger work orientation in the group of women who postpone pregnancies to their 30ies, as compared to younger mothers. Pregnant employees' *"Strategies of Secrecy, Silence and Supra-performance"* [5] may shed light on this picture. In short, pregnant employees explain how they strive to adapt to workplace norms of occupational performance by delaying the announcement of their pregnancy, avoiding discussing it and compensating through increased flexibility and longer working hours, to demonstrate to their employer that the pregnancy does not make them less predictable or reliable as employees. Keeping sickness absence at an absolute minimum is also part of these strategies. Although these strategies seem quite hazardous, they also seem to reflect an important implicit assumption: the women do not want their pregnancy to jeopardise their occupational attachment. Women who postpone pregnancy to their early 30ies may be characterized by a general orientation toward future employment which also influences their number of sick days during pregnancy. From the late 30ies, the number of sick days during pregnancy increases with age, possibly due to increased biological challenges.

It is also worth noticing that young women with previous deliveries are more prone to sickness absence than first-time pregnant women, although the difference between these groups decreases with age. In other words, child care seems to inflate sickness absence more strongly among younger than among older pregnant women, which might indicate that early transition to motherhood is associated with rather traditional gender roles, while women who postpone pregnancy have partners who spend more time caring for children.

Future research on sickness absence should aim to investigate the relative importance of working conditions, social environment, motivation, and health complaints for sickness absence during pregnancy. One should also investigate if other risk factors for sickness absence apply to pregnant women, as compared to non-pregnant women and men. Causes and consequences of sickness absence among young pregnant women with previous deliveries may be of particular interest, as these are particularly prone to absence and possibly also future labour market exclusion.

Conclusion

Young pregnant women have higher frequency of sickness absence than their older counterparts. Contrary to expectations, the age differentials in sickness absence are stronger among pregnant women with previous deliveries than among those undergoing their first pregnancies. Occupational class largely accounts for the age differentials, but only among first-time pregnant women.

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This work was supported by The University of Bergen, which had no influence on the content of this article. The author has no conflicting interests. Use of the Norwegian population registry in this project was approved by The Norwegian Data Protection Authority. No informed consent was required, because the data were analysed anonymously. There is no additional data available.

Author contributions

Anja M. S. Ariansen designed the study, conducted the analyses, and wrote the paper.

Competing Interests

None

Data Sharing Statement

No additional data

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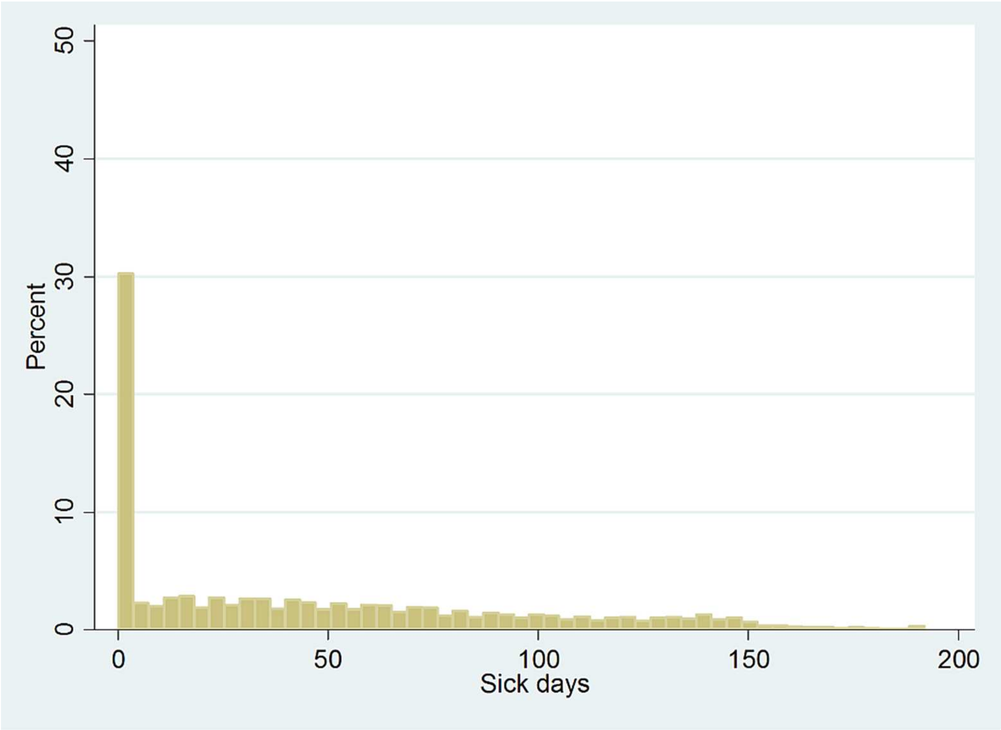
Figure legends

Figure 1. Distribution of days of sickness absence in the study population.

Figure 2. Days of sickness absence in different age groups. Only full-time employees included (>=37 weekly working hours).

Figure 3. Marginal effect of age in Models 1 to 4 in the regression analysis.



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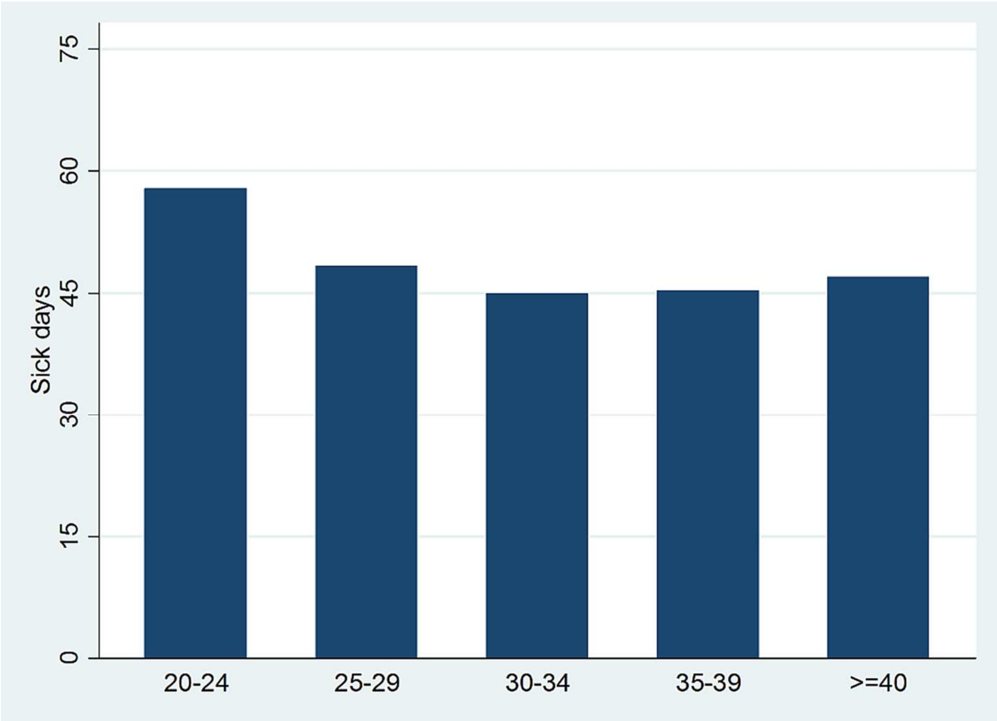

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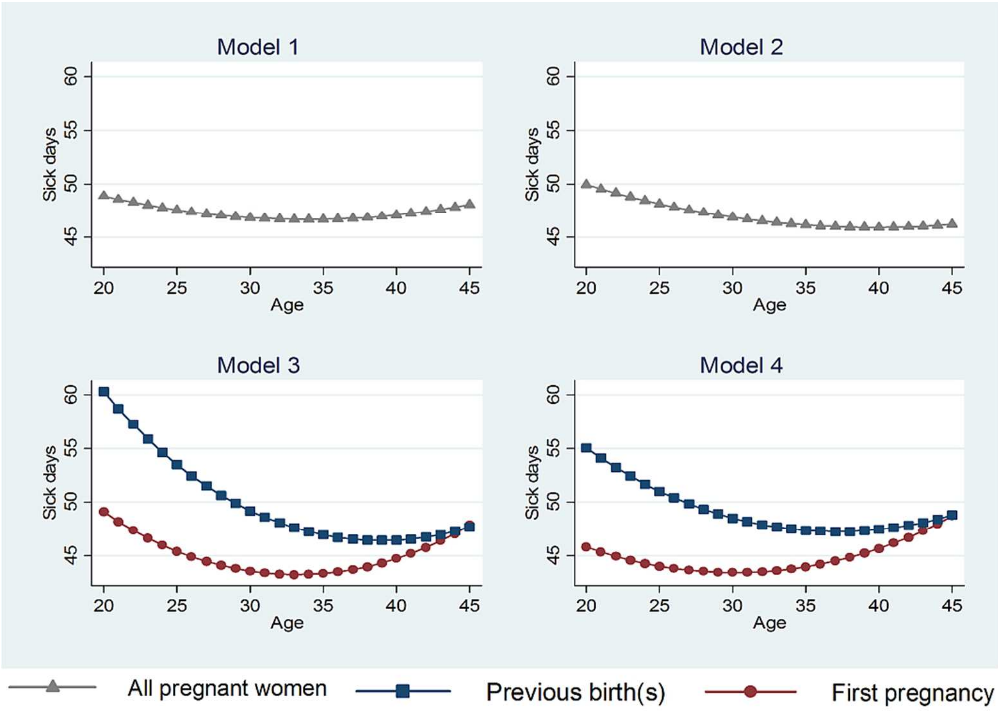

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	12
		(*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	8-11
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	*8-11*
Bias	9	Describe any efforts to address potential sources of bias	9-10
Study size	10	Explain how the study size was arrived at	12
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11-12
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	12-13
		(*b*) Describe any methods used to examine subgroups and interactions	10
		(*c*) Explain how missing data were addressed	12
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	12
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	12
		(b) Give reasons for non-participation at each stage	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	14-15
		(b) Indicate number of participants with missing data for each variable of interest	12
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	18
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10, 16
		(*b*) Report category boundaries when continuous variables were categorized	
		(*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	17-18
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
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	21

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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 www.strobe-statement.org.