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Pre-pregnancy mental distress and musculoskeletal pain and sickness absence during pregnancy – a twin cohort study

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Background: Sickness absence (SA) among pregnant women is high. The aim of this study was to examine whether factors known to predict SA in general also predict SA during pregnancy by estimating the association between prior mental distress and musculoskeletal pain and SA during pregnancy, and to assess the influence of familial (genetic and shared environmental) factors. **Methods:** In this prospective cohort study, data from 2076 female twins born 1967–79 who participated in a questionnaire study in 1998 were linked to register data on SA and childbirth during the years 1998–2008. Baseline measures included mental distress (symptoms of anxiety and depression; SCL-5) and musculoskeletal pain (lumbar spine, neck/shoulder and/or persisting muscular pain). SA was measured as a ratio of days on SA divided by potential working days. Negative binomial regression was performed for individual and within-pair effects. **Results:** Musculoskeletal pain, but not mental distress, was prospectively associated with overall SA during pregnancy in the adjusted individual-level analyses. With each standard deviation increase in musculoskeletal pain, SA granted for any disorder increased with 12% (IRR 1.12, 95% CI = 1.07–1.17) and SA granted for pregnancy related disorders increased with 9% (IRR 1.09, 95% CI = 1.02–1.17). Within-pair estimates were similar, suggesting little or no familial confounding. **Conclusions:** Women with previous musculoskeletal pain are at increased risk of SA during pregnancy, whereas no increased risk in women with previous symptoms of mental distress could be demonstrated. SA during pregnancy seems partly to be associated with different factors than SA in general.

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Introduction

Sickness absence (SA) rates among pregnant women are high and have increased over the past decades in several industrialized countries, without clear medical explanations.[1–4] In Norway, a longitudinal study of pregnant women found that three out of four women had been absent due to sickness for at least one week during their pregnancies.[5] The percentage of workdays lost due to long-term SA during pregnancy has ranged from around 20% to 25% over the last decade in Norway, while the SA rate among non-pregnant women in the same age group has ranged from around 5% to 7%.[6] In addition to more serious pregnancy related disorders and complications, common symptoms such as nausea, fatigue and back pain may reduce women's capacity to stay in the workforce during pregnancy and result in long-term SA if the work situation cannot be adjusted. In 2008, about two-thirds of SA spells among pregnant Norwegian women were registered with a pregnancy-related diagnosis, and half of these were unspecified disorders or symptoms.[6] Increased attention is given to what causes so many women with normal pregnancies to be absent from work and whether the rate of SA during pregnancy is too high.[7] SA may be influenced by many factors from the individual (e.g. health, attitudes and social situation) to various societal levels, including national, workplace and local community.[8] In general population studies, mental distress, that is, anxiety and depression and musculoskeletal symptoms at the individual level are among the most important predictors of SA,[9,10] but little is known about predictors of SA during pregnancy.

Mental illness and musculoskeletal problems are among the most common complications in pregnancy[11,12] and account for a large proportion of pregnant women's SA with a specified diagnosis.[6] Mental disorders in pregnancy are often preceded by prior symptoms of mental distress.[13] Mental distress has also been associated with the amplification of normal physiologic symptoms in pregnancy.[14] A previous study of regular employees showed that somatization was an important predictor of SA, and a key to understanding why anxiety and depression are related to SA.[15] There is also evidence that women with musculoskeletal trauma or weakness are more vulnerable to the increased physiological strain caused by pregnancy.[16] Previous low back pain is one of the most consistent risk factors for developing low back and/or pelvic girdle pain in pregnancy.[17,18] All in all, it is reasonable to assume that women with symptoms of mental distress and musculoskeletal pain who later become pregnant are at higher risk of SA during pregnancy, both for pregnancy-related disorders, and for mental and musculoskeletal disorders.

If there is an association between pre-pregnancy mental distress and musculoskeletal pain and SA during pregnancy, the twin study design can be used to account for unmeasured familial influences that may explain this association. Results from recent, large scale twin studies show that genetic factors explain around 35–50% of the variation in SA.[19,20] This might reflect both genetic susceptibility to disorders or health symptoms that reduce work capacity and other risk factors for SA, such as socio-economic status[21] or personality.[8] A previous study of young adult twins showed that the association between mental distress and SA granted for mental disorders was explained by genetic and non-shared environmental factors, whereas the association between mental distress and SA granted for somatic disorders could be explained by genetic factors alone.[22]

The high rate of SA among pregnant women and the use of mainly pregnancy-related diagnoses imply that results from general population studies are not directly generalizable to pregnant women. The current study utilizes a population based sample of female twins in fertile age to (a) investigate whether mental distress and musculoskeletal pain are prospectively related to four types of SA, that is, granted for any disorder, for pregnancy-related disorders, for mental disorders and for musculoskeletal disorders, during pregnancy, and (b) assess the influence of familial (the joint effect of genetic and shared environmental) factors on these associations.

Methods

Participants

The sample for the current study originated from the Norwegian Institute of Public Health Twin Panel (NIPHTP). The twins were identified through the national Medical Birth Registry, established 1 January 1967. The participants were twins born between 1967 and 1979 who took part in a large questionnaire study in 1998. By using national identification numbers issued to all Norwegians at birth, NIPHTP was linked to registries at Statistics Norway containing data on childbirths and SA benefits for the years 1998–2008. Details about NIPHTP are described thoroughly elsewhere.[23] In brief, 12 700 twins were invited to the questionnaire study and 8045 (63.3%) responded after one reminder. Of these, 7710 were linked to SA data, while 335 twins withdrew from the study. In addition, 12 participants were excluded due to lack of data on zygosity. A total of 4457 were females, constituting the basis of the current sample.

The first full period of pregnancy registered after 1st January 1998 was selected, using a gestation period of 40 weeks as an approximation for all women in the sample. To ensure that data on SA for the entire period were available, we excluded births before 8th October 1998. The cohort thus comprised 2653 women who gave birth between 8th October and 31st December 2008. We excluded participants who received other medical benefits during pregnancy ($n = 81$), those with <140 employment days (i.e. half of approximated pregnancy period; $n = 302$), those who had registered more sick days than potential working days ($n = 4$), and participants who were already pregnant at the time of the 1998 questionnaire study ($n = 190$). Our final sample of 2076 women included 358 complete twin pairs (206 monozygotic [MZ]; 152 dizygotic [DZ]) and 1360 single twins (375 MZ; 985 DZ).

Zygosity was initially determined using questionnaire items previously shown to correctly classify >97% of the twin pairs,[24] followed by DNA analyses on a subgroup of the sample. The discrepancy between classification based on the questionnaire and DNA markers implied an expected misclassification rate of <2% for the whole sample.

Participant consent was granted *via* the return of a completed questionnaire or specific consent form. The Regional Committees for Medical and Health Research Ethics approved of the study and the linkage with registry data from Statistics Norway.

Measures

Predictors

Mental distress was measured in the 1998 questionnaire using a five-item short-version (SCL-5[25]) of the Hopkins Symptoms Checklist-25,[26] asking respondents about symptoms of anxiety and depression during the past 14 days. SCL-5 has been shown to be reliable and to correlate at 0.92 with the full version.[25]

Musculoskeletal pain was measured by three questions in the 1998 questionnaire asking the respondent whether they had ever had 'recurrent neck/shoulder pain', 'lumbar spine pain' or 'persisting muscular pain'. Total scores ranged from 0, 'no pain', to 3, 'pain at three sites'.

Outcome

SA's exceeding 16 days are covered by the mandatory Norwegian Insurance Scheme for a duration up to 52 weeks. Thus, the minimum SA period recorded in this study was 16 days. For each day from 1 January 1998 to 31 December 2008, we had information on whether each participant was registered as employed and on SA from the governmental registry The Historical-Event Database (FD-

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Table 1 Characteristics of the sample

	N (%)	Mean	SD	Range
Age at childbirth	2076	29.9	3.4	20–41
Educational attainment in 2008	2075	4.2	1.3	1–7
Number of previous childbirths	2076	0.3	0.6	0–2
1 previous birth	404 (19.5%)			
2+ previous births	143 (6.9%)			
Mental distress	2052	1.4	0.4	1–4
Number of musculoskeletal pain sites	2076	0.4	0.7	0–3
1 pain site	435 (21.0%)			
2 pain sites	142 (6.8%)			
3 pain sites	30 (1.5%)			
SA—any diagnosis	2076	24.6	25.3	0–100
SA—pregnancy related illness	2076	13.6	22.0	0–100
SA—mental disorder	2076	0.9	6.8	0–87.7
SA—musculoskeletal disorder	2076	5.0	14.5	0–100

Note: Mean SA is percentage of workdays lost.

Trygd). In order to account for multiple SA's and varying degree of employment, we constructed a ratio of days on SA divided by days eligible for SA for the 280 days (40 weeks) prior to the day of childbirth. Diagnoses set by physicians when SA's were granted were also available, coded according to the International Classification of Primary Care-2 (ICPC-2).[27] Four variables were constructed: SA granted for pregnancy related disorders (diagnoses in the W-chapter), SA granted for mental disorders (diagnoses in the P-chapter), SA granted for musculoskeletal disorders (diagnoses in the L-chapter), and SA granted for any disorder (including missing diagnoses).

Potential confounding factors

The respondents' age when giving birth was calculated by subtracting their birth year from the year of the childbirth, both available from The Historical-Event Database.

Data on the highest completed education were available annually from 1998 to 2008 from the Norwegian Educational Database (NUDB) administered by Statistics Norway, ranging from no education to PhD or equivalent. Because some participants may not have had time to complete their education due to young age, we used the highest achieved education at the end of the follow-up period in 2008.

Number of previous childbirths was available from The Historical-Event Database.

Statistical analysis

To estimate the associations between mental distress, musculoskeletal pain and later SA during pregnancy, negative binomial regression was performed for the whole sample, adjusting standard errors for dependency within twin pairs (Stata command *nbreg* option *vce [cluster clustvar]*). First, we estimated crude associations between each exposure variable (mental distress or musculoskeletal pain) and the SA outcomes separately. Second, we adjusted these associations for age at childbirth, educational attainment and number of previous births. Third, we entered mental distress and musculoskeletal pain simultaneously into the regression models. Incidence-rate ratios (IRR) with 95% confidence intervals (CI) were computed, expressing the percentage increase of SA per unit increase on the exposure variable.

To assess familial confounding, conditional fixed-effects (within-twin pair) negative binomial regression was performed (Stata command *xtnbreg* option *fe*). The within-twin pair effect consists of each individual twin's deviation from the twin pair's mean-level exposure effect, so that a significant within-twin pair effect reflects effects of mental distress and musculoskeletal pain unconfounded by shared genetic effects and shared environmental risk that makes the twins more similar to each other, such as neighborhood, school and socio-economic status of parents. For MZ twins, all effects of genes and shared environment are controlled for, while for DZ twins, effects of shared environment and 50% of genetic effects are controlled for. Combining MZ and DZ pairs gives lower control for confounding genetic factors than analyses of MZ pairs only, but higher statistical power. Because of the small number of complete twin pairs in our sample, we ran the model with MZ and DZ pairs combined.

A total of 24 participants had missing on the total score of mental distress and one participant had missing on educational level. These cases were dropped pairwise. All analyses were run in Stata 14.0.

Results

Descriptive results

In the total sample, 66.9% were on SA granted for any disorder at some point during their pregnancy. Table 1 shows the basic characteristics of the sample. Mean age at the time of giving birth was 29.9 (SD = 3.4) and mean educational level 4.2 (SD = 1.3), corresponding to above upper secondary schooling. The majority were giving birth for the first time (74%). On average, 24.6% of workdays were lost to SA granted for any disorder, including 13.6% for pregnancy related disorders, 0.9% for mental disorders and 5.0% for musculoskeletal disorders. There was no evidence of multicollinearity between variables (correlations ranging from -0.24 to 0.20).

Regression analyses

Table 2 shows the estimated associations between mental distress and musculoskeletal pain and each SA outcome. In the crude analyses (left column) mental distress and musculoskeletal pain were each significantly associated with increased SA granted for any disorder, for pregnancy related disorders and for mental disorders, while only musculoskeletal pain was significantly associated with SA granted for musculoskeletal disorders. Adjusting for measured background factors (second column) slightly reduced the associations between mental distress and musculoskeletal pain and SA granted for any disorder and for pregnancy related illness. For SA granted for mental and musculoskeletal disorders the estimates increased slightly, but CI were wide and overlapping. In the final adjusted individual-level model (third column), where mental distress and musculoskeletal pain were added simultaneously, mental distress was only significantly associated with SA granted for mental disorders, with an increased risk of 46% (IRR 1.46, 95% CI = 1.04–2.04). Musculoskeletal pain, on the other hand, remained significantly associated with all categories of SA. One SD increase in musculoskeletal pain sites showed an increased risk of 12% (IRR 1.12, 95% CI = 1.07–1.17) for SA granted for any disorder, and between 9% and 51%

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Table 2 Negative binomial regression of sickness absence (SA) during pregnancy on mental distress and musculoskeletal pain

		Random effects (individual-level) models			Fixed effects (within-twin pair model)
		Crude IRR (95% CI)	Adjusted 1[a] IRR (95% CI)	Adjusted 2[b] IRR (95% CI)	Adjusted 3[b] IRR (95% CI)
SA granted for any disorder	Mental distress	**1.09 (1.05–1.14)**	**1.07 (1.03–1.12)**	1.04 (1.00–1.09)	1.06 (0.93–1.20)
	Musculoskeletal pain	**1.14 (1.10–1.19)**	**1.13 (1.08–1.17)**	**1.12 (1.07–1.17)**	1.11 (0.98–1.25)
SA granted for pregnancy related illness	Mental distress	**1.08 (1.01–1.15)**	1.07 (1.00–1.14)	1.04 (0.98–1.12)	0.94 (0.78–1.12)
	Musculoskeletal pain	**1.12 (1.05–1.20)**	**1.10 (1.03–1.18)**	**1.09 (1.02–1.17)**	1.07 (0.90–1.27)
SA granted for mental disorders	Mental distress	**1.58 (1.20–2.08)**	**1.60 (1.18–2.17)**	**1.46 (1.04–2.04)**	n.a.
	Musculoskeletal pain	**1.49 (1.13–1.96)**	**1.72 (1.24–2.37)**	**1.51 (1.08–2.12)**	n.a.
SA granted for musculoskeletal disorders	Mental distress	1.11 (0.98–1.26)	1.08 (0.94–1.23)	1.03 (0.91–1.18)	n.a.
	Musculoskeletal pain	**1.18 (1.05–1.32)**	**1.21 (1.07–1.37)**	**1.20 (1.06–1.36)**	n.a.
N observations	Mental distress	2052	2051	2051	287/198 complete pairs resp.
	Musculoskeletal pain	2076	2075		

Notes: Bold values signify $P<0.05$; All models are adjusted for dependency within twin pairs; Mental distress and musculoskeletal pain scores were standardized, that is, one unit signifies 1 SD; In fixed effects analyses pairs with all zero outcomes are dropped; n.a.: not applicable due to small sample size.
a: Adjusted for age, education, number of births.
b: Mental distress and musculoskeletal pain analysed jointly, adjusted for age, education, number of births.

increased risk in the other SA categories. Scaling musculoskeletal pain in number of pain sites instead of standard deviations gave an 18% (IRR 1.18, 95% CI = 1.11–1.25) increase in SA per increase in pain site. Since the IRR has a multiplicative effect on the outcome scale, the difference between no pain and pain at two sites is $1.18^2 = 1.39$, that is, a 39% increase in SA, and the effect of having pain at all three sites compared with no pain is $1.18^3 = 1.64$, that is, a 64% higher rate of SA.

In the within-twin pair analyses (right column), the associations between exposures and SA granted for any disorder and pregnancy-related disorders were broadly similar to the previous models. However, the associations were no longer significant and CI were wide.

The average time between the 1998 questionnaire and year of child birth was 4.69 years (SD = 2.73, range = 0–10). As the differing time lapse of participants may have an effect on the results, we tested eight models (fully adjusted individual-level), two for each SA category, with interaction terms between time lapse and each exposure. There were no significant interaction effects at the $\alpha = 0.01$ level.

Discussion

In this population-based sample of young female twins, we investigated whether mental distress and musculoskeletal pain were prospectively related to four types of SA granted during pregnancy, while also assessing the influence of familial factors. Our main findings were that mental distress was only associated with SA granted for mental disorders during pregnancy after adjusting for individual background factors, but not significantly associated with SA granted for any disorder, pregnancy related disorders or musculoskeletal disorders. Musculoskeletal pain, however, was associated with SA granted for any of the four categories. After controlling for common genetic and environmental effects, the associations lost their significance, but were similar in strength, suggesting little influence of familial factors.

Most SA during pregnancy in Norway is granted for musculoskeletal or unspecified disorders/symptoms.[6] The high level and increased use of unspecified diagnoses in the last decade has led to speculations about whether this represents unnecessary SA. Previous musculoskeletal pain, but not mental distress, predicted SA during pregnancy in the present study, suggesting that the reasons for the overall high level of SA among pregnant women are more somatic than psychological in origin. This is especially interesting with regard to the large proportion of SA during pregnancy diagnosed with unspecified pregnancy-related complaints. We were not able to distinguish between different pregnancy-related SA diagnoses, but our findings suggest that mental distress is not a major underlying risk factor for unspecified diagnoses of SA during pregnancy. Musculoskeletal pain, on the other hand, may explain some of this, but more likely it explains musculoskeletal pain typical for pregnancy, such as low back and pelvic girdle pain, which has increasingly been classified in the pregnancy-related diagnosis chapter rather than the musculoskeletal diagnosis chapter over the last decade.[6]

In line with studies of SA in the general population showing that musculoskeletal pain increases the risk of subsequent SA,[9,28] musculoskeletal pain was prospectively associated with SA during pregnancy. Thus, pre-existing musculoskeletal pain may indicate a vulnerability that heightens the risk of SA during pregnancy, perhaps due to a worsening of the same symptoms or to a general liability for musculoskeletal problems that may be triggered by the increased physiological strain caused by pregnancy.[16–18] Another possible explanation is that stress and lack of coping with employment during pregnancy lead to symptoms that by the woman and the physician are easily linked to pregnancy-induced musculoskeletal complaints because of a history of musculoskeletal pain. Early contact with a physiotherapist and individual-based treatment has previously been found to reduce SA among women experiencing musculoskeletal pain during pregnancy.[29] Our findings suggest that early intervention aimed at pregnant women who suffered from musculoskeletal pain *before* pregnancy could further reduce the high level of SA among pregnant women.

After adjusting for familial factors, the associations between musculoskeletal pain and SA during pregnancy were nearly identical, but no longer statistically significant. CI became wider, indicating lower statistical power, a common problem in fixed effects analyses.[30]

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Despite the non-significant result, the similar strength of the association leads us to conclude that there appeared to be little or no influence of genetic or shared environmental factors on the association between prior musculoskeletal pain and SA during pregnancy. However, studies using larger datasets are needed to confirm the present findings.

The results of our study should be interpreted with some potential limitations in mind. First, the statistical power in the fixed-effects analyses was limited, leading to uncertainty around estimates. Second, only individuals who were employed at baseline and during pregnancy were included in the study, thus excluding women who were not part of working life, perhaps due to ill health or full-time studies. Third, since the study only considered long-term SA (lasting at least 16 days) it is unknown whether the results also apply for short-term SA. Fourth, the data were not originally collected for this particular study, implying that conclusions should be drawn with caution. Finally, the results are likely to be best generalizable to other countries with high female workforce participation and similar welfare schemes.

Conclusion

Pregnant women have a considerable higher level of SA than the population in general. Musculoskeletal pain, but not mental distress, was prospectively associated with SA during pregnancy, suggesting that early intervention aimed at women with previous musculoskeletal symptoms is one viable way to prevent SA among pregnant women.

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Conflicts of interest: None declared.

Key points

- There was no evidence of an association between prior mental distress and sickness absence (SA) during pregnancy after adjusting for individual background factors, whereas prior musculoskeletal pain and SA were associated.
- There was little evidence of confounding by familial factors on the association between musculoskeletal pain and SA during pregnancy.
- Early intervention aimed at pregnant women who suffered from musculoskeletal pain prior to pregnancy could be one possibility to reduce the high level of SA among pregnant women.

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