RESEARCH REPORT

Psychosocial and physical work environment, and risk of pelvic pain in pregnancy. A study within the Danish national birth cohort

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Objective: The sparse knowledge of the aetiology of pelvic pain in pregnancy makes evidence based prevention a limited option. The aim of this study was to examine the relation between pelvic pain in pregnancy and physical and psychosocial working conditions.

Methods: This study used self reported data on working conditions for 1219 cases and 1539 controls, sampled as a nested case-control study within the Danish national birth cohort. Cases and controls were selected on the basis of self reported pelvic pain intensity, pain localisation, and pain impact on daily living activities. Exposure data were collected prospectively; early in pregnancy and before the onset of pelvic pain. Main outcome measures were odds ratios for pelvic pain in pregnancy as a function of physical and psychosocial working conditions.

Results: Pregnant women with fixed evening work and with rotating shifts (without night shift) had odds ratios for pelvic pain in pregnancy of 1.76 (95% confidence intervals 1.04 to 2.96) and 1.65 (1.22 to 2.24), respectively, compared with women with day work. Physically strenuous work was associated with an almost 50% increased risk of pelvic pain in pregnancy (1.47; 1.17 to 1.84). In women who were under high psychosocial strain at work odds ratio was 1.39 (1.12 to 1.74) compared with women with low job strain.

Conclusion: Both physically and psychosocially demanding working conditions, measured by physically strenuous work, rotating shifts, and high job strain, are associated with an increased reporting of pelvic pain in pregnancy.

Pelvic pain is a common ailment during pregnancy,[1] and some women suffer from pain and/or pelvic instability during pregnancy and/or puerperium to an extent that it affects their ability to carry out daily activities, for example, walking.[2–4] This condition has been entitled symptom giving pelvic girdle relaxation[5] (in the following termed as ''pelvic pain''). The diagnostic criteria are, however, not precise and neither is the aetiology. Symptoms are pain around the pelvic joints. Pain can occur at all levels from discomfort to complete immobilisation.[2 3]

The reported incidence of pelvic pain varies substantially in the literature from 2% to 42% of all pregnant women.[5–13] A lack of distinct diagnostic criteria is probably the main reason for this variation, as the diagnosis predominantly relies on subjective pain reporting.[4 6 14–16] Evaluations of clinical tests show that the women's answers to pain provocation tests are more reliable than the judgment of palpation made by skilled examiners.[8] Onset is most frequent between third and seventh month of pregnancy[16] and 9% of women with pelvic pain during pregnancy still suffer from pelvic joint pain two years after childbirth.[17] Pelvic pain is one of the most commonly used indicators in Denmark for sick absence during pregnancy (one third of pregnancy related sick leave days).[11 18–20] It is a neglected condition of substantial public health impact.

A softening of the pelvic joints is one of many physiological changes during pregnancy, and could seem an obvious biological cause of the condition, but the reason why some women experience severe pain is still unknown. Relaxin, a peptide hormone, is involved in the softening of the pelvic joints and may have a part for pelvic pain. Studies on serelaxin and pelvic pain have, however, showed conflicting results.[21–25]

The incidence of pelvic pain has been found to be similar in Scandinavia and Africa in both rural and non-rural areas,[26] and identification of risk factors related to working conditions could lead to a better understanding of the nature of the condition and may suggest preventive measures. A Danish cohort study found increased risk of pelvic pain in women working in draught and cold or with uncomfortable working postures.[11] Frequent twisting and bending or forward body bending have also been suggested associated with the condition,[9] and both physical and psychosocial work stressors are associated with other types of musculoskeletal pain disorders.[27–30] High occupational demands combined with low decision latitude are known to be predictive for the development of several types of diseases correlating with stress hormones.[31 32]

The aim of this study was to examine the relation between both physical and psychosocial working conditions and the reporting of pelvic pain during pregnancy or shortly after delivery.

METHODS

The background cohort study

From 1997 to 2003 women were recruited to the Danish national birth cohort, a nationwide study of 100 000 pregnant women and their offspring. Our study on pelvic pain in pregnancy was carried out as a case-control study within this birth cohort. Pregnant women in Denmark were invited to the birth cohort study by their general practitioner and were included when the study centre had registered a signed informed consent form. In the birth cohort study the women took part in four telephone interviews: (1) in 12th–16th pregnancy week, (2) in 30th pregnancy week, (3) six months after childbirth, and (4) 18 months after childbirth.

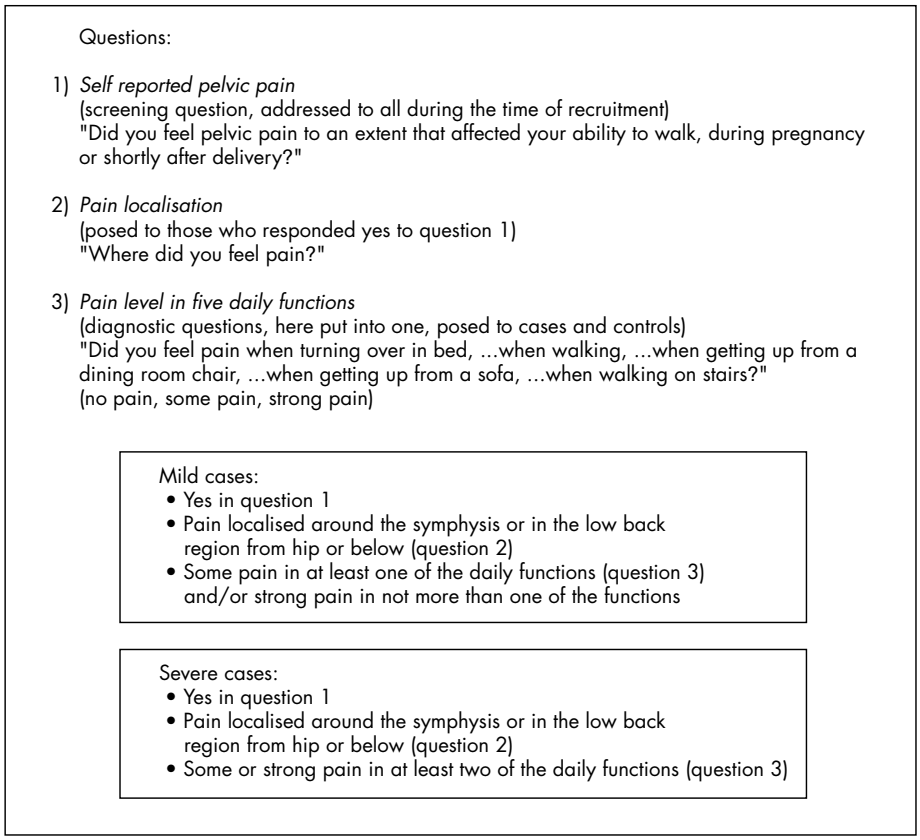

Figure 1 Case definition according to the questions asked in the interview.

About 60% of all eligible women received information on the study (based upon the degree of collaboration from the general practitioners and the midwives). Except for two counties about 35% of all pregnant women were recruited for the study, thus it is estimated that about 60% of those invited participated in the study. Details about the Danish national birth cohort are presented elsewhere.[33]

Based on sample size calculations we aimed at including 1500 cases and 1500 controls. At the time of recruitment to the birth cohort we expected 20 000 women per year to complete the third interview, and we expected an end point incidence of 10%. As only 75% of the potential cases were expected to fulfil the final inclusion criteria, a one year period of recruitment for the pelvic pain study was scheduled. However, the actual inclusion rate to the birth cohort was lower and consequently recruitment was extended to cover the period from April 2000 to November 2001 during which 15 972 women completed the third interview.

Selection of cases and controls and measurement of outcome

A screening question in the third interview was used to identify potential cases for the pelvic pain study (fig 1, question 1). Controls were selected among all women who took part in this interview during a five week period and who responded negatively to the screening question; 2486 potential cases and 2340 potential controls were identified this way. The selection of controls was split up into five single weeks spread equally over the data collecting period to avoid any climatic influence. Exposure data were collected in the first interview, so only women who had completed both the first and the third interview were included. Thus, we selected for further analysis the 2215 potential cases (89%) and 2082 potential controls (89%) who had completed both interviews.

All potential cases were asked about specific pain localisation in the third interview (fig 1, question 2) and 549 were excluded because they reported pain located outside the pelvic area. Furthermore, all women, irrespective of their answer to the screening question, were asked about pain intensity when performing daily functions (fig 1, question 3). For the remaining 1666 potential cases, 44 reported no pain in any of the five daily functions (fig 1, question 3) and were therefore excluded. Furthermore, cases were categorised into mild (523) and severe (1099), see figure 1. Our definition of severe cases corresponds closely to the one used by Larsen *et al*.[11] Based on the pain intensity question 6% (115) of the 2082 potential controls were excluded because they reported pain levels equivalent to the severe case group, leaving 1622 cases and 1967 controls in the study.

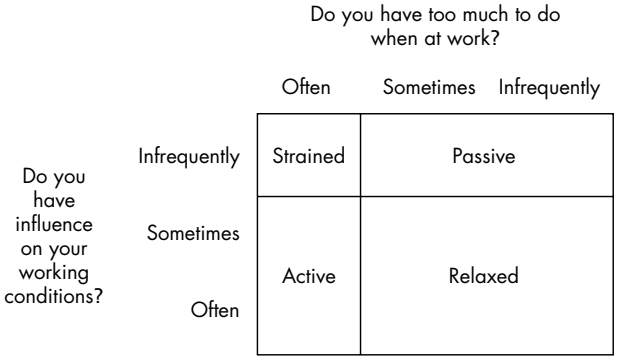

Figure 2 Graphic illustration to show how job strain categories were constructed.

Measurement of exposure

Data on exposures were collected from the first interview. If a woman worked a minimum of 15 hours per week at the time of this interview or had been doing so within three months before, she would be asked about occupational exposures. Data on physical working conditions were obtained from the following variables: job status (job title, classified from the Danish version of *The International Standard Classification of Occupations*, DISCO-88), number of working hours per week, working posture (predominantly sitting, predominantly standing or walking, or a mixture of the three), working hours (day, evening, night, rotating without night, rotating with night), daily work related carrying of heavy burdens (no, 11–20 kilos, >20 kilos), and physically strenuous work in general (often, some times, infrequently).

The job strain model is constructed on the basis of demand and control levels in working life and it combines information on these two parameters into four categories: relaxed, passive, active, and strained. ''Relaxed'' refers to low job strain and ''strained'' refers to high job strain.[31 32] Demands were measured by the following question in the first interview: ''Do you have too much to do when at work?'' (often, some times, infrequently), and control was measured by the question: ''Do you have influence on your working conditions?'' (often, some times, infrequently). High demands were defined a priori by the answer ''often'' to make the high strain category as strained as possible (see fig 2). Similarly, low control was defined by the answer ''infrequently''. Information on social support was obtained from the question: ''Do you receive help from your colleagues when you have problems at work?''.

The following possible confounding factors were chosen from the literature and collected from the first interview: age, parity, pre-pregnant BMI, previous low back pain, smoking, and psychiatric illnesses. Data on previous pelvic pain were available from the third interview.

Statistical analysis

Associations were analysed by means of logistic regression using both the restricted (severe) case group and the entire

Table 1 Numbers and percentages of severe cases, mild cases, and controls according to physical working conditions and job strain, and to overall working status

		Severe cases		Mild cases		Controls	
Variables	**Value**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Women in work* (n = 2758)							
Job status	in executive jobs or jobs requiring higher education	125	16	96	24	311	20
	in jobs requiring middle range education	268	33	131	32	531	35
	in the office or welfare area or selfemployed	344	43	156	38	582	38
	in skilled or unskilled jobs	70	9	24	6	108	7
	missing	3	0	2	1	7	1
Working hours	day	611	75	311	76	1278	83
	evening	28	4	17	4	31	2
	night	15	2	6	2	16	1
	rotating shifts (without night)	87	11	33	8	103	7
	rotating shifts (with night)	69	9	42	10	111	7
Number of working hours per week	15–30	140	17	80	20	278	18
	31–37	580	72	283	70	1062	69
	>37	88	11	44	11	197	13
	missing	2	0	2	1	2	0
Working posture	predominantly sitting	158	20	87	21	385	25
	predominantly standing or walking	239	30	129	32	353	23
	a mixture of the three	410	51	192	47	799	52
	misssing	3	0	1	0	2	0
Daily work related carrying of heavy burdens	no	501	62	245	60	1115	72
	yes, 11–20 kilos	143	18	88	22	232	15
	yes, >20 kilos	163	20	75	18	188	12
	missing	3	0	1	0	4	0
Physically strenuous work	sometimes or infrequently	558	69	309	76	1272	83
	often	252	31	100	24	265	17
	missing	0	0	0	0	2	0
Job strain†	relaxed	274	34	136	33	639	42
	passive	238	29	122	30	460	30
	active	96	12	55	13	166	11
	strained	201	25	93	23	272	18
	missing	1	0	3	1	2	0
Women, working		810	100	409	100	1539	100
Women, not working		289‡		114		428‡	
All women n = 3589		1099		523		1967	

*Includes women working a minimum of 15 hours per week at the time of the interview or within three months before the interview. Students with same working pattern are also included. †Job strain categories: relaxed, low demands and high control; passive, low demands and low control; active, high demands and high control; strained, high demands and low control. ‡Includes one missing.

Table 2 Odds ratios for pelvic pain in pregnancy according to physical working conditions and job strain. Severe and mild cases analysed together. Only women in work (n = 2758)

Exposure variables	Value	Crude OR	Adjusted OR*	95% CI
Job status	in executive jobs or jobs requiring higher education	1	1	–
	in jobs requiring middle range education	1.06	0.87	0.69 to 1.10
	in the office or welfare area or self employed	1.21	1.00	0.80 to 1.25
	in skilled or unskilled jobs	1.22	0.86	0.60 to 1.23
Working hours	day	1	1	–
	evening	2.01	1.76	1.04 to 2.96
	night	1.82	1.36	0.66 to 2.82
	rotating shifts (without night)	1.61	1.65	1.22 to 2.24
	rotating shifts (with night)	1.39	1.34	0.99 to 1.87
Number of working hours per week	15–30	1	1	–
	31–37	1.03	1.12	0.91 to 1.38
	>37	0.85	0.87	0.64 to 1.17
Working posture	predominantly sitting	1	1	–
	predominantly standing or walking	1.64	1.04	0.80 to 1.35
	a mixture of the three	1.18	1.02	0.83 to 1.25
Daily work related carrying of heavy burdens	no	1	1	–
	yes, 11–20 kilos	1.49	1.12	0.88 to 1.44
	yes, >20 kilos	1.89	1.14	0.86 to 1.50
Physically strenuous work	sometimes or infrequently	1	1	–
	often	1.95	1.47	1.17 to 1.84
Job strain†	relaxed	1	1	–
	passive	1.22	1.11	0.92 to 1.35
	active	1.42	1.32	1.02 to 1.71
	strained	1.68	1.39	1.12 to 1.74

*Exposure variables mutually adjusted and adjusted for confounders that changed the fully adjusted estimates >5%. Working hours adjusted for previous pelvic pain. Work related carrying of heavy burdens adjusted for previous pelvic pain and body mass index. For status of job, number of working hours per week, working posture, physically strenous work, and job strain no relevant confounders were identified. †Job strain categories: relaxed, low demands and high control; passive, low demands and low control; active, high demands and high control; strained, high demands and low control.

case group. Odds ratios (OR) are presented as crude estimates and adjusted estimates. In the final model the exposure variables under study were mutually adjusted and also adjusted for relevant confounders. Selection of which confounders to include was based on the change in estimates principle. All putative confounders were included in the model, and if one factor when removed changed the estimates more than 5% this variable was kept in the model. Tests for interaction between job strain and social support and between job strain and physical working conditions were performed using the likelihood ratio test statistic. Analyses were carried out using SPSS 10.0 software.

RESULTS

During recruitment to the case-control study 16% of the women reported pelvic pain to an extent that affected their ability to walk, and 8% reported strong pelvic pain according to the severe case definition used in this study (data not shown).

About three quarters of both cases and controls reported that they were working at the time of the first interview or had been working during the previous three months (table 1). Severe cases were slightly more often out of work (289 of 1099 = 26%) than mild cases (114 of 523 = 22%) and controls (428 of 1967 = 22%).

All the following analyses are restricted to the 1219 cases and 1539 controls who were working at the time of the first interview or had been working within the past three months. Students were included if they worked at least 15 hours per week.

We found that age, pre-pregnant BMI, the prevalence of previous back pain, and psychiatric illnesses had a uniform distribution over exposure categories. Women who had suffered from pelvic pain previously were more likely to hold high status jobs than women with no pelvic pain history. Women who had given birth before were more likely than nullipara to hold jobs of lower status, to carry heavy loads at work, and to work part time. Smoking was more common among women in lower job status groups and among women with strenuous work (data not shown).

Table 2 presents ORs for pelvic pain as a function of physical working conditions and job strain, analysed for the entire case group. Restricting analyses to severe cases did not change the estimates much (data not shown). When we adjusted for all possible confounders (see measurement of exposure section) the estimates were similar to the ones shown in table 2 except for working hours and for carrying of heavy burdens at work, for which reason these exposures were adjusted (see footnote to table 2). Working hours outside fixed daytime were associated with an increased risk of pelvic pain after adjustment for the other job exposures and confounders. The estimates were statistically significant for fixed evening workers (OR 1.76) and rotating shift workers (without night shift) (OR 1.65). Physically strenuous work was associated with an almost 50% increased risk of pelvic pain (OR 1.47). Women in the high strained or in the active job strain groups were more likely to report pelvic pain than women in the passive or the relaxed groups (OR 1.39 and 1.32, respectively).

The association between job strain and pelvic pain was not modified by physical working conditions or by social support (data not shown). To form a more homogenous population we restricted data to include health care workers only (243 cases, 228 controls). Pelvic pain ORs adjusted for possible confounders were 3.72 (95% confidence intervals (CI) 1.74 to 7.99) for rotating shift work without nightshift, 1.83 (1.05 to 3.20) for rotating shift with nightshift, 1.45 (0.87 to 2.40) for physically strenuous work, and 1.01 (0.55 to 1.84) for high

job strain. We also tried to exclude all students (left were 598 cases, 1216 controls) and found ORs of 1.67 (1.21 to 2.31) for rotating shift work without nightshift, 1.44 (1.04 to 1.99) for rotating shift with nightshift, 1.39 (CI 1.08 to 1.79) for physically strenuous work, and 1.31 (1.03 to 1.68) for high job strain.

DISCUSSION

Pelvic pain was a common problem among women in the Danish national birth cohort. We found rotating shift work, physically strenuous work, and demanding work (high job strain) to be associated with pelvic pain. We found no association with job status, work posture, or carrying of heavy burdens at work.

Our findings on job strain are supported by results from one cross sectional study[9] and need to be confirmed by others. The same study has reported work posture to be associated with pelvic pain,[9] which we did not see. This may be attributable to reverse causality in the cross sectional study or simply to random variation. We only found one study that had examined shift work and pelvic pain, and they found no association.[11]

Job strain consists of complex concepts like job demand and job control. According to Karasek a number of items should be included to fully describe the demand dimension: workload, time available, speed, and exertion. We believe, however, that these features partly are reflected in the answer to the question: ''do you have too much to do when at work?''. The control variable used in this study (''do you have influence on your working conditions?'') reflects to a larger extent decision authority and to a smaller extent skill discretion, which was not measured. Both decision authority and skill discretion are described to be part of the control dimension.

It was never expected that the birth cohort would provide a representative sample of pregnant women in Denmark. We have, however, sufficient variation in the exposure status to perform meaningful comparisons. Selection bias could explain the associations found if the decision to take part in the birth cohort study was based upon both working conditions and pelvic pain. This type of bias is unlikely because recruitment to the birth cohort took place before the onset of pelvic pain.

Confounding could also explain the associations found between work related risk factors and pelvic pain. Only little is known about the causes of pelvic pain, and therefore we do not know if we have adjusted for all other determinants that correlate with exposure. The fact that demographic factors (age, parity) and lifestyle factors (smoking, body mass index) did not confound the association, speaks against strong confounding (body mass index confounded carrying of heavy burdens only). However, body mass index was based upon self reported data on weight, which is known to be underestimated among overweight women, and therefore residual confounding may exist.

A number of 549 women who answered yes to the screening question subsequently reported pain outside the pelvic area. These women were excluded from further analysis, as were 115 controls who reported pain equivalent to the severe case group in the following questions on pain intensity. We did not include the 549 potential cases in the control group and we excluded the 115 potential controls because we wanted to identify a control group who clearly did not have pain. We did not add the 115 to the case group afterwards because this would break the sampling design of the study and could result in a less distinct case group.

The fact that 6% of the initially selected controls fulfilled the criterion for strong pain in daily functions and 40% fulfilled the criterion for mild pain, although they did not say yes to the screening question, may suggest that pelvic pain or pain similar to pelvic pain is common during pregnancy and that pelvic pain may just represent the tail of a distribution rather than a distinct entity.

We tried to limit the study to more homogenous groups to better adjust for social confounding. Excluding students showed similar estimates as the ones found for all. When restricting data to health care workers only we found a notably increased risk in women working in rotating shift without nightshift, pointing to some interaction between working hours and working sphere. Estimates were adjusted for previous pelvic pain, so the explanation could not be that women with previous pelvic pain are spared night work when pregnant again. However, it may be that women are spared night work for other reasons that could be related to pelvic pain.

Outcome data were based upon self reported pelvic pain. Measuring pelvic pain has to be based upon self reports from the women as an ''objective'' clinical test in any case has to be ''validated'' with reference to symptoms.[8] This is not different from most other pain related diseases like headache or lower back pain. It may be argued that clinical examination is necessary to diagnose pelvic pain. The aim of this study was to explore possible associations related to pelvic pain in pregnancy, as reported by the women, more than stating the incidence of the condition. As subjective symptoms of pelvic pain correlate well with results of clinical tests we should be able to capture an association with this study design.[8]

We recorded pelvic pain six months after delivery, which may cause some underreporting of milder cases of shorter duration. For studies to be comparable a similar end point registration is needed. We tried to get comparable data from all participants in the study. All interviewers underwent the same training programme before interviewing, and they had the same explanatory text available on their computers, in lay and medical terms, when interviewing.

As job situation changes rapidly over time and as health selection to the workforce depends upon the level of unemployment and general social conditions, one cannot expect any large agreement between different studies from different populations or different time periods. Standardised job descriptions will not solve this ''healthy worker selection'' problem. The good possibilities in Denmark for pregnant women to be taken out of the workforce and receive an economic compensation are expected to attenuate the associations we studied. We are only able to identify causal links that have not been eliminated by medical or social interventions.

The strengths of this study are its size, the fact that exposure data are collected prospectively and in a population with a high incidence of pelvic pain, and the good quality of data on exposures and confounding factors. The weaknesses are mainly related to the lack of an objective test for pelvic pain and the fact that pelvic pain was measured six months after delivery.

If the associations are not spurious they may operate on biological or psychological mechanisms and they may involve

What this paper adds

This study within the Danish national birth cohort finds that psychosocially demanding work environment and some measures of physically demanding work are associated with an increased risk of pelvic pain in pregnancy. The study contributes to the elucidation of methodological difficulties in handling those types of diseases and syndromes that are predominantly based on subjective pain reporting.

intermediate factors, which we have not recorded. Regardless of these mechanisms; if the associations are causal the incidence of pelvic pain should go down if the causes are removed.

This study includes only women who were or had been working during the actual pregnancy, and as no interviews were performed earlier than pregnancy week 12, all work exposure was measured within pregnancy. The risk factors we study are all avoidable, especially for a short time period of nine months. Pregnant women can be placed at work that does not entail physically strenuous work, rotating shifts, and high job strain.

In conclusion, we found that both physically and psychosocially demanding working conditions, measured by physically strenuous work, rotating shifts, and high job strain, are associated with an increased reporting of pelvic pain in pregnancy.

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Ethics approval: the Danish national birth cohort and the case-control study on pelvic pain have been approved by the committee for biomedical research ethics in the municipalities of Copenhagen and Frederiksberg on behalf of all ethic committees in the country, and by the Danish Data Protection Agency.

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