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Job strain and time to pregnancy

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Objectives The association between fertility and job strain defined as high job demands and low job control has not previously been studied. A follow-up study was conducted with prospective collection of information on job strain among women, achievement of pregnancy, and potential confounding variables.

Methods A total of 297 Danish couples without previous reproductive experience was followed for a maximum of 6 menstrual cycles from termination of birth control until pregnancy. Job demand and job control were measured by a questionnaire developed by Karasek and his co-workers.

Results The odds ratio and 95% confidence interval (95% CI) for conception per menstrual cycle for women with high job strain was 0.9 (95% CI 0.5—1.5) when compared with that of women in low-strain jobs. Only in secondary analyses restricted to couples with no suspected competitive causes of reduced fertility was a statistically significant reduced odds found for women with high-strain jobs compared with all other jobs.

Conclusions The main finding of this study did not corroborate a hypothesis of a substantial detrimental effect of job strain on fecundability.

Key terms fecundability, fertility, occupation, prospective data, reproduction, stress.

The impact of psychosocial work conditions on somatic diseases has been studied since the beginning of the 1970s, and much inspiration has been provided by the job decision-job demand model developed by Karasek & Theorell in the 1980s (1). In the field of human reproduction this model has been used in studies of various end points, such as menstrual cycle pattern, spontaneous abortion, birthweight, and gestational age (2—6).

So far no studies have dealt with job decision and demand in relation to fecundity. Animal studies and physiological considerations have suggested that exposure to psychological stressors may be related to functional changes in the female reproductive system at levels such as the autonomic nerve system, the endocrine system, and the immune system (7—11). Furthermore, stressors may induce behavioral changes in sexual activity.

The objective of this study was to estimate whether job strain influences couple fecundability, defined as the probability of conception in a menstrual cycle with no use of contraception. Information on both exposure and outcome was collected prospectively during a follow-up period of up to 6 menstrual cycles.

Subjects and methods

From 1992 to 1994, 430 couples were recruited after a nationwide mailing of a personal letter to 52 255 trade union members (metal workers, office and commercial workers, nurses and day-care workers) who were 20—35 years of age, were living with a partner, and were childless. Only couples without earlier reproductive experience who intended to discontinue contraception in order to conceive a child were eligible for enrollment. We estimate that 10—20% of the eligible couples

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participated. A detailed description of the cohort and design has been given elsewhere (12).

The couples were enrolled into the study when they discontinued birth control, and they were followed up to 6 menstrual cycles or until a pregnancy was recognized by a general practitioner. At enrollment both partners filled out a questionnaire on job strain, psychological distress, and demographic, medical, reproductive, occupational and life-style factors. On the 21st day of each menstrual cycle during the follow-up, the couples completed questionnaires on changes in occupational exposures and life-style factors, and the woman recorded vaginal bleeding and sexual intercourse in a diary.

First-morning urine samples from days 1 to 10 in each menstrual cycle, starting the first morning with menstrual bleeding, were stored in a freezer for the determination of human choriongonadotropic hormone, which indicates early embryonic loss (12). Information on spontaneous abortion in clinically recognized pregnancies was collected by postal questionnaire or interview 1 year after the 6-cycle follow-up was terminated. A 100% response-rate was achieved.

Only cycles in which the female partner was employed for at least 25 hours a week were included in the analyses (table 1). Furthermore, women who were pregnant when filling out the entry questionnaire or who had left any job-strain items missing were excluded. No cycles with reported sexual abstinence from day 11 to 20 in the menstrual cycle resulted in a pregnancy. These cycles were also excluded. Altogether 297 couples contributing 1159 menstrual cycles were included in the analysis.

Psychological job strain was assessed according to the questionnaire developed by Karasek and his colleagues (1, 13). The concept includes at least 2 dimensions, job demands and job control (24 items). Furthermore information on support from the subject's supervisor and coworkers was requested (12 items). On the basis of the information collected at the start of the follow-up, the couples were categorized into 4 levels according to the women's scores on the 2 dimensions. The couples were also categorized according to the women's scores for the combined dimensions (job strain). Both job demand and job control were divided according to the median score values, the result being 4 different types of jobs, namely, low-strain jobs (low demand and high control score), active jobs (high demand and high control), passive jobs (low demand and low control), and high-strain jobs (high demand and low control). Finally, other indicators of job stressors were examined, including shift work and knowledge about work schedule in advance. Information on changes in female job strain during the follow-up was collected on the 21st day of each menstrual cycle. The participants were asked to rate the changes in female job demand and job control as more, the same, or less.

The unit of observation in the analyses was a menstrual cycle, and each cycle was numbered according to the number of menstrual cycles since the discontinuation of contraception. The association between job strain and fecundability was estimated by a logistic regression model controlling for confounding factors (14, 15). This model provides a fecundability odds ratio (OR), which is the estimated odds of conception in a menstrual cycle for the exposed group divided by the corresponding odds for the unexposed group. Menstrual cycle numbers were entered as dummy variables to adjust for changes in base-line fecundability with an increasing number of cycles of trying to conceive. Potential confounding variables were selected according to their biological relevance irrespective of the association with exposure in the present data set. The following variables were included: center (east, west), recruitment group (metal workers, nurses, office workers, day-care workers), further education of the woman (yes, no), age of the woman (≤24, 25—29, ≥30 years), body mass index of the woman (≤19, 20—24, ≥25 kg/m^2), regular use of intrauterine devices or oral contraceptives the year before enrollment (yes, no), self-reported reproductive disease of either the man or the woman (yes, no), sperm density (≤20, ≥21·10^6 spermatozoa/ml), female cigarette smoking (yes, no), caffeine intake (≤149, ≥150 mg caffeine/day) and weekly alcohol consumption (yes, no). Menstrual cycle length and

Table 1. Identification of the cycles included in the analyses, showing the reasons for exclusion and the final number of pregnancy attempts accepted.

	Couples	Cycle						Total
		1	2	3	4	5	6	
Pregnancy attempts under observation	430	430	358	287	241	187	158	1661
Employed <25 hours/week (entry)	86	86	70	57	48	39	35	335
Pregnant when completing questionnaire[a] (entry)	29	29	13	6	3	-	-	51
Invalid or missing scores (entry)	18	18	13	10	9	8	7	65
Employed <25 hours/week (follow-up)	.	1	3	2	6	5	2	19
No midcycle intercourse[b] (follow-up)	.	5	4	14	4	5	-	32
Pregnancy attempts included in analyses	297	291	255	198	171	130	114	1159

[a] Filled out entry questionnaire after 28th day in entry cycle which resulted in pregnancy.
[b] From 20 to 11 days prior to expected onset of the next menstrual bleeding.

frequency of sexual intercourse may be determinants of fertility, as well as intermediate steps in a causal chain between job strain and fertility. Models both with and without these factors were analyzed [categories: menstrual cycle length (≤34, ≥35 days), frequency of sexual intercourse per week (<1, ≥1)]. Possible interactions between exposure and confounders were evaluated by stratified analyses.

Results

During the follow-up 170 women had a clinically detected pregnancy (table 2). The median score on the job-demand and job-control axes were 30 (range 12—46) and 72 (range 28—94), respectively. The distribution of various job descriptors and potential confounding variables are given in an appendix with the median position of each stratum on the job strain axes. The association between fecundability and psychosocial factors related to the job are shown in table 3. The crude odds ratios were statistically insignificant, and adjustment for potential confounding variables provided unchanged estimates (data not shown).

The crude fecundability was 11.8% for the women in high-strain jobs compared with 17.1%, 15.1%, and 13.0% for the women in passive jobs, active jobs, and low-strain jobs, respectively. The fecundability odds ratio for the women in high-strain jobs versus women in low-strain jobs was 0.9 [95% confidence interval (95% CI) 0.5—1.5] (table 4). The estimates were robust to adjustment for potential confounding variables (table 4). Compared with that of all other jobs, the adjusted OR was 0.8 (95% CI 0.5—1.2) for the high-strain jobs. When a more restrictive definition was used for high-strain job (job control score below lower tertile and job demand score above upper tertile), the corresponding OR was 0.7 (95% CI 0.4—1.3). Stratification by mean menstrual cycle length, frequency of sexual intercourse, and the other potential confounding variables revealed similar estimates.

When couples with reduced fecundity suspected a priori were excluded from the analysis (male or female reproductive disease), sperm count $<20 \cdot 10^6$/ml, unsafe contraceptive method in the year before enrollment, <1 weekly sexual intercourse), a significantly reduced fecundability among the women in high-strain jobs was found [OR for high-strain jobs in comparison with low-strain jobs being 0.4 (95% CI 0.2—1.0) and OR for the tertile of women with the highest job strain compared with all other women also being 0.4 (95% CI 0.2—0.9), N=415 cycles].

During the follow-up 15% and 9% of the women reported changes in job demands and job control, respectively, and the changes were mostly towards higher job control and higher job demands (table 2). Eliminating this source of misclassification in exposure by censoring cycles with reported change in job strain provided results similar to the ones obtained in the analyses based on the entire number of cycles (N=898, data not shown).

The proportion of pregnancies terminated by pregnancy loss (subclinical early embryonal loss or spontaneous abortion of a clinically recognized pregnancy) was 29.5%. The odds ratio for pregnancies conceived by women in a high-strain job was 0.9 (95% CI 0.4—2.2) when compared with all other pregnancies.

Discussion

The main finding of this study did not corroborate a hypothesis of a substantial detrimental effect on fecundability among women in high-strain jobs. When we restricted the cohort to couples with no other suspected causes of reduced fertility, a 60% reduction of the odds was seen. However, this result was data-driven and should be confirmed by others.

Table 2. Characteristics of the menstrual cycles of the 297 participating couples.

	Cycle						Total
	1	2	3	4	5	6	
Pregnancy attempts included in analyses	291	255	198	171	130	114	1159
Termination of follow-up							
Pregnancy	33	42	28	32	19	13	167[a]
Stop attempt after completing cycle	2	5	5	7	3	2	24
Change in job control (from previous cycle) (%)							
Cycles with higher score	8	7	8	9	7	3	7
Cycles with lower score	1	1	0	4	4	3	2
Change in job demands (from previous cycle) (%)							
Cycles with higher score	14	13	18	17	14	15	15
Cycles with lower score	0	2	0	0	0	0	0

[a] An additional 3 women became pregnant in a period of working less than 25 hours/week and were excluded from the cycle-specific analyses.

Several precautions were taken to eliminate information bias and the differential selection of subfertile couples into the study. Couples with a priori knowledge about their own reproductive capability were not eligible, and we excluded couples who completed the questionnaire after a pregnancy was detected or when they might have had some knowledge that a pregnancy was underway. Thus information on job-strain measures was collected prospectively in relation to the outcome.

Planning bias may arise if the use of unsafe birth control methods is associated with the exposure of interest (16). If women in high-strain jobs use less efficient birth control methods, the most fertile of these couples may conceive unintentionally and thus never become eligible for this study. Planning bias cannot be completely ruled out without knowledge of exposure among nonplanners, but, if birth control methods vary considerably, this variation would probably be reflected among the enrolled couples as well. Among the high-strain women, 66.7% used oral contraceptives or intrauterine devices compared with 66.2% of the women in other jobs. It is therefore not likely that this potential bias had a major influence on our results.

The way the couples interpreted and responded to our psychosocial questionnaires may have been influenced by their educational and social background, and an association between, for example, educational background and job strain was found. However, the same issues were not statistically significantly associated with fecundability, and adjustment for education, trade union, or other a priori selected confounding variables failed to change the estimates substantially.

This study was part of a larger study of a wide range of environmental and biological determinants of fertility, and it is likely that the demanding protocol has conferred a differential selection of couples according to their job strain. However, the median values of the job demand and job control scores of 30 and 72, respectively, found in our study are comparable with the findings in a cohort of pregnant women attending a Danish antenatal clinic at 16 gestational weeks (29 and 70, respectively (5, personal communication). The findings of our study may thus apply to job strain experienced by representative samples of women in the general population. However, it is not justified to generalize the results to populations with extreme levels of job strain.

Possible adverse effects of job strain have primarily been studied in the field of cardiovascular diseases. A simplified model suggests that job stressors result in chronic distress, which through physiological or behavioral changes may lead to heart disease (17). In the present study both job demands and job control were related to the level of distress measured by the general health questionnaire (GHQ). Previous analyses of our cohort revealed reduced fertility among the women with a high level of distress, most pronounced if the menstrual cycles exceeded 30 days (unpublished observations). Adding the GHQ score of the women to our model of job strain and fertility failed to change our estimates.

Table 3. Work-related psychosocial factors — crude[a] fecundability odds ratios (OR) and 95% confidence intervals (95% CI).

Work-related psychosoical factor	Cycles (N)	OR	95% CI
High job control (percentiles)			
0—25	322	0.8	0.5—1.4
26—50	311	1.3	0.8—2.1
51—75	308	1.0	0.6—1.6
76—100	218	Reference	.
High job demands (percentiles)			
0—25	313	Reference	.
26—50	293	1.3	0.8—2.0
51—75	300	1.0	0.6—1.5
76—100	253	1.0	0.6—1.6
Social support (percentiles)			
0—50	537	1.3	0.9—1.8
51—100	622	Reference	.
Hours at work per week (hours)			
25—39	904	Reference	.
≥40	255	1.1	0.8—1.7
Regular workhours			
Yes	733	Reference	.
No	423	1.2	0.8—1.6
Work shift			
Only daytime	860	Reference	.
Evening and daytime	139	1.5	0.9—2.4
Night work (≥25%)	157	1.2	0.7—1.9
Knowledge about work schedule a week in advance			
Yes, usually	963	Reference	.
No, often changes or overtime	130	0.6	0.3—1.1

[a] Adjusted for cycle number.

Table 4. Psychosocial job-strain measures — crude and adjusted fecundability ratios (OR) and 95% confidence intervals (95% CI).

Psychosocial job-strain measure	Cycles (N)	Crude[a] OR	95% CI of the crude OR	Adjusted[b] OR	95% CI of the adjusted OR
Categorized into 4 levels by median values					
High-strain job[c]	288	0.9	0.5—1.5	0.9	0.5—1.5
Passive job	345	1.4	0.9—2.2	1.4	0.9—2.3
Active job	265	1.2	0.7—1.9	1.0	0.6—1.8
Low-strain job	261	Reference	.	Reference	.
Categorized into 2 levels by median values					
High-strain job[c]	288	0.7	0.5—1.1	0.8	0.5—1.2
All other jobs	871	Reference	.	Reference	.
Categorized into 2 levels by tertile values					
High-strain jobs[d]	113	0.7	0.4—1.4	0.7	0.4—1.3
All other jobs	1046	Reference	.	Reference	.

[a] Adjusted for cycle number.
[b] Adjusted for cycle number, center, recruitment group, education, age of the woman, regular use of intrauterine devices or oral contraceptives the year prior to enrollment, self-reported reproduction-related disease of the man or woman, oligospermia, body mass index of the woman, cigarette smoking, caffeine, and alcohol consumption.
[c] Job control below median value, job demand above median value.
[d] Job control below lower tertile, job demand above upper tertile.

Furthermore, no indication of a mediation through changes in sexual behavior (reduced frequency of unprotected intercourse) was found.

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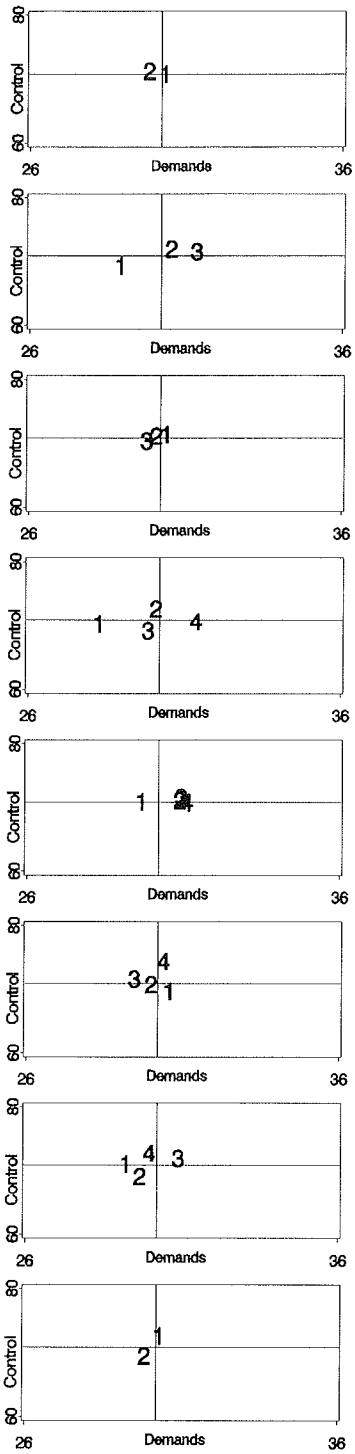
Appendix

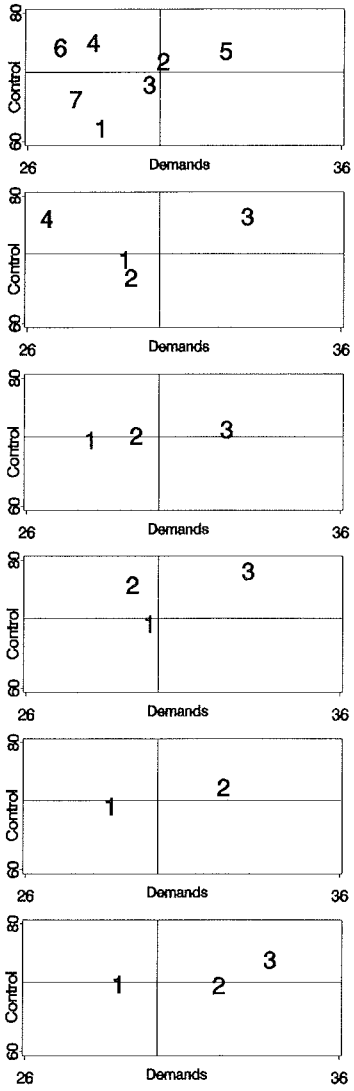
Characteristics of the population at the time of enrollment and their distributions of the median scores for job control and job demands[a]

Category	Frequency	Karasek dimensions
Center		
1: Zealand	150	
2: Jutland	147	
Age (year)		
1: ≤24	95	
2: 20—24	182	
3: ≥25	20	
Body mass index (kg/m²)		
1: ≤19	57	
2: 20—24	169	
3: ≥25	69	
Mean menstrual cycle length (d)		
1: ≤26	38	
2: 27—29	112	
3: 30—32	70	
4: ≥33	72	
Smoking (cigarettes/d)		
1: 0	203	
2: 1—9	33	
3:10—19	51	
4: ≥20	10	
Alcohol consumption (drinks/week)		
1: 0	73	
2: 1—4	119	
3: 5—9	67	
4: ≥10	38	
Caffein intake (mg caffein/d)		
1: 0—149	76	
2: 150—299	74	
3: 300—699	119	
4: ≥700	28	
Gender of index person		
1: female	152	
2: male	145	

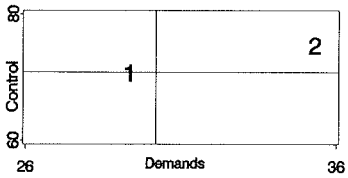
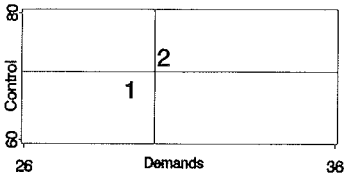
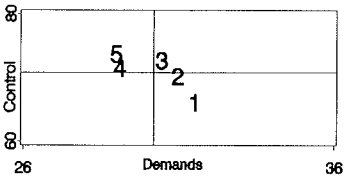


(continued)

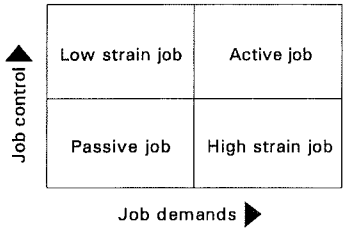
Category	Frequency	Karasek dimensions
Education		
1: 9—10 grade	11	
2: high school	5	
3: vodational	144	
4: further education	137	
Trade		
1: production industry (11—39)	35	
2: wholesale and retail (20—24)	41	
3: commercial service (71—83)	57	
4: education and research (93.1)	12	
5: health institutions (93.3)	102	
6: social welfare (93.4)	33	
7: other (99)	17	
Source of recruitment (trade union)		
1: metal	115	
2: office	92	
3: nurses	77	
4: day care	13	
Colleagues (N)		
1: ≤9	109	
2: 10—19	66	
3: ≥20	103	
Subordinates (N)		
1: none	253	
2: 1—5	26	
3:10—19	51	
4: ≥6	17	
Regular work hours		
1: yes	184	
2: no	112	
Workshift		
1: only day time	216	
2: evening and day time	39	
3: night work (≥25%)	41	



(continued)

Category	Frequency	Karasek dimensions
Knowledge about work schedule in advance		
1: yes, usually	251	
2: often changes/ overtime	30	
Sedentary at work >1 h/d		
1: yes	118	
2: no	169	
Psychological stress (GHQ[b] — 30)		
1: 80—100%	53	
2: 61—80%	53	
3: 41—60%	49	
4: 21—40%	65	
5: 0—19%	76	

[a]



[b] GHQ = General Health Questionnaire.

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