Prematurity and work in pregnancy

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ABSTRACT The frequency of low birth weight (≤ 2500 g) and of preterm birth (< 37 weeks) was studied in 22 761 single live births in relation to maternal employment, taking account of 11 non-occupational confounding factors. There was some increase of low statistical significance in both types of prematurity in service and manufacturing sectors of industry. A substantial excess of preterm births was seen in women employed in food and beverage service (O/E = 1.29, $p = 0.03$) and psychiatric nursing (O/E = 2.47, $p < 0.01$) and of low birth weight in food and beverage service (O/E = 1.30, $p = 0.02$), in chambermaids and cleaners (O/E = 1.42, $p = 0.03$), and in those employed in the manufacture of metal and electrical and certain other goods (O/E = 1.57, $p < 0.01$). Heavy lifting and long hours of work were consistently related to both outcomes, changing shift work less consistently. Noise was associated with low birth weight in the health and manufacturing sectors. The findings of this study are unlikely to have resulted from subject or observer bias but the role of unidentified factors related to selection for work are difficult to assess.

Prematurity is the most important predisposing cause of neonatal mortality and morbidity. Advances in perinatal care have improved the survival of premature infants but failed to reduce the proportion that are handicapped.^{1,2} Birth weight, a more reliable measure than duration of gestation, has mainly been used to identify prematurity³; however, the causes of low birth weight (2500 g or less) vary with race⁴ and with such maternal characteristics as stature,^{3,5,6} father's occupation,^{3,7} spouse's occupation,³ educational level,⁴ history of previous miscarriage or premature birth,⁸ and in some studies with age and parity.⁹ Cigarette smoking has been shown consistently to depress birth weight,¹⁰⁻¹² as have several studies of moderate or heavy alcohol consumption.¹³⁻¹⁵ Preterm birth, defined as before 37 weeks, has been studied less mainly because of uncertainty in determining the duration of gestation.³ Maternal height, educational level, and socioeconomic status appear to be more strongly related to low birth weight than to preterm birth and cigarette smoking much more strongly.¹⁶

Several reports suggest that women who work outside the home have fewer babies of low birth weight than those who do not—for example, in France,¹⁷ Wales,¹⁸ and in the United States.⁴ On the other

hand, women in England who worked until at least the 28th week were found to have a higher rate of low birthweight infants than did housewives.¹⁹ This was in the 1950s, however, when the nature of women's employment probably differed. Factors related to the selection of women for employment may be responsible for the generally better experience of working women, which might obscure ill effects from certain types of work.

In a study of occupational factors in preterm birth in France, Mamelle and colleagues reported that certain work requirements and environmental conditions were significantly associated with preterm birth.²⁰ The factors identified were related to posture, employment on industrial machines, physical exertion, mental stress, and a generally adverse working environment. These authors constructed a "fatigue index" based on the presence or absence of specified aspects of the five factors listed, yielding a total score of 0 to 5. The rate of preterm birth was found to increase systematically with rising score; however, this has not been tested against independent data.

Montreal survey

In a study of occupational factors in pregnancy in Montreal 56 067 women were interviewed in a two year period, 1982-4, soon after delivery or spontaneous abortion. Information was obtained about both

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recently completed (current) and previous pregnancies—104 649 in all. The methods used have been described²¹ as have the frequency of four main adverse outcomes (spontaneous abortion, stillbirth, congenital defect, and low birth weight) reported for 60 occupational groups in six main occupational sectors. In four sectors (managerial, health, clerical, and sales) there was no increase in the ratio of numbers of low birth weight children (≤ 2500 g) observed (O) to expected (E), when expected numbers were calculated after accounting for major confounding variables. In the service sector, however, the ratio was 1.12 ($p < 0.01$) and in the manufacturing sector 1.19 ($p < 0.01$). Occupational groups with significantly raised ratios were chambermaids and cleaners and women employed in the manufacture of food and drink, metal and electrical products, and clothing. In clothing manufacture the ratio was raised only in previous pregnancies which lowered confidence in the finding. In the present report the relation between prematurity by gestational period (preterm birth) and prematurity by weight (low birth weight) and specific occupational factors are examined in greater detail.

Methods

STUDY SUBJECTS

This analysis was confined to single current pregnancies—that is, those just completed—because duration of gestation had been more accurately determined than in previous pregnancies, in over half by ultrasound examination. Live born babies with congenital defects were excluded from the low birth weight group in our previous report because mutually exclusive categories of outcome were used. They were, however, included in the present study. These abnormalities affected about 3.6% of live births and few were likely to have influenced birth weight. Pregnancies were selected for study in which the women were employed for 30 or more hours a week at conception and remained working under substantially the same conditions until they left or reached at least the 28th week.

CONFOUNDING FACTORS

The statistical methods used to allow for the effect of potentially confounding factors by logistic regression were described in the earlier report.²¹ The same eight variables (age, gravidity, previous spontaneous abortion, ethnic group, height, educational level, cigarette smoking, and alcohol consumption) were entered into the present analyses but this time for both preterm birth and low birth weight. Risk of low birth weight rose with age and fell with gravidity. It was raised by a history of previous spontaneous abortion, was somewhat higher at low than high educational status,

and rose substantially with increasing cigarette smoking and diminishing height. The effects of these confounding variables for preterm births were mainly similar but of a lower order. Noteworthy differences were that the risk for age 20–29 was lower than for ages below 20 or above 29, and there was no relation to gravidity. Height and smoking showed similar but much smaller differences. We had wished to include three additional variables in the regression analysis—occupation of the woman's father,²² spouse's educational level, and history of low birth weight—but the capacity of the computer was insufficient to cope with them. Adjustment for these variables was made at a second stage by a stratification process, using the categories of each factor to correct expected numbers obtained after allowance by logistic regression for the eight primary confounders.

OCCUPATIONAL FACTORS

Probabilities calculated from the logistic regression analyses were used to obtain expected numbers of preterm births and of children of low birth weight for comparison with numbers observed in specific groups. To test the significance of raised ratios, a one sided Pearson chi square test was calculated from the observed and expected numbers of pregnancies with and without adverse outcome. For occupational groups in which the expected number of an adverse outcome was less than five, an exact (one sided) p value was calculated on the assumption that the observed number followed a Poisson distribution; this was found to be an adequate approximation to the more strictly correct but computationally cumbersome binomial distribution. Ninety per cent confidence intervals were also computed on this assumption. Values lower than 0.1 are reported in this paper, to the nearest 0.01 between 0.10 and 0.01, and otherwise as $p < 0.01$. Underlying patterns of O/E ratios were investigated by Poisson regression methods using the GLIM computer package.²³

Ratios of observed to expected (O/E) were calculated for 60 occupational groups in six main industrial sectors as defined in the Standard Occupational and Industrial Classifications of Statistics Canada,^{24 25} and for groups subject to particular work requirements and environmental conditions as recorded in the questionnaire. Questions had been asked on working hours, assembly line and piece work, type of shift, work posture, weight lifting, other physical effort, noise, vibration, temperature, and the use of photocopier or visual display terminal. Table 1 shows the percentage of pregnancies subject to these factors, generally at their highest level, in each of the six sectors. Lifting of heavy weights and other physical effort were commonest in the health, services, and manufacturing sectors; long periods of standing in

Table 1 Percentage of pregnancies subject to adverse work requirements and environmental conditions by major occupational sector

	Occupational sector						Total
	1 Managerial	2 Health	3 Clerical	4 Sales	5 Services	6 Manufacture	
Work requirements:							
Lifting heavy weights (≥ 15/day)	1.8	10.1	1.7	0.3	9.7	11.1	4.8
Other physical effort (great)	5.5	17.5	3.5	8.2	19.7	11.9	8.3
Standing (≥ 8 h/d)	1.8	10.6	3.3	23.0	39.4	24.1	10.4
Long working week (≥ 46 h/w)	4.5	5.0	1.0	14.8	13.6	2.2	4.0
Assembly line	0.1	0.3	0.4	0.2	1.3	30.5	—
Piece work	0.1	0.3	0.2	0.7	0.9	12.6	1.8
Changing shift	0.9	12.9	0.9	0.7	0.4	1.6	2.9
Use of VDU (≥ 15 h/w)	6.8	2.1	16.9	3.5	0.3	1.2	9.2
Environmental conditions:							
Noise (great)	4.0	17.3	15.6	14.1	27.3	49.8	20.4
Vibration (great)	0.3	2.3	2.5	1.0	3.6	8.7	2.4
Too cold	3.7	2.6	7.4	9.8	5.5	5.7	5.9
Too hot	19.7	26.3	2.0	16.0	26.7	29.0	22.1
Total pregnancies	4224	2795	9898	1200	1739	2905	22761

sales, services, and manufacturing; and long working hours in sales and services. Assembly line and piece work were virtually limited to manufacturing jobs, changing shifts (either rotating or irregularly changing) to the health sector, and use of a visual display terminal to clerical occupations. Noise and heat were common complaints in most sectors, especially in services and manufacturing. The managerial sector was characterised by a low frequency of all factors except complaints of heat.

An index was constructed using the same criteria as those of Mamelle and colleagues,²⁰ except that in our study the environment was categorised by noise, cold, and chemical substances whereas Mamelle and her colleagues included also a wet atmosphere. It should be noted that there may have been differences of degree especially in physical effort and lifting. Exact comparisons of the percentage of women with a high score were not possible because Mamelle *et al* did not

use a standard occupational classification. In France, however, after exclusion of professional, clerical, administrative, and sales occupations 38–42% of women had a high index compared with 30% of women in manufacturing work in our study; the comparable figures for clerical workers were 2.2% in France and 1.6% in Canada.

Results

Of 22 761 single live births to women in paid employment for 30 or more hours a week at conception, 1688 (7.4%) were preterm (< 37 weeks) and 1504 (6.6%) were of low birth weight (≥ 2500 g). There was a large overlap: 928 (4.1%) were both preterm and of low birth weight. Table 2 shows the ratios of observed to expected numbers of preterm and low birth weight children by occupational sector. The managerial sector had the lowest ratios for both preterm and low

Table 2 Ratios of observed (O) to expected (E) preterm and low birthweight births for all women employed 30 or more hours a week at the start of pregnancy, for those who left work before 28 weeks, and those who remained in employment for at least 28 weeks

Occupational sector	Preterm						Low birth weight					
	Total		Worked < 28 wks		Worked ≥ 28 wks		Total		Worked < 28 wks		Worked ≥ 28 wks	
	O	O/E	O	O/E	O	O/E	O	O/E	O	O/E	O	O/E
1 Managerial	258	0.91	98	0.86	160	0.95	205	0.89	76	0.84	129	0.91
2 Health	191	0.98	100	1.06	91	0.90	169	1.05	80	1.03	89	1.07
3 Clerical	725	1.00	289	0.96	436	1.03	660	0.99	255	0.95	405	1.02
4 Sales	86	0.98	52	1.15*	34	0.80	73	0.91	47	1.14	26	0.66
5 Services	164	1.14**	111	1.14	53	1.15	144	1.05	104	1.11	40	0.95
6 Manufacture	264	1.03	157	1.04	107	1.04	253	1.10*	148	1.09	105	1.14*

* $p < 0.1$; ** $p < 0.05$.

Table 3 Ratios observed (O) to expected (E) of preterm (<37 weeks) and low birthweight (≤ 2500 g) children by occupation

Sector and occupation (SOC, SIC)	Pregnancies	Preterm (<37 weeks)		Low birth weight (≤ 2500 g)	
		O	O/E	O	O/E
1 Managers, lawyers (1111-49, 2341-9)	806	55	1.03	31	0.69
Accountants and analysts (1171-3)	589	36	0.91	34	1.01
Other administrators (1174-9)	568	33	0.84	28	0.81
Physical scientists (2111-2119)	90	2	0.36	5	1.17
Life scientists (2131-9)	100	4	0.62	5	1.02
Architects, engineers (2141-69)	139	6	0.67	4	0.58
Mathematicians, statisticians (2181-9)	246	17	1.05	16	1.15
Social scientists (2311-39)	356	24	1.00	19	0.96
Librarians, archivists (2350-2519)	161	8	0.72	5	0.55
Teachers, university, and post-secondary (2711-19, 2791-3)	182	15	1.23	9	0.95
Teachers, secondary (2733)	209	8	0.59	6	0.62
Teachers, primary and other (2731, 2739, 2797, 2799)	527	32	0.90	28	1.05
Teachers, retarded children (2795)	251	18	1.11	15	1.09
2 Physicians, dentists (3111-3119)	149	5	0.52	4	0.54
Nursing supervisors (3130)	88	10	1.56	5	0.94
Nurses (3131a)	901	58	0.91	59	1.17
Nurses, psychiatric (3131b)	48	9	2.47***	4	1.28
Nurses, operating room (3131c)	36	1	0.38	1	0.47
Nursing assistants (3134)	205	16	1.00	8	0.56
Nursing aides and orderlies (3135)	161	12	0.89	12	0.95
Physiotherapists (3137)	90	2	0.38	2	0.52
Ergotherapists, dietitians, etc. (3138-9, 3152-4, 3136, 3162-9)	238	17	1.07	14	1.10
Medical laboratory technicians (3156)	250	18	1.09	15	1.16
Radiology technicians (3155)	83	3	0.55	5	1.14
Dental hygienists, technicians (3157, 3158, 3161)	136	12	1.28	7	0.87
Commercial artists, photographers (3311-22, 3335-9)	241	16	1.00	19	1.37
Writers, translators (3351-9)	130	11	1.24	10	1.27
Sports women, dancers (3360-79, 3334)	39	1	0.39	4	1.69
3 Secretaries (4110-1)					
—industrial sectors, 1-47	492	27	0.76	30	0.95
Secretaries (4110-1)					
—others sectors, 48-99	2421	175	1.00	167	1.06
Typists and clerks (4113)					
—industrial sectors, 1-47	63	6	1.36	5	1.39
Typists and clerks (4113)					
—others sectors, 48-99	269	15	0.75	8	0.45
Book keepers (4130, 1, 5, 7, 9)	2578	182	0.97	175	1.01
Cashiers (4133)	796	70	1.16	63	1.12
Office machine operators (4140-3)	741	47	0.85	39	0.77
Storekeepers, dispatchers (4150-9)	359	32	1.14	30	1.13
Record clerks (4160-9)	174	15	1.17	7	0.62
Supervising receptionists, information clerks (4170-1)	386	33	1.14	27	1.02
Telephone, postal, reception clerks (4172-9)	185	17	1.18	12	0.83
Specialised clerks (4190-5)	406	29	1.01	23	0.88
General office clerks (4197)	648	44	0.93	40	0.91
Other clerical workers (4199)	380	33	1.19	34	1.30*
4 Saleswomen, commodities (5135)	486	40	1.07	31	0.89
Other sales occupations, commodities (5130-3, 5141-49)	461	31	0.94	27	0.92
Sales occupations, services (5170-99)	253	15	0.86	15	0.94
5 Food and beverage preparation (6121, 6129)	199	19	1.16	12	0.83
Food and beverage service (6123, 6125)	538	57	1.29**	60	1.30**
Chambermaids, cleaners, janitors (6133, 6142, 6191)	262	30	1.25	30	1.42**
Hairdressers (6143)	307	19	0.78	15	0.65
Child care workers (6147)	117	13	1.32	10	1.16
Laundry and dry cleaners (6160-6169)	77	5	0.74	7	1.06
Other service occupations (remainder 6111-6199)	196	17	1.14	7	0.50
Agriculture, horticulture (7113-7719)	43	4	1.27	3	1.16

Table 3 Continued

Sector and occupation (SOC, SIC)	Pregnancies	Preterm (< 37 weeks)		Low birth weight (< 2500 g)	
		O	O/E	O	O/E
6 Manufacture (8110-8599, 9310-9519)					
Food and drink (industrial sectors 10-12)	148	11	0.86	15	1.20
Rubber and plastic (industrial sectors 15-16)	71	8	1.24	7	1.17
Leather (industrial sector 17)	158	13	0.92	11	0.76
Textiles (industrial sectors 18-19)	186	16	0.95	18	1.17
Clothing (industrial sector 24)	1455	132	1.01	112	1.02
Metal, electrical (industrial sectors 29-39)	442	47	1.25*	55	1.57***
Other occupations (8710-9199, 9530-9919) and other sectors	445	37	1.02	35	0.98

*p < 0.01; **p < 0.05; ***p < 0.01.

birthweight children, the services sector had a slightly increased ratio of preterm births (1.14, $p = 0.04$) and the manufacturing sector of low birth weight (1.10, $p = 0.08$). These findings were not significantly affected by adjustment for the socioeconomic index of Blishen and McRoberts,²² nor by history of previous premature birth, but adjustment for spouse's educational level increased the ratios in the managerial sector for preterm birth from 0.91 to 0.95 and for low birth weight from 0.89 to 0.94. As seen in table 1, long hours of standing and physical effort were notable requirements in the services sector and, additionally, assembly line and piece work in manufacturing. Complaints of noise and heat were also common but not specifically in these sectors. There were considerable differences between sectors (table 2) in the proportion of women who left paid employment before the 28th week (managerial 24%, health 34%, clerical 25%, sales 38%, services 60%, and manufacture 49%). The O/E ratios for prematurity and low birth weight were not importantly related to duration of employment, except in the sales sector where they were lower in women who continued after the 28th week.

Of the 60 occupational groups shown in table 3, the O/E ratios for preterm birth were increased for women in food and beverage service (1.29, $p = 0.03$) and for the small group of psychiatric nurses (2.47, $p < 0.01$). Compared with the average frequencies of work requirements and conditions in table 1, food and beverage service entailed much heavy weight lifting (13.8%), physical effort (17.5%), standing (40.9%), and long working hours (11.9%). Psychiatric nurses also reported frequent physical effort (27.1%) and changing work shifts (18.7%). The O/E ratio for low birthweight children was raised in workers in the food and beverage services (1.30, $p < 0.05$) and in chambermaids and cleaners (1.42, $p = 0.03$). The work of chambermaids and cleaners was also characterised by frequently reported physical effort (27.9%), standing (31.3%), and long working

hours (10.7%). In the group that included workers in metal and electrical manufacture, where there was an increase in the O/E ratio for both low birth weight (1.57, $p < 0.01$) and preterm birth (1.25, $p = 0.06$), the work entailed moderate frequencies of physical effort (14.7%), standing (22.22%), and heavy lifting (12.0%), in addition to noise (48.6%) and vibration (7.0%).

Table 4 shows O/E ratios according to work requirements and environmental conditions in the six sectors and in total. The patterns for low birth weight and preterm birth are similar. Overall, there were significantly increased ratios for both outcomes in women who lifted heavy weights (1.25 and 1.26, $p < 0.01$) or who worked 46 hours or more a week (1.34, $p < 0.01$, and 1.24, $p = 0.03$). For preterm birth, the association with lifting was evident in five of the six sectors and for long hours in all six. For low birth weight, the associations were almost as consistent. Poisson regression analysis gave relative risks, adjusted for sector, of 1.25 ($p = 0.02$) for lifting and 1.35 ($p < 0.01$) for long hours. Changing shift work was strongly but irregularly related to low birth weight (1.38, $p < 0.01$) and less strongly to preterm birth. Noise was associated with low birth weight (O/E 1.11, $p = 0.02$) but not with preterm birth, and only in the health and manufacturing sectors.

Although there was appreciable correlation between some of the factors considered, further analysis suggested that none of the positive associations with preterm birth or low birth weight was due to this. The raised relative risks for lifting heavy weights, working long hours, and noise were unaffected by adjustment for the possible confounding effects of one with the other. A few other O/E ratios were raised in table 4—for example, with physical effort and vibration—but few to a statistically significant degree. No significant interaction was found between these factors and occupational sector.

The relation between work factors and outcome

Table 4 Ratios observed (O) to expected (E) preterm and low birthweight according to work requirements, environmental conditions, and major occupational sector

		Preterm							Low birth weight							
Sector:		1	2	3	4	5	6	Total	1	2	3	4	5	6	Total	
Work requirements:																
Lifting heavy weights (15/day)	O	8	17	16	9	21	38	109	8	16	12	7	15	44	102	
	O/E	1.48	0.84	1.20	1.58	1.47**	1.36**	1.25***	1.70	0.89	0.93	1.29	1.08	1.71***	1.26***	
Other physical effort (great)	O	17	40	28	7	29	36	158	13	35	23	4	26	39	140	
	O/E	1.05	1.17	1.10	0.94	1.01	1.16	1.10	0.94	1.21	0.95	0.57	0.91	1.35**	1.06	
Standing (≥ 8 h/day)	O	6	18	28	23	66	62	204	4	16	24	17	58	61	180	
	O/E	1.12	0.88	1.09	1.10	1.17	1.00	1.07	0.89	0.95	0.98	0.88	1.06	1.07	1.02	
Long working week (≥ 46 h)	O	18	11	10	14	29	7	89	10	11	9	12	27	7	76	
	O/E	1.44*	1.21	1.38	1.07	1.51**	1.33	1.34**	0.88	1.43	1.24	1.00	1.49**	1.53	1.24**	
Changing shift	O	3	29	6	1	17	2	58	2	34	7	0	12	5	60	
	O/E	1.11	1.11	0.92	1.61	1.88***	0.52	1.18	0.83	1.62***	1.11	—	1.30	1.34	1.38***	
Use of VDU (≥ 15 h/week)	O	23	6	124	2	1	3	159	20	6	109	2	0	5	142	
	O/E	1.19	1.59	1.03	0.67	2.46	1.19	1.06	1.21	1.88*	0.97	0.66	—	2.05*	1.03	
Experimental conditions:																
Noise (great)	O	35	33	111	16	41	138	375	37	36	110	12	40	141	376	
	O/E	0.86	1.17	0.96	1.28	1.07	1.08	1.03	1.07	1.49***	1.00	0.96	1.03	1.20**	1.11**	
Vibration (great)	O	4	1	9	0	10	27	52	3	1	13	0	5	26	48	
	O/E	1.33	0.49	0.83	—	2.05**	1.22	1.18	1.14	0.55	1.15	—	1.01	1.26	1.14	
Too cold	O	11	5	47	13	8	11	95	10	5	55	10	10	15	105	
	O/E	1.03	1.00	0.85	1.45	0.95	0.77	0.93	1.08	1.21	1.05	1.20	1.13	1.05	1.08	
Too hot	O	52	50	126	16	39	79	362	40	45	107	17	33	80	322	
	O/E	0.96	1.00	0.90	1.16	1.04	1.07	0.98	0.89	1.07	0.82	1.27	0.93	1.17	0.96	
Total	O	258	191	725	86	164	264		205	169	660	73	144	253		
	O/E	0.91	0.98	1.00	0.98	1.14**	1.03		0.89	1.05	0.99	0.91	1.05	1.10		

*p < 0.1; **p < 0.05; ***p < 0.01.

were analysed separately for women who had stopped working before the 28th week and for those who continued longer. The only significant interaction detected by the Poisson regression analysis between a work factor and period of employment was with standing, but overall there was no association between standing and either preterm birth or low birth weight. Despite the lack of significant interaction, it may be noted that the association between heavy lifting and preterm birth and low birth weight was limited to women who stopped working before the 28th week; in those still at work at 28 weeks there was no association with either (O/E = 1.04; 0.96). Long working hours and changing shift were associated with preterm birth and low birth weight in both employment periods.

The composite score, based on the Mamelle approach, showed a weak but statistically significant association with both indices of prematurity. The O/E ratios for preterm birth in women with scores of 0, 1, 2, and 3 or more were 0.97, 0.98, 1.07, and 1.16 respectively (p = 0.02). The corresponding figures for low birth weight were 0.96, 0.98, 1.18, and 1.05 (p = 0.02).

In addition to their paid employment women were asked to report the number of hours a week of housework. There was no evidence overall that the O/E

ratios for low birth weight or preterm birth increased with amount of housework. In fact the highest ratios were in those who did the least amount (<5 hours a week)—1.29 (p < 0.01) for both preterm birth and low birth weight.

Discussion

In this type of survey statistically significant associations may be evidence of causation or have resulted either from confounding factors or from biased data. The basic information about working conditions and pregnancy outcome was obtained from mothers by nurse interviewers after birth of the child so the possibility exists of subject and observer bias. Such bias could well occur if the outcome was emotionally distressing, as with abortion, stillbirth, or congenital defect, but would be less probable after the birth of a premature but usually healthy live infant. We think it unlikely, therefore, that bias contributed importantly to the associations with heavy lifting, long hours, changing shift, or noise. Nor is it probable that the high O/E ratios in specific service and other occupations resulted from bias since the recording and classification of type of employment could not easily have been influenced by outcome.

The question of whether these various associations could be explained by confounding factors is more

difficult. Recognised confounders were included in the preliminary logistic regression analyses on which the expected figures were based. Their substantial effect on the estimated risk of prematurity underlines the importance of having taken them into account. We cannot assume that these regression analyses completely achieved their objective but a more serious question concerns the possible existence of undefined factors, particularly those associated with selection for certain types of employment, which could also have affected the outcome of pregnancy. For example, if women with specific characteristics not adequately covered by the recognised confounders tended to apply for or be recruited to psychiatric nursing, the observed excess of prematurity might be due to these characteristics rather than to the physical effort or changing shifts commonly required of this professional group. Questions of this nature cannot be resolved by one epidemiological study; cause and effect are shown only by finding similar associations in varied circumstances or, occasionally, by some form of experiment. The essential similarity of our findings with those of Mamelle *et al* is therefore important. Also in favour of a causal interpretation is the inherent biological plausibility of the findings; it would not be surprising if work that entailed physical stress and fatigue induced premature labour. Even in the absence of further proof it would be prudent for women to avoid or be relieved of such work in pregnancy. The association of noise with low birth weight, although apparently independent of weight lifting and long hours, appears less plausible since the mechanism is obscure.

It had been hoped that factors associated with premature labour would be distinguished from those associated with low birth weight but little discrimination was achieved, probably because of extensive overlap between the two groups. Later analyses based on (a) weight for gestation and (b) gestation for weight may help to answer this question.

The comparison of O/E ratios in relation to employment before and after the 28th week suggests that if heavy lifting affected the risk of preterm birth or low birth weight it did so early rather than late in pregnancy. The absence of an association between heavy lifting and prematurity in women who worked during the third trimester certainly fails to support the hypothesis of an immediate effect on the initiation of labour. On the other hand, selection related to maternal health or the nature of the job (or the woman's assessment of what it entailed) could equally explain the apparent absence of risk from heavy lifting in women who continued to work after 28 weeks.

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References

- 1 McDonald AD. *Children of very low birth weight*. London: Spastics Society and Heinemann, 1967.
- 2 Alberman E, Benson J, McDonald AD. Cerebral palsy and severe educational subnormality in low-birthweight children: a comparison of births in 1951-53 and 1970-73. *Lancet* 1982;ii:606-8.
- 3 Baird D. Environmental and obstetrical factors in prematurity with special reference to experience in Aberdeen. *Bull WHO* 1962;26:291-5.
- 4 Garn SM, Shaw HA, McCabe KD. Effect of socio-economic status and race on weight-defined and gestational prematurity in the United States. In: Reed DM, Stanley FJ, eds. *The epidemiology of prematurity*. Baltimore-Munich: Urban and Schwarzenberg, 1977:127-43.
- 5 Alberman E. Sociobiologic factors and birth weight in Great Britain. In: Reed DM, Stanley FJ, eds. *The epidemiology of prematurity*. Baltimore-Munich: Urban and Schwarzenberg, 1977:145-56.
- 6 Kleiman JC, Madans JH. The effects of maternal smoking, physical stature and educational attainment on the incidence of low birth weight. *Am J Epidemiol* 1985;121:843-55.
- 7 Drillien CM. The social and economic factors affecting the incidence of premature birth. *Journal of Obstetrics and Gynaecology of the British Empire* 1957;64:161-84.
- 8 Bakketeig LS. The risk of repeated preterm or low birth weight delivery. In: Reed DM, Stanley FJ, eds. *The epidemiology of prematurity*. Baltimore-Munich: Urban and Schwarzenberg, 1977:231-41.
- 9 Kaltreider DF, Kohl S. Epidemiology of preterm delivery. *Clin Obstet Gynaecol* 1980;23:17-30.
- 10 Simpson WJ. A preliminary report of cigarette smoking and the incidence of prematurity. *Am J Obstet Gynecol* 1957;73:808-15.
- 11 Lowe CR. Effect of mothers' smoking habits on birth weight of their children. *Br Med J* 1959;ii:673-6.
- 12 Naeye RL. Effects of maternal cigarette smoking on the fetus and placenta. *Br J Obstet Gynaecol* 1978;85:732-7.
- 13 Hanson JW, Streissguth AP, Smith DW. The effects of moderate alcohol consumption during pregnancy on fetal growth and morphogenesis. *J Pediatr* 1978;92:457-60.
- 14 Little R. Moderate alcohol use during pregnancy and decreased infant birth weight. *Am J Public Health* 1977;67:1154-6.
- 15 Kaminski M, Rumeau-Rouquette C, Schwartz D. Consommation d'alcool chez les femmes enceintes et issue de la grossesse. *Rev Epidemiol Santé Publique* 1976;24:27-40.
- 16 Fedrick J, Anderson ABM. Factors associated with spontaneous pre-term birth. *Br J Obstet Gynaecol* 1976;83:342-50.
- 17 Saurel MJ, Kaminski M. Pregnant women at work. *Lancet* 1983;ii:475.
- 18 Murphy JF, Dauncey M, Newcombe R, Garcia J, Elbourne D. Employment in pregnancy: prevalence, maternal characteristics, perinatal outcome. *Lancet* 1984;ii:1163-6.
- 19 Stewart A. A note on the obstetric effects of work on pregnancy. *Br J Prev Soc Med* 1955;9:159-61.
- 20 Mamelle N, Laumon B, Lazar P. Prematurity and occupational activity during pregnancy. *Am J Epidemiol* 1984;119:309-22.
- 21 McDonald AD, McDonald JC, Nolin AD, *et al*. Occupation and pregnancy outcome. *Br J Ind Med* 1987;44:521-6.
- 22 Blishen BR, McRoberts HA. A revised socio-economic index for occupations in Canada. *Canadian Review of Sociology and Anthropology* 1976;13:71-3.
- 23 Baker RJ, Nelder JA. *The GLIM system: release 3*. Oxford: Numerical Algorithm Group, 1978.
- 24 *Standard occupational classification*. Ottawa: Statistics Canada, 1980.
- 25 *Standard industrial classification*. Ottawa: Statistics Canada, 1980.