International Journal of Biomedical Research
ISSN: 0976-9633 (Online); 2455-0566 (Print)
Journal DOI: https://doi.org/10.7439/ijbr
CODEN: IJBRFA

Original Research Article

Occupational fatigue score and risk of preterm birth

Bansal Aditi*, Saini Surbhi, Srivastava Ankita, Rajoria Lata and Gangal Shweta

Department of Obstetrics and Gynaecology, S.M.S. Medical college, Jaipur, India

QR Code

***Correspondence Info:**
Dr. Aditi Bansal
Assistant Professor,
Department of obstetrics and Gynaecology,
S.M.S. Medical College, Jaipur, India

***Article History:**
Received: 21/04/2018
Revised: 27/04/2018
Accepted: 27/04/2018
DOI: https://doi.org/10.7439/ijbr.v9i4.4754

Abstract

The aim of present study was to determine the elements of fatigue in occupations which constitute possible risk factors for the course of a pregnancy, and, in particular, that could cause premature birth. A total of 400 women with singleton pregnancies at ≥ 28 weeks' gestation were enrolled in the study conducted at the Labor room, Zenana Hospital, Jaipur. Patients reported the number of hours worked per week and answered specific questions designed to determine the following 5 sources of occupational fatigue: posture, work with industrial machines, physical exertion, mental stress, and environmental stress. Fatigue was quantified (0-5 index) according to the number of these sources positively reported. Simple and Mantel-Haenszel $\chi 2$ tests were used to test the univariate association and hypothesis of a linear trend between sources of occupational fatigue and spontaneous preterm delivery. Covariables were considered by multivariate logistic regression analysis. Women who did not work outside the home were considered separately from those who worked but did not report any sources of occupational fatigue. Women with sternous activity had higher occurrence of preterm birth. 18 % preterm mothers had high occupational fatigue index as compared to 75% term mothers, with p value <0.1,which was significant.

Keywords: Occupational fatigue, singleton pregnancy, preterm delivery.

1. Introduction

The mother undergoes certain modifications in order to adapt to the needs of the fetus. These changes modify, in particular, the cardiovascular and respiratory functions, which also undergo variations during physical effort. The result is that a physical effort may cause physio-pathological reactions in pregnant women. These physiological modifications lead us to think that pregnancy has effects on the way of life, and, inversely, working has consequences for pregnancy and the development of the fetus.

The consequences for the mother can be determined easily by direct observations during various activities. However, epidemiological studies are needed to determine the consequences for the fetus and to establish a relationship between the way of life and the evolution of pregnancy. For this purpose we have performed research into the elements of the way of life which constitute possible risk factors, and which are evaluated by the perinatal indicators: intrauterine mortality, prematurity and low birth weight [1].

Although many studies from developed countries have established a relationship between various occupational working conditions during pregnancy and preterm birth, there is little data available in developing countries where both maternal physical labor during pregnancy and preterm birth are common. Of the occupational conditions present at the beginning of pregnancy, demanding posture (bending, squatting, arms raised above shoulder level) for at least 3 hours per day, whole-body vibrations, and high job strain combined with low or moderate social support were significantly found to be associated with preterm delivery[2].

There was no association seen between PTD risk and the following conditions, whether or not the worker took recourse to preventive measures: maximum number of hours worked per week, possibility to sit when standing, pushing or pulling objects, having to climb stairs, absence of breaks, piece work or assembly line, noise, long commuting time to work, and exposure to environmental tobacco smoke at work.

Various studies have found higher PTD risk for pregnant working women exposed to demanding posture for at least 3 hours per day, whole-body vibrations, high job strain combined with low or moderate social support, and a cumulative index composed of nine work conditions. Women who experienced a change in these work conditions following recourse to preventive job withdrawal or reassignment had lower risks of PTD and very PTD than those who did not. Although the associations are small, most of them are consistent for PTD and very PTD.[2]

2. Method and material

This case control study was conducted in the Department of Obstetrics and Gynaecology, S.M.S. Medical College, Zenana Hospital, Jaipur during the year 2009-10 including a total number of 200 cases and 200 controls. Pregnant women with gestational age ≥28 weeks admitted in the labor room were included in our study.

2.1 Inclusion criteria

Singleton live pregnancy with longitudinal lie ≥28 weeks with spontaneous labour or rupture of membranes.

2.2 Exclusion criteria

Preterm labour induced for maternal or fetal conditions;
Multiple gestations;
Antepartum hemorrhage;
Intrauterine fetal demise;
Irregular menstrual cycle;
Not sure of LMP

2.3 Subject selection

Group A:

Singleton live pregnancy with longitudinal lie admitted in labor with gestation age between 28- <37 weeks

Group B:

Singleton live pregnancy with longitudinal lie admitted in labor with gestation age ≥37 weeks

All the patients were subjected to thorough questioning, examinations and required tests.

2.4 Occupational fatigue index [3]

Patients reported the number of hours worked per week and answered specific questions designed to determine the following 5 sources of occupational fatigue: posture, work with industrial machines, physical exertion, mental stress, and environmental stress. Fatigue was quantified (0-5 index) according to the number of these sources positively reported. Each score is 'high' if one or more elements of the job listed are present.

Table 1: Occupational fatigue index

Occupational fatigue source	High score if
Posture	Standing position for more than 3 hours per day
Work on industrial machine	Industrial conveyer belt Independent work with sternous effort or vibrations
Physical exertion	Continuous or periodical physical effort Carry load of >10kg
Mental stress	Routine work Varied tasks requiring little attention without stimulation
Environment	At least 2 or 3 of these- significant noise level, cold temperature, very wet atmosphere Manipulation of chemical substances

We quantified fatigue by the number of high scores, i.e., by the total number of sources of high fatigue which were experiences by the woman while she is working. Fatigue is considered to be intense when three sources of fatigue are simultaneously rated as high (index ≥3)

Simple and Mantel-Haenszel $\chi 2$ tests were used to test the univariate association and hypothesis of a linear trend between sources of occupational fatigue and spontaneous preterm delivery.

3. Results and Observations

Table 2: Occupational fatigue source and score

Occupational fatigue source and score	Group A		Group B	
	No.	%	No.	%
Posture				
Low	57	28.50	157	78.50
High	143	71.50	43	21.50
Work on machine				
Low	195	97.50	199	99.50
High	5	2.50	1	0.50
Physical exertion				
Low	102	51.00	141	70.50
High	98	49.00	59	29.50
Mental stress				
Low	0	0	0	0
High	200	100.00	200	100.00
Environment				
Low	176	88.00	178	89.00
High	24	12.00	22	11.00
OF score level OFI				
Low (<3)	164	82.00	185	92.50
High (>3)	36	18.00	15	7.50

$X^2_{posture=}$ 100.49 p <0.0001
$X^2_{work\ on\ machine}$ = 1.523 p = 1.320
$X^2_{physical\ exertion}$= 15.950 p<0.0001
$X^2_{environment}$ = 0.100 p= 0.7518
X^2_{OFI}= 9.91 p<0.01

Figure 1: Occupational Fatigue Score in Group A

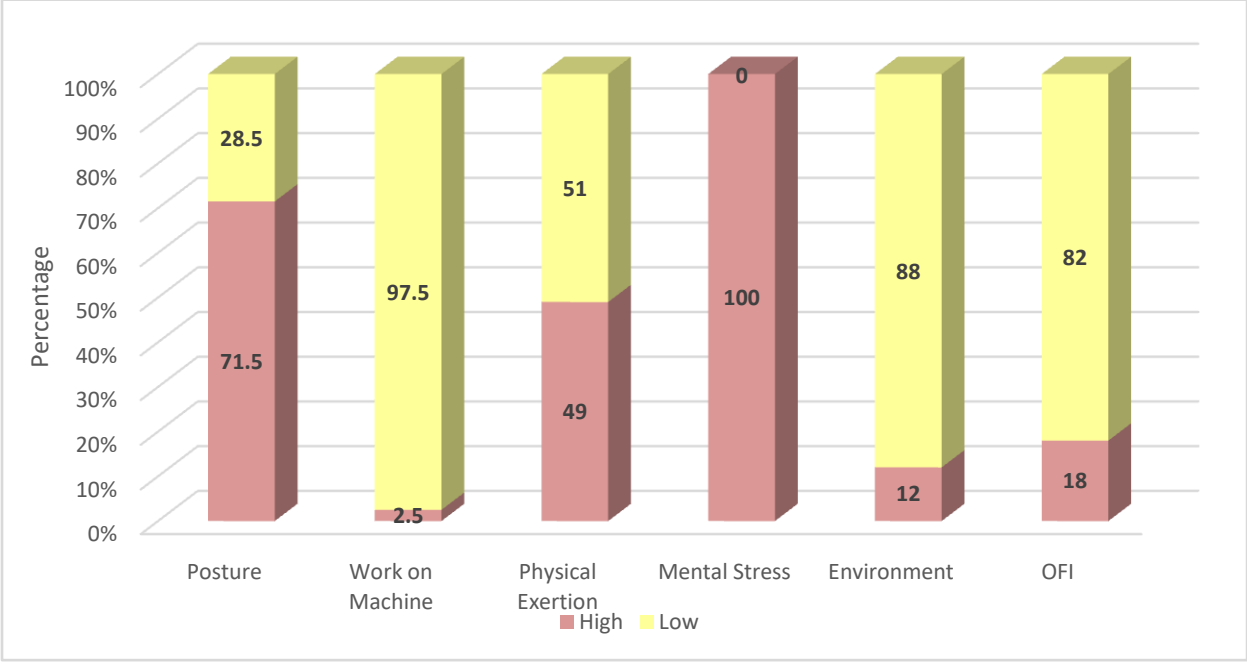
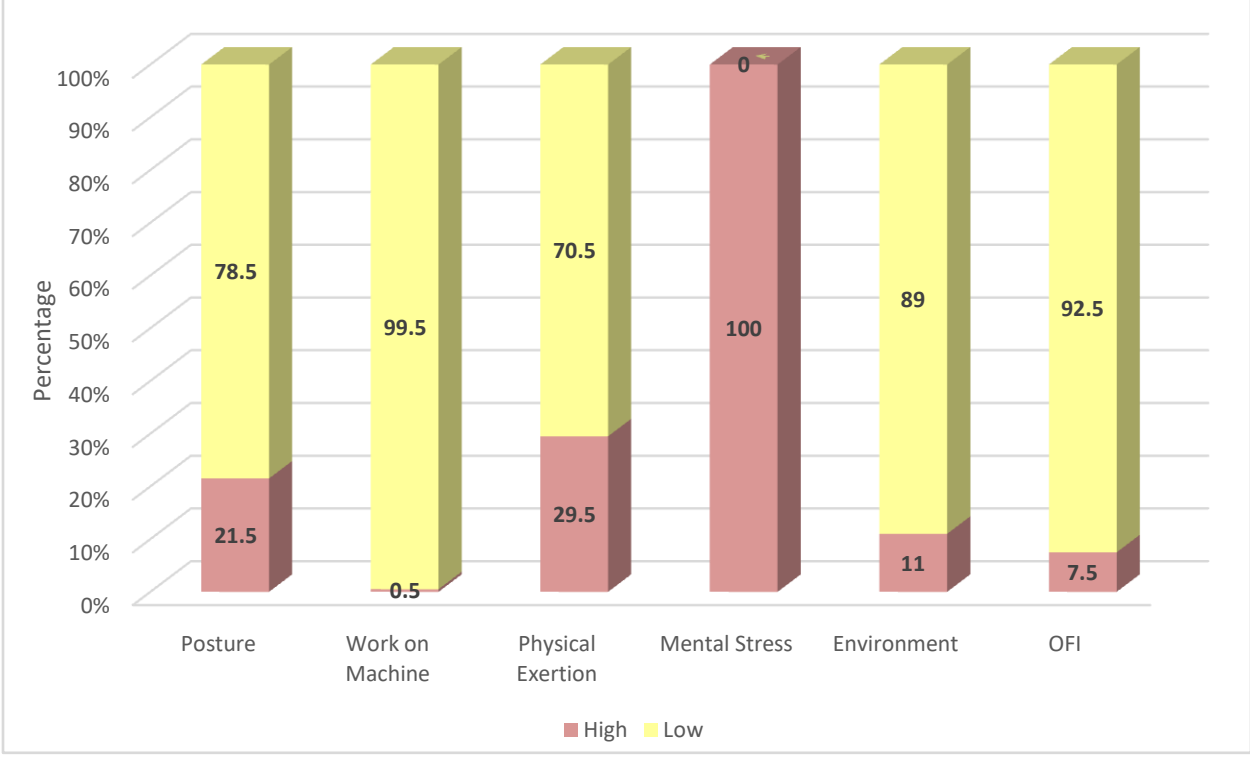


Figure 2: Occupational Fatigue Score in Group B



According to our observation 2 of the fatigue scores indicated increased risk of preterm birth that was statistically significant.

1. Posture (p value<0.0001)
2. Physical exertion (p value<0.0001)

Mental stress as an occupational fatigue source was present in all the cases and controls. Work on machine and environment scores were insignificant for preterm birth.

The distribution of occupational fatigue index was a significant factor for preterm birth with significantly more number of women with higher indices, an indicator of sternous activity (p value<0.01). Thus preterm birth was commoner in women involved in sternous activities.

Women with sternous activity had higher occurrence of preterm birth. 18 % preterm mothers had high occupational fatigue index as compared to 75% term mothers, with p value <0.1, which was significant. Two fatigue sources, standing for ≥3 hours per day and high physical exertion were significantly higher in preterm group.

4. Discussion

Occupational fatigue score was employed by many researchers to ascertain the effect of various occupational factors on preterm birth.

According to a study by Carol *et al* [4], when the number of high scores increased from 0-5, the rate of preterm delivery increased from 2.3% to 11.1%, being statistically significant. Preterm delivery was not significantly higher for black women with low (<3) and high (>3) occupational fatigue scores.

Table 3: Occupational fatigue score According to a survey by N Mamelle and F Munoz [5],

Occupational fatigue source and score	%women preterm (case)	%women at term (control)	OR	95% confidence limit
Posture				
Low	55.4	56.0	1	
High	44.6	44.0		
Work on machine				
Low	89.7	84.0	1.7	1.01-2.9
High	10.3	16.0		
Physical exertion				
Low	83.8	82.0	1.1	0.78-1.54
High	16.2	18.0		
Mental stress				
Low	81.4	74.0	1.5	1.03-2.3
High	18.6	26.0	4	
Environment				
Low	60.5	53.5	1.3	0.94-1.9
High	39.5	46.5	3	

Two of the fatigue scores indicated increased risks of preterm birth that are significantly significant:

1. Work on machine score (OR-1.7)
2. Mental stress score (OR- 1.54)

The environment score seems to be related to the risk of preterm birth but not significantly so (OR -1.3). Posture and physical exertion were insignificant for preterm birth.

According to Henriksen *et al* [6], compared with women who reported walking or standing 2 hours or less per day, women who reported more than 5 hours of both had more than 3 times the rate of delivering preterm (OR-3.3, CI-1.4-18.0)

According to Saurel-Cubizolles *et al* [7] study, amongst working women, moderate excess risk was observed for women working >42 hours/week (OR-1.33, CI- 1.1-1.6), standing >6 hours/day (OR- 1.26, CI-1.1-1.5), low job satisfaction (OR – 1.27, CI- 1.1-1.5)

Newman *et al* [8] in their research quoted that each source of occupational fatigue was independently associated with a significantly increased risk of preterm premature rupture of membranes among nulliparous women but not among multiparous women. The risk of preterm premature rupture of membranes increased (P = 0.002) with an increasing number of sources of occupational fatigue-not working outside the home, 2.1%; working but not reporting fatigue, 3.7%; working with 1 source of fatigue, 3.2%; working with 2 sources of fatigue, 5.2%; working with 3 sources of fatigue, 5.1%; and working with 4 or 5 sources of fatigue, 7.4%. There was also a significant relationship (P = 0.01) between preterm premature rupture of membranes and an increasing number of hours worked per week among nulliparous women. Neither spontaneous preterm labor nor indicated preterm delivery was significantly associated with occupational fatigue among either nulliparous or multiparous women.

Physically demanding work during pregnancy, including standing and walking at work during pregnancy for more than 3 h per day, lifting more than 5 kg, physical effort or physical exertion and jobs with a combination of two or more tasks with physical effort or an Occupational Fatigue Score of >2, is significantly associated with an increased risk of PTD. The exposure to physically demanding work mostly occurred during the first trimester. [9]

The relationship between demanding posture in work and PTD was examined in three studies by other researchers [2,10,11].

Bonzini *et al* [10] reviewed the relationship between PTD and five occupational exposures (long working hours).

The risk of preterm birth was elevated threefold in women whose work at 34 weeks entailed trunk bending for more than 1 h/day [10]. In the study of Croteau *et al*[2], the occupational conditions present at the beginning of pregnancy, demanding posture (bending, squatting, arms raised above shoulder level) for at least 3 h per day, were significantly associated with PTD. The association was higher when not eliminated by preventive measures (OR 1.7) than when they were eliminated early during pregnancy (OR 1.4)[2,10,11]

Bonzini *et al* [10] reviewed the relationship between PTD and five occupational exposures (long working hours)

Bonzini *et al* [12] reviewed the relationship between preterm delivery and five occupational exposures (long working hours, shift work, lifting, standing and heavy physical workload). They pooled 12 studies that compared standing for at least 3 h with lower exposures. The summary estimate OR was 1.28 (95 % CI 1.11–1.47), and that for the subset of six studies with low risk of bias was 1.26 (95 % CI 0.96–1.66).

Mozurkowich *et al* [13] examined the association between prolonged standing, defined as more than 3 h per day or the predominant occupational posture and PTD. This association which was statistically significant (OR 1.26, 95 % CI 1.13–1.40), was consistent across all study designs and meta-analytic methods. Physically demanding work, defined as heavy and/or repetitive lifting or load carrying, manual labour, or significant physical exertion, was significantly associated with PTD (OR 1.22, 95 % CI 1.16–1.29). On the basis of data from six studies with a total of 7,719 women, Mozurkowich evaluated the association between a cumulative work fatigue score and PTD across analytic methods.

In a recent review, Savitz and Murnane [14] note that some studies of recreational physical activity have generated mixed results regarding PTD. In most European countries, socio-economic inequalities in ill health are an important determining factor for entering and aintaining paid employment [15]. In some studies, working women are, on average, healthier and at lower a priori risk of PTD and other adverse pregnancy outcomes than women who do not work [16-18]. Other studies could not confirm this association [19].

5. Conclusion

The 5 sources of occupational fatigue: posture, work with industrial machines, physical exertion, mental stress, and environmental stress are used to calculate the score. Fatigue is quantified (0-5 index) according to the number of these sources positively reported. Mental stress as an occupational fatigue source was present in all the cases and controls. The preterm birth is found to be commoner in women involved in sternous activities. Work on machine and environment scores are insignificant for preterm birth.

Physically demanding work, standing and walking, lifting and carrying, physical exertion and demanding posture during pregnancy may increase a woman's risk of PTD. A cumulative index of at least two tasks with physical effort or physically demanding work shows a positive association with PTD. In general, small to moderate elevations of risks were found. These results should be interpreted with caution because of the lack of accurate and objective exposure.

References

[1]. Mamelle N., Laumon B. (1984) Occupational Fatigue and Preterm Birth. In: Chamberlain G. (eds) Pregnant Women at Work. Palgrave, London

[2]. Croteau A, Marcoux S, Brisson C. Working activity in pregnancy, preventive measures, and the risk of preterm delivery. *Am J Epidemiol* 2007; 166:951–965.

[3]. Nicole Mamelle, Bernard Laumon, Philippe Lazar. Prematurity and occupational activity during pregnancy. *Am J Epidemiol*, 1964; 119: 309-22.

[4]. Carol A Hickey, Suzanne P Cliver, Francis X Mulvihill, Sandre F Mcneal, Howard J Hoffman, Robert L Goldenberg. Employment related stress and preterm delivery: a contextual examination. *Public Health Rep*, 1995 Jul-Aug; 110(4): 410-418.

[5]. Mamelle N and Munoz F. Occupational working conditions and preterm birth: a reliable scoring system. *Am J Epidemiol*, 1987 Jul; 1216(1): 150-152.

[6]. Henriksen Tine Brink, Hedegaard Morten, Jorgen Secher Niels. Allen J Wilcox. Standing at work and preterm delivery. *British Journal of Obstetrics and Gynaecology*, March 1995; 102: 198-206.

[7]. Saurel-Cubizolles MJ, Zeitlin J, Lelong N, Papiernik E, Di Renzo GC, Bre´art G, Europop Group. Employment, working conditions, and preterm birth: results from the Europop case-control survey. *J Epidemiol Community Health* 2004; 58: 395–401.

[8]. Newman R B *et al*: Occupational fatigue and preterm premature rupture of membranes, *American Journal of Obstetrics and Gynecology* February 2001; 184 (3): 438-446.

[9]. Beukering V M *et al*: Physically demanding work and preterm delivery: a systematic review and meta-analysis *International Archives of Occupational and Environmental Health*. January 2014; 87(8).

[10]. Bonzini M, Coggon D, Godfrey K, Inskip H, Crozier S, Palmer KT. Occupational physical activities, working hours and outcome of pregnancy: findings from the Southampton Women's Survey. *Occup Environ Med* 2009; 66(10): 685–690.

[11]. Tuntiseranee P, Geater A, Chongsuvivatwong V, Kor-anantakul O. The effect of heavy maternal workload on fetal growth retardation and preterm delivery. *J Occup Environ Med* 1998; 40:1013–1021.

[12]. Tuntiseranee P, Olsen J, Geater A, Kor-anantakul O (b) Are long working hours and shift work risk factors for subfecundity? A study among couples from southern Thailand. *Occup Environ Med* 1998; 55(2): 99–105

[13]. Bonzini M, Coggon D, Palmer KT. Risk of prematurity, low birth weight, and preeclampsia in relation to working hours and physical activities: a systematic review. *Occup Environ Med* 2007; 64: 228–243.

[14]. Mozurkewich EL, Luke B, Avni M, Wolf FM. Working conditions and adverse pregnancy outcome: a meta-analysis. *Obstet Gynecol* 2000; 95:623–634.

[15]. Savitz DA, Murnane P. Behavioral influences on preterm birth: A review. *Epidemiology* 2010; 21(3): 291–299.

[16]. Schuring M, Burdorf A, Kunst A, Mackenbach J. The effects of ill health on entering and maintaining paid employment: evidence in European countries. *J Epidem Commun Health* 2007; 61(7): 597–604.

[17]. Stengel B, Saurel-Cubizolles MJ, Kaminksi M. Healthy worker effect and pregnancy: role of adverse obstetric history and social characteristics. *J Commun Health* 1987; 41:312–320.

[18]. Murphy JF, Dauncey M, Newcombe R, Garcia J, Elbourne D. Employment in pregnancy: prevalence, maternal characteristics, perinatal outcome. *Lancet* 1984; 8387: 1163–1166.

[19]. Rodrigues T, Barros H. Maternal employment status: anindicator of spontaneous preterm delivery risk. *Eur J Epidemiol* 2008; 23(10): 689–693.

[20]. Jansen PW, Tiemeier H, Verhulst FC, Burdorf A, Jaddoe VW, Hofman A, Moll HA, Verburg BO, Steegers EA, Mackenbach JP, Raat H. Employment status and the risk of pregnancy complications: the Generation R Study. *Occup Environ Med* 2010; 67(6): 387–394.