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To Compare the Effects of Maternal Occupational Activities on Birth Weight: A Cross Sectional Study

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Abstract

Background: Work related factors have been suggested to adversely impact outcomes of pregnancy. The aims of this study were to compare neonatal birth weight in employed and non-employed women and to investigate the relation of 5 common occupational factors including working hours, shift work, standing, bending forward, and physical workload intensity to neonatal birth weight.
Methods: This cross sectional study was carried out on 370 pregnant women, 185 employed and 185 non-employed. Information were collected about working conditions including working hours, shift work, standing, walking, bending, squatting, physical workload intensity, socio - demographic characteristic, as well as obstetric history of each patient by interview. Association between maternal occupational activity and neonatal birth weight was adjusted for medical and obstetric, occupational details were studied using logistic regression analysis.
Results: The mean birth weight in employed and non-employed women were 3052 $\pm$ 359.3, 3236.3 $\pm$ 377.2, respectively, which had a meaningful difference (P = 0.001). The mean of birth weight in employed women had a significant correlation with shift work (P = 0.0001), working hours per week (P = 0.001), and heavy a work load (P = 0.0001). After using linear multivariate regression, this study showed that employment and preterm delivery had the most significant effects on low birth weight.
Conclusions: Neonatal birth weight in employed women is less than non-employed women. Therefore, careful prenatal visits to monitor growth of fetus and adjustment of working hours will be suggested.

Keywords: Neonatal Birth Weight, Working Hours, Low Birth Weight, Employment

1. Background

In Iran, as in most parts of the world, women of reproductive age now make up a substantial proportion of the total work force. Several reproductive hazards associated with some types of work are well established - for example, from athletes and pesticides at work (1, 2). However, there is less certain evidence regarding work load hazards that affect pregnant women. Sleep deprivation or disrupted circadian rhythms that occur in some womens' work schedules can cause neuroendocrine changes, affect the timing of parturition, fetal growth, and birth weight (3, 4). On the other hand, the royal college of obstetrician and gynecologists as well as the American college of obstetrician and gynecologists recommend that all women should be encouraged to exercise (especially aerobic condition), which can reduce fatigue, stress, anxiety, and even delivery complications (5, 6). However in general, some women may remain clinically anxious regarding the disadvantages of working activities on their pregnancy, especially on the birth weight. Low birth weight (LBW) is an important indicator of reproductive health and general health status of population. It is a major public health problem world wild. The mortality of LBW can be reduced if the maternal risk factors are detected early and managed (7-9). However, the evidence base was small for risk assessment of small for gestational age in employed women (3, 10). On the other hand, most studies of working hours and work shifts employed a similar definition, however, for other exposures (such as intensity workload), they were not defined clearly. The aims of the present study were to compare the neonatal birth weight of employed and unemployed women to identify the risks of the relating 5 occupational characters (working hours, shift work, bending, standing, and intensity work load) on neonatal birth weight.

2. Methods

After ethical approval from the ethics committee of Shahed University of Medical Sciences, this cross sectional study was performed in Mustafa Khomeini teaching hospital in Tehran, Iran, between 2010 - 2012, on 370 women who had been given birth (in the first days after birth).

An inclusion criterion was singleton pregnancy leading to live birth.

The exclusion criteria were maternal cardiac or renal disease, cigarette smoking, and opium addiction.

Written informed consent was taken by the participants.

Occupational details, previous obstetric history, and maternal demographic features were obtained by interview. Neonatal sex and birth weight were abstracted from hospital records.

These definitions were used in this study extracted from the study of Palmer et al. They conducted a systematic review of the literature regarding the risks arising from 5 common workplace exposures (prolonged working hours, shift work, lifting, standing, and heavy physical workload) (5, 6).

Preterm delivery: birth of a living fetus before 37 completed weeks of gestation.

Low birth weight: birth weight less than 2500 gram.

Preeclampsia: gestational hypertension with proteinuria.

Prolonged standing: standing $\geq$ 4 hours/day.

Prolonged bending: bending $\geq$ 1 hours/day.

Prolonged working hours: working $\geq$ 40 hours/week.

Shift work: A, night shift work (worked from 20 p.m. until 8 a.m.).

B, Evening shift work (worked from 14 p.m. until 19 or 20 p.m.).

Physical activity: Moderate - intensity activities (required moderate physical effort and caused small increase in breathing or heart rate) and vigorous - intensity activities (required hard physical effort and caused large increase in breathing or heart rate) extracted from the part of activity at work in the global physical activities questionnaire. The global physical activity questionnaire was developed by WHO for physical activity surveillance in countries. It collects information on physical activity participation in 3 settings (or domains) as well as sedentary behavior (11-14).

Statistical analysis was carried out with SPSS 16 software. Quantitative data was analyzed by ANOVA or t-test and the qualitative data were analyzed by the Chi-square test.

Then linear multivariate regression model (by the Sata statistics app) was used to assess the occupational effect on birth weight to exclude confounding factors.

3. Results

This was a cross sectional study carried out on 370 pregnant women: 185 employed and 185 non-employed women. Their age ranged from 17 to 42 years (mean 28.82 $\pm$ 5.06). The mean age of non-employed women and employed women were 28.89 $\pm$ 5.14, 28.75 $\pm$ 4.99, respectively, 88.1% of housewives and 93.5% of working women were in low risk age (18 - 35). Of these, 101 (54.6%) of employed women and 120 (64.9%) of non-employed women were prime-gravid (Table 1).

Of these, 18 (9.7 %) of non- employed women and 0% of employed women had an education of less than a diploma. 102 (55.01%) and 66 (35.7%) of non-employed and employed women had diploma, respectively. There was no significant difference between the 2 groups in respect of their pre-pregnancy weight, weight gain, and weight in the end of pregnancy. No significant differences were seen between 2 groups in previous LBW delivery, history of preterm labor (on themselves or in their family), gender of neonates, and cesarean section (P value > %05) (Table 1). The characteristics of employed women: 41 (22.2%) worked more than 40 hours per week, 71 (38.4%) had vigorous activity, 46 (24.9%) stood more than 4 hours per day, and 12 (6.5%) sat continuously for more than 1 hour per day.

The mean of neonatal birth weights were 3236.3 $\pm$ 377.2 and 3052.4 $\pm$ 359.3 in non- employed and employed women respectively, which had a significant difference (P = 0.0001). The risk of a low birth weight (< 2500 gr) was higher in employed women than non-employed women. This difference was significant (P = 0.02), however, there is no significant relationship between preterm labor and maternal employment status (P = 0.2) (Table 1). Linear multivariate regression was used to estimate B coefficient of study variables with birth weight. All variables with a P value less than 0.5 in univaried analysis entered the linear multivariate regression models. The variables were age, education level, change in BMI during pregnancy, gravity, parity, abortion, infertility, diabetes, preterm labor, and job status. This analysis showed that significant relations seemed to be between birth weight and parity, preterm labor, and job status (Table 2).

Table 3 demonstrated the relation between working hours and shift work to neonatal birth weight and Table 4 demonstrated the relation between physical activity, standing, and bending to neonatal weight.

Our results highlight that the neonate of employed women who worked > 40 hours per week, night working shifts, are at a high risk of low birth weight (Table 3). The mean neonatal birth weight of employed women that had mild, moderate, and vigorous physical activity were 3097 $\pm$ 399, 13016.1 $\pm$ 320.3, and 2811 $\pm$ 308.3, respectively. Therefore neonatal birth weights of working women who had vigorous physical activity were lower than others significantly (Table 3).

However, no statistically significant relations seemed between birth weight and long hours sitting or standing

Table 1. Baseline Characteristic of Study Participants Based on Job Status

Variable	Employed (%)	Nonemployee Women	All Women	P Value
Age				
< 18	0 (0)	2 (1)	2 (0.5)	
18 - 35	173 (94)	163 (88)	336 (91)	
> 35	12 (6)	20 (11)	32 (8.5)	0.117
Education (%)				0.001
≤ Diploma	66 (36)	120 (65)	186 (50.5)	
> Diploma	119 (64)	65 (35)	184 (49.5)	
Gravidity				
1	120 (65)	101 (55)	221 (60)	
2	54 (29)	52 (28)	106 (29)	
3 ≤	11 (6)	32 (17)	43 (11)	0.003
History of Preterm labor in people studied	28 (15)	20 (11)	48 (13)	0.279
Family history of preterm labor	12 (6)	15 (8)	27 (7)	0.89
Preterm labor	28 (15)	20 (11)	48 (13)	0.22
LBW	12 (6)	3 (2)	15 (4)	0.02
Diabetes	22 (12)	12 (6)	34 (9)	0.07
Child sex				
Boy	101 (55)	97 (52)	198 (54)	
Girl	84 (45)	88 (48)	172 (46)	0.68
Mode of delivery				
NVD	20 (11)	18 (10)	38 (10)	0.73
C/S	165 (89)	167 (90)	332 (90)	

($P > 0.05$) (Table 4)

4. Discussion

This study was done to compare neonatal birth weight between employed and non-employed pregnant women and to explore the relation between 5 common work place exposures: working hours, shift work, standing, sitting and physical workload, as well as neonatal birth weight. This study identified working for more than 40 hours per week, shift and heavy intensity work load related to birth weight and logistic regression analysis demonstrated that maternally occupation affected birth weight significantly regardless any relation to characteristics of occupational exposures. Bonzini is one of the few researchers that studied the adverse effect of work and associated factors in pregnancy. He and his associates conducted a systematic review to assess the evidence relating 3 major adverse outcomes (preterm delivery, low birth weight, and preeclampsia) to shift work.

They also analyzed the correlation between standing, physical workload during pregnancy, and SGA. In summary, this systematic review as well as the other studies that they did, demonstrated maternal occupation and had a mild to moderate effect on birth weight without respecting characteristics of their work, which was the same as our study. Furthermore, they concluded that it would seem prudent to advise against long working hours (> 40 hours per week), prolong standing and heavy physical work, particularly late in the pregnancy. The risk of preterm labor was elevated nearly threefold in mothers whose work, at 34 weeks, entailed bending for > 1 hour/day. In addition, if a mother worked > 40 hours/week a small head circumference was more common in her baby (1, 15, 16).

Oths and colleagues conducted a prospective study to find the relation between job strain and birth outcomes. They concluded that women with high strain jobs had babies with a birth weight of 190 gram lower than those born in low strain jobs or were unemployed (10). Makowiec - Dabrowska and associates recorded that a prolonged time

Table 2. Linear Multivariate Regression of Participants' Characteristics and Job Status with Birth Weight

	B Coefficient (95%CI)	P Value
Age		
≤ 20	R[a]	
21 - 30	-100 (-256, 56)	0.209
≥ 31	-85 (-254, 84)	0.324
Education		
≤ Diploma	R	0.9
> Diploma	-2.50 (-90, 85)	
Change in BMI	19 (0.58, -37)	0.04
Gravid		
Primi gravid	R	0.16
Multi gravid	72 (-29, 173)	
Abortion		
0	R	0.37
≥ 1	-63 (-187, 60)	
Parity		
Nuli Para	R	0.03
Multi Para	-131 (-253, -10)	
Infertility	-1 (-139, 137)	0.9
Diabetes	143 (6, 279)	0.04
Preterm labor	-154 (-273, -76)	0.01
Job		
Housewife	R	0.000
With job	-215 (-305, -125)	

[a] R, References.

Table 3. The Relation of Working Hours, Shift Work, and Vigorous Physical Activity to Birth Weight

Variable	Number	Mean Neonate Birth Weights (gr) ± SD	P Value
Shift work			0.0001
Morning	105 (56.8%)	3124.1 ± 320.6	
Evening	7 (3.8%)	2778.5 ± 172.8	
Morning and evening	63 (34.1%)	3019.3 ± 403.1	
Night	10 (5.4%)	2700 ± 219.8	
Working hours per week			0.001
< 40 hours	144 (77.8%)	3097.4 ± 337.7	
> 40 hours	41 (22.2%)	2894.3 ± 391.4	
Vigorous physical activity			0.0001
Had not (yes)	114 (61.6%)	3202.6 ± 303.3	
Had (no)	71 (38.4%)	2811.2 ± 308.3	

of work, excessive effort, and forced body position during the work performance contributed mostly to the risk of pathology in the newborn (14). In the other study, it was demonstrated a significant association between the highest tertile of physical activity level in the 1st trimester and birth weight was demonstrated. This significant association continued after adjustment for maternal weight and energy intake (17). The results of these studies are similar to this study.

Teitelman AM et al. studied the associations of the prolonged standing with the rate of preterm birth and low birth weight. They found that the low birth weight was higher among those in the standing group (5.5%) compared with those in the sedentary (4%) and active groups (4%), however, this association was not significant when confounding factors were controlled (18). Lin Y_C and colleagues found the birth weights of a newborn from mother on different shifts were significantly different. Mothers with persistent rotating shift work had more likely the lightest newborn birth weight (19). Aminian et al. assessed the relationship between physical activity and birth weight. They found that the shifting work mother's newborns birth weight was significantly lower than the morning work mother's newborns birth weight. The shifting work affected significantly on newborns birth weight (20, 21). Our findings on occupational activity and birth weight are fairly consistent with these studies.

Contrary to our finding, Sclunssen V et al. studied the associations between shift work and abortion, still birth, and birth weight. They found that no convincing associations were observed between shift work and birth weight, however, fixed night work could be increased abortion and still birth (21). Henriksen TB et al. and Snijder CA et al. found no evidence that work, per-se, had any detrimental or beneficial effects on the risk of having a small for gestational age and risk of low birth weight was small (22, 23).

Eqhbalian et al. and Goshtasebi A et al. assessed risk factors of low birth weight in Iran. In these studies, maternal education, pregnancy age, and sex of fetus were the most important factors in birth weight; however, they did not find any correlation between the mother's job and low birth weight (24, 25). Perhaps the reason for the different results is lack of uniformity in the definition of occupational details. Finally, what happens during work? It has been suggested that some work schedules such as, night shift, can induce neuro-endocrine changes as a results of sleep deprivation or disrupted circadian rhythms (may af-

Table 4. The Relation of Standing and Bending of Mothers to Birth Weight

Variable	Number	Mean Neonatal Birth Weight (gr)	SD	P Value
Standing or walking more than 4 hours per day	46 (24.9%)	2998.9	335.3	0.245
Standing or walking less than 4 hours per day	139 (75.1%)	3070.1	366.6	
Bending more than 1 hours per day	12 (6.5%)	3016.6	318.6	0.722
Bending less than 1 hours per day	173 (93.5%)	3054.9	362.6	

fect fetal growth and the timing of parturition). On the other hand, some characteristics or positions during work, such as long standing, may affect utero-placenta circulation, especially in the third trimester of a pregnancy, and may cause fatigue (1, 3, 26).

In conclusion, these finding suggest the need for caution during work scheduling during pregnancy, as well as careful prenatal visits to monitor growth of fetus and advise women with previous pregnancy complications (for example, at risk to preterm birth) - to minimize physical activity. Fatigue on work should be avoided and adequate periods of rest should be advice.

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Footnote

Conflict of Interest: None declared.

References

1. Bonzini M, Coggon D, Palmer KT. Risk of prematurity, low birthweight and pre-eclampsia in relation to working hours and physical activities: a systematic review. *Occup Environ Med.* 2007;**64**(4):228–43. doi: 10.1136/oem.2006.026872. [PubMed: 17095552].
2. Burdorf A, Brand T, Jaddoe VW, Hofman A, Mackenbach JP, Steegers EA. The effects of work-related maternal risk factors on time to pregnancy, preterm birth and birth weight: the Generation R Study. *Occup Environ Med.* 2011;**68**(3):197–204. doi: 10.1136/oem.2009.046516. [PubMed: 21172792].
3. Mahoney MM. Shift work, jet lag, and female reproduction. *Int J Endocrinol.* 2010;**2010**:813764. doi: 10.1155/2010/813764. [PubMed: 20224815].
4. Singhammer J, Mittelmark MB, Daltveit AK, Tell GS. The influence on birthweight of maternal living conditions a decade prior to giving birth. *Nor Epidemiol.* 2005;**15**(1):91–8. doi: 10.5324/nje.v15i1.231.
5. Palmer KT, Bonzini M, Bonde JPE. Pregnancy, occupational aspects of management, concise guidance. *Clin Med.* 2013;**13**(1):75–9. doi: 10.7861/clinmedicine.13-1-75.
6. Artal R, O'Toole M. Guidelines of the American College of Obstetricians and Gynecologists for exercise during pregnancy and the postpartum period. *Br J Sports Med.* 2003;**37**(1):6–12. [PubMed: 12547738].
7. The royal college of obstetricians and gynaecologists. . Royal College of obstetricians and Gynecologists exercise in pregnancy. London: RCOG; 2006.
8. Kliegman RM, Behrman RE, Jenson HB, Stanton BM. Nelson textbook of pediatrics. Philadelphia, Pennsylvania: Elsevier Health Sciences; 2011.
9. Deshpande Jayant DPD, Bengal VB, Pee Guusha D, Susan B, Deshpande Jayant D, Phalke DB, et al. Maternal risk factors for low birth weight neonates, A hospital based case control study in rural area of western maharashtra. *Natl J Community.* 2011;**2**(3):394–8.
10. Oths KS, Dunn LL, Palmer NS. A prospective study of psychosocial job strain and birth outcomes. *Epidemiology.* 2001;**12**(6):744–6. [PubMed: 11679805].
11. Bull FC, Maslin TS, Armstrong T. Global physical activity questionnaire (GPAQ): nine country reliability and validity study. *J Phys Act Health.* 2009;**6**(6):790–804. [PubMed: 20101923].
12. Cleland CL, Hunter RF, Kee F, Cupples ME, Sallis JF, Tully MA. Validity of the global physical activity questionnaire (GPAQ) in assessing levels and change in moderate-vigorous physical activity and sedentary behaviour. *BMC Public Health.* 2014;**14**:1255. doi: 10.1186/1471-2458-14-1255. [PubMed: 25492375].
13. Baghiani Moghaddam MSBAF, Asghari Jafarabadi M, Allahverdipour H, Dabagh Nikookheslat S, Safarpour SH. The Iranian version of international physical activity questionnaire, (IPAQ) in Iran, Content and construct validity, factor structure internal consistency and stability. *World Appl Sci J.* 2012;**18**(8):1073–80. doi: 10.5829/idosi.wasj.2012.18.08.754.
14. Makowiec-Dabrowska T, Hanke W, Sobala W, Radwan-Wlodarczyk Z, Koszada-Wlodarczyk W. [Risk of certain obstetric pathologies in women employed in working conditions non-complying with the current legal status on work load and working conditions appropriate for pregnant women]. *Med Pr.* 2003;**54**(5):415–25. [PubMed: 14978890].
15. Bonzini M, Palmer KT, Coggon D, Carugno M, Cromi A, Ferrario MM. Shift work and pregnancy outcomes, a systematic review with meta analysis of currently available epidemiological studies. *(BJOG), Int J Obstet Gynecol.* 2011;**118**(12):1429–37. doi: 10.1111/j.1471-0528.2011.03066.x. [PubMed: 21790955].
16. 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):685–90. doi: 10.1136/oem.2008.043935. [PubMed: 19770355].
17. Dwarkanath P, Muthayya S, Vaz M, Thomas T, Mhaskar A, Mhaskar R, et al. The relationship between maternal physical activity during pregnancy and birth weight. *Asia Pac J Clin Nutr.* 2007;**16**(4):704–10. [PubMed: 18042532].
18. Teitelman AM, Welch LS, Hellenbrand KG, Bracken MB. Effect of maternal work activity on preterm birth and low birth weight. *Am J Epidemiol.* 1990;**131**(1):104–13. [PubMed: 2293743].

19. Lin YC, Chen MH, Hsieh CJ, Chen PC. Effect of rotating shift work on childbearing and birth weight: a study of women working in a semi-conductor manufacturing factory. *World J Pediatr.* 2011;**7**(2):129–35. doi: 10.1007/s12519-011-0265-9. [PubMed: 21574029].
20. Aminian ORA, Sadeghian Haghighi K. Evaluation of the effect of shift work on birth weight and gestational age of new born in employed women. *Tadbir Kalaye Jam, (TKJ).* 2011;**2**(1):6.
21. Schlunssen V, Viskum S, Omland O, Bonde JP. [Does shift work cause spontaneous abortion, preterm birth or low birth weight?]. *Ugeskr Laeger.* 2007;**169**(10):893–900. [PubMed: 17359731].
22. Henriksen TB, Savitz DA, Hedegaard M, Secher NJ. Employment during pregnancy in relation to risk factors and pregnancy outcome. *Int J Obstet Gynecol.* 1994;**101**(10):858–65. doi: 10.1111/j.1471-0528.1994.tb13546.x.
23. Snijder CA, Brand T, Jaddoe V, Hofman A, Mackenbach JP, Steegers EA, et al. Physically demanding work, fetal growth and the risk of adverse birth outcomes. The Generation R Study. *Occup Environ Med.* 2012;**69**(8):543–50. doi: 10.1136/oemed-2011-100615. [PubMed: 22744766].
24. Eghbalian F. Low birth weight causes survey in neonates. *Iran J Pediatr.* 2007;**17**:27–33.
25. Goshtasebi AMF. Birth weight in Kohkilooye and boyer ahmad province Iran. *Tehran Univ Med J.* 2001;**59**(5).
26. Cunningham FGLK, Bloom SL, Hauth JC, Roves DJ, Spong CY. Williams obstetrics. 23 ed. New York: MC Graw Hill; 2010. pp. 205–6.