

Association of Maternal Working Condition with Low Birth Weight: The Social Determinants of Health Approach

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Abstract

Background: The socioeconomic conditions have made more job opportunities available to women. This has created interest to conduct studies on the effect of working lifestyle on pregnancy outcomes. **Aim:** This study was conducted with the aim to assess the relationship between mothers' working status as a social determinant and the incidence of low birth weight (LBW) of the newborn. **Subjects and Methods:** This case-control study was conducted on 500 women with normal weight infants (control group) and 250 women with LBW infants (case group) in selected hospitals in Tehran. Data were collected using a researcher-made questionnaire, designed to assess the effect of mothers' prenatal lifestyle, as a social determinant, on LBW of the newborn. A section of the questionnaire involved assessment of mother's working condition in terms of the work environment, activities, and job satisfaction. Data were analyzed using Chi-square and logistic regression tests. **Results:** LBW among employed mothers was 5 times more likely than unemployed ones (odds ratio = 5.35, $P < 0.001$). Unfavorable work conditions such as humid environment, contact with detergents, and being in one standing or sitting position for long hours were significantly associated with LBW ($P < 0.001$). **Conclusion:** The present study showed that unfavorable work conditions were associated with LBW; therefore, they need special attention.

Keywords: Low birth weight, Pregnancy, Socioeconomic factors, Working conditions

Introduction

With the social and economic changes in recent years, women's roles have also significantly changed and with a considerable increase in women's share of the job market, 42% of the working population is now women, making up a necessary factor in the national economy.^[1] As in most developing countries, along

with socioeconomic changes, women's willingness to work and job opportunities have increased in Iran.^[2]

Because of the nature of their gender, women are exposed to different physiological changes including menstruation,

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pregnancy, and child care that can influence their conditions and type of work.^[1] Moreover, more desire of women to work outside home usually means postponing marriage and pregnancy to later years, which eventually affects their personal and social health.^[3] Furthermore, work conditions such as stress, prolonged standing, and contact with chemicals could lead to adverse consequences such as spontaneous abortion, preterm birth, low birth weight (LBW), and neonatal abnormalities. There is also published evidence of adverse effects of occupational stress on fetal growth and development.^[4] The effect of working conditions on unfavorable pregnancy outcomes is a controversial issue. Working conditions are linked to personal health through psycho-social, behavioral, and psychological mechanisms. These risk factors can be classified into four main categories of physical, chemical, ergonomic, and psychosocial, for example, physical and chemical hazards, repetitive movements, hard and intense physical work, working shift, and lack of control [Figure 1].^[5] Therefore, biological, psycho-social, and social differences together with exposure to occupational risk factors create a particular gender pattern for occupational health problems.^[1]

Most studies aiming to assess the effects of working conditions on pregnancy outcome did not identify the same working conditions as a risk factor, nor did they consider the relationship between working conditions and adverse pregnancy outcomes such as LBW, while many studies have reported the effects of duration, working shift, and occupational stress on these outcomes.^[6-8] Pregnancy outcomes such as LBW and preterm delivery are extremely important and dangerous factors that affect neonatal mortality and morbidity.^[9] Birth weight is an important determinant of the newborn's survival, growth and development, and physical health. In terms of the public health, average birth weight in society indicates the quality of healthcare, availability of care, and nutrition to mothers, and it is a useful benchmark for monitoring the quality of prenatal care and intrauterine growth.^[10,11]

Infant birth size reflects two factors: Gestational age and fetal growth. Therefore, it should be considered with gestational

age; otherwise, larger size that occurs with aging could interfere with expression of growth and maturity of the fetus.^[12] According to the World Health Organization, LBW is defined as weight <2500 g. LBW neonates as compared to normal weight neonates are more likely to be exposed to such risks as cerebral palsy, mental retardation, neurological impairments, respiratory diseases, sudden death syndrome, and intensive care complications. In addition to psycho-physical problems, maintaining and treatment of these infants costs 6 times as much as other infants.^[13]

In recent years, despite advances in health, high prevalence of LBW still persists which reflects the need for attention to its influencing factors. The socioeconomic changes in the society and increased number of working women, and also, conflicting results of studies on the effect of occupation on adverse pregnancy outcomes, and lack of studies that would investigate this factor's relationship with pregnancy outcomes on the one hand, and priority of studying occupational accidents to identify causes mechanisms, and preventative interventions,^[9,14] encouraged the researchers to conduct a study in this area.

The present study is the results of part of a larger study titled "the relationship model of mother's prenatal lifestyle and low birth weight."

Subjects and Methods

This case-control study was conducted in Tehran in 2012. The data were collected through a researcher-made questionnaire, designed to measure lifestyle with the approach of social determinants of health.

The questionnaire contained 132 items in 10 sections: Three sections covered general characteristics, pregnancy history, and laboratory test results recorded in the file, and seven sections included physical activity, occupation, nutrition, stress control, self-care, social relationships, and inappropriate health behaviors.

Regarding the psychometrics of the questionnaire, face and content validities (qualitative and quantitative aspects), criterion validity,^[15] and construct validity (exploratory factor analysis) were used.

Cronbach's alpha coefficient of 0.709 also confirmed high internal consistency of occupation.^[16]

In this study, the results related to occupational lifestyle were presented with 18 items of 5-point Likert style including work environment, duty, working shift, job satisfaction, and employer's perceived empathy.

In this study, the city of Tehran was first divided into five geographical zones; North, South, East, West, and center.

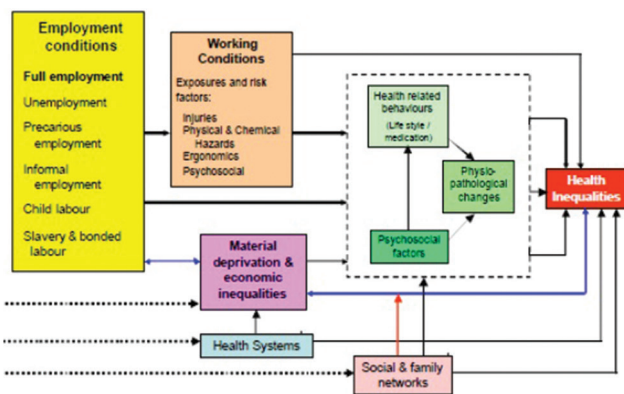


Figure 1: The conceptual framework of the relationship between working condition and health inequalities in 2007

Subsequently, from the hospitals that had a maternity ward in each zone, clusters that included one or two governmental or social security hospitals, were selected according to their delivery rates. Following a review of literature, the required sample size was determined by considering a 10% prevalence rate for LBW, and calculating research variables. The number of items in the measurement tool and key concepts was determined as 3–10 samples for each variable.^[17]

Accordingly, 250 infants with a weight of 2500 g or less were selected as the case group, and 500 infants weighing more than 2500 g were assigned to the control group. The inclusion criteria included:

Mothers

- Iranian women 15–45 years old, at a gestational age of 37–42 weeks based on the 1st day of their last menstruation period or sonography, who went to the selected hospitals for their delivery
- Lack of problems such as multiple pregnancy, cardiovascular diseases, diabetes, renal diseases, thyroid disorders, pulmonary diseases, autoimmune disorders, preeclampsia, placental abruption, premature rupture of membranes, hepatitis, AIDS, and other problems. Mothers who had not used any drugs that could affect the birth weight during pregnancy.

Infants

Infants weigh <4500 g, with no known medical problems such as congenital abnormalities and cardiac or pulmonary diseases.

After obtaining permission from university and hospital authorities, we presented the required information to the study population and invited them to participate. The questionnaire was then filled out by a team of trained people. First, the researcher selected mothers with inclusion criteria in the delivery room and monitored them until delivery. At the time of delivery, a researcher went to the delivery room, and immediately after delivery, if the infant had no medical problems, congenital disorders, cardiac-pulmonary diseases, etc., and the infant's weight was 2500 g or lower using the scale in the delivery room, it was placed in the case group. If it weighed between 2500 g and 4500 g, it was placed in the control group [Figure 2]. Measurement accuracy of all scales in the delivery rooms was determined by the researcher as follows: A standard weight (control weight of 100 g) was used to calibrate the scale after every 10 samples. Following transference of the mother to the postpartum care unit, women who were in a good condition and willing to participate in the study were asked to fill out a consent form.

Questions related to the patient's file including laboratory test results and ultrasound examinations were completed by the researcher using the mother's medical file. Another section that included demographic and lifestyle questions was filled out by interviewing the mother.

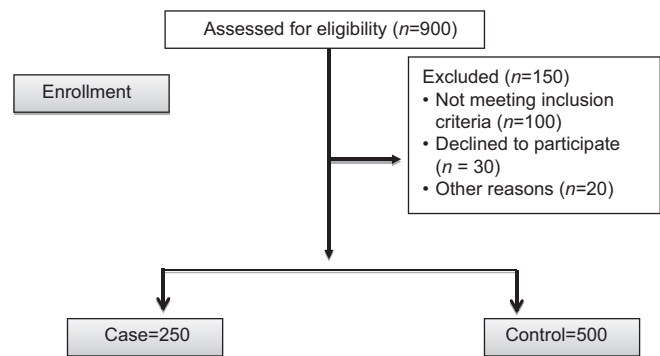


Figure 2: Consort flow diagram

In this section, information related to other factors affecting LBW such as socioeconomic conditions (family income per annum, education, occupation, household size, spouse's occupation), pregnancy parameters (age, number of pregnancies), and mother's health status (blood pressure, increased weight, body mass index [BMI]) were collected and used in the results of this study.

Ethical considerations

The study was conducted following permission obtained from the chancellors of the Tehran University of Medical Sciences, Shahid Beheshti University of Medical Sciences and the General Department of Social Security for their affiliated hospitals. Moreover, prior to the study, the pregnant women signed an informed consent form after they had been informed of the objectives of the study and were assured that their information would remain confidential that they could withdraw from the study at any time and that their privacy was respected.

The study was approved by the Welfare and Rehabilitation Sciences University and the Ethics Committee of the Research Center for the Social Determinants of Health.

Statistical analysis

The data were analyzed and interpreted in SPSS, Version 16 (Chicago, IL, USA) using *t*-test Chi-square, Fisher and logistics regression at confidence interval of 95% and $P < 0.5$.

Results

In this study, out of the participating 750 pregnant women (case and control), 12.1% (91/750) were employed, and the rest were a homemaker. There was no significant difference between the two groups in terms of mean age, mean BMI, pregnancy age, pregnancy intervals, and family income. However, mothers' mean increased weight during pregnancy showed a significant difference between the two groups ($P < 0.01$). In assessing education levels, chances of having LBW neonates in illiterate mothers were 3 times higher compared to educated mothers ($P = 0.03$, odds ratio [OR] = 3.27). Spouse's occupation and mother's employment were other variables associated with

LBW, and with an unemployed spouse, the chances of this outcome would be 4.5 times as much ($P < 0.001$, OR = 4.49). Mother's employment versus housekeeper also increased the chance of LBW by 5.4 times ($P < 0.001$, OR = 5.4). Table 1 presents personal social details of participants in the two groups separately.

In terms of the work environment and materials that mother had been in contact with, LBW had a significant relationship only with humidity and contact with cleaning materials ($P < 0.001$). However, other variables, such as noise, had insignificant relationships. Types of activity in prolonged standing and sitting ($P < 0.001$) and working shift ($P = 0.03$) were related to LBW. Furthermore, a significant relationship was found between mother's level of activity (in her own view) ($P = 0.023$), feeling tired ($P < 0.01$), work stress ($P < 0.01$), and job satisfaction ($P = 0.01$) and this outcomes [Table 2].

The results of the regression test for unfavorable working conditions revealed that chances of LBW were 5 times as much as that with favorable working conditions ($P < 0.01$, OR = 4.89). The best and worst scores for the questionnaire were 18 and 90, respectively, based on physical, ergonomic, mental conditions of work. Lack of spouse's help in house ($P = 0.04$, OR = 1.44)

Table 1: Comparing some personal social factors of research units in the two groups of normal weight and low weight infants 2012

Variables	Normal* mean (SD)	LBW mean (SD)	t-test
Age (years)	27.34 (5.2)	27.95 (5.3)	$P=0.13$
Weight before pregnancy (kg)	63.07 (11.65)	63.94 (11.47)	$P=0.33$
Weight gain (kg)	13.92 (5.29)	12.68 (5.06)	$P<0.01$
BMI (kg/m ²)	24.25 (4.14)	25.54 (4.08)	$P=0.35$
Hb	11.98 (1.1)	11.97 (1.9)	$P=0.94$
Hct	36.35 (3.6)	4.1 (36.98)	$P=0.22$
Interval of pregnancy (month)	5.47 (1.17)	1.39 (5.22)	$P=0.06$
Residential density per unit	26.9 (12.65)	28.03 (12.99)	$P=0.25$
	n (%)	n (%)	χ^2
Educational			
Illiterate	5 (1)	8 (3.2)	$P=0.03$
Literate	495 (99)	242 (5.8)	OR=3.273 CI=1.05-10.11
Husbands' job*			
Unemployed	12 (2.2)	23 (9.2)	$P<0.001$
Employed	488 (97.8)	227 (90.8)	OR=4.49 CI=2.15-9.37
Mothers job*			
Employed	29 (5.8)	62 (24.8)	$P<0.001$
Housekeeper	471 (94.2)	188 (75.2)	OR=5.35 CI=3.34-8.58

*Normal weight - infants weighing 2500 g and more, Low weight - infants weighing <2500 g, *Significant. OR: Odds ratio, CI: Confidence interval, SD: Standard deviation, BMI: Body mass index, Hb: Hemoglobin, Hct: Hematocrit, LBW: Low birth weight

Table 2: Frequency distribution of occupational status of participants in two groups of mothers with LBW and with normal birth weight neonates

Variables	Normal n (%)	LBW n (%)	Result
Moisture			
Always	1 (3.4)	6 (9.7)	$F=16.66$
Often	6 (20.7)	39 (62.9)	$P<0.001$
Sometimes	0 (0)	7 (11.3)	
Seldom	1 (4.3)	2 (3.2)	
Never	21 (72.4)	8 (12.9)	
Noise			
Always	5 (17.2)	2 (3.2)	$\chi^2=4.16$
Often	6 (20.7)	16 (25.8)	$P=0.13$
Sometimes	4 (13.8)	14 (22.6)	
Seldom	1 (3.4)	24 (38.7)	
Never	13 (44.8)	6 (9.7)	
Detergents			
Always	0 (0)	22 (35.5)	$F=26.77$
Often	8 (27.6)	20 (32.3)	$P<0.001$
Sometimes	0 (0)	11 (17.7)	
Seldom	1 (3.4)	0 (0)	
Never	20 (68.9)	9 (14.5)	
Standing			
Always	8 (27.6)	9 (14.5)	$F=21.27$
Often	5 (17.2)	32 (51.6)	$P<0.001$
Sometimes	3 (10.3)	15 (24.2)	
Seldom	12 (41.4)	4 (6.5)	
Never	1 (3.4)	2 (3.2)	
Sitting			
Always	10 (34.5)	4 (6.4)	$F=23.58$
Often	6 (20.7)	26 (41.9)	$P<0.001$
Sometimes	2 (6.9)	22 (35.5)	
Seldom	11 (37.9)	9 (14.5)	
Never	0 (0)	1 (1.6)	
Walking			
Always	8 (27.6)	2 (3.2)	$F=2.14$
Often	3 (10.3)	27 (43.5)	$P=0.35$
Sometimes	7 (24.1)	19 (30.6)	
Seldom	10 (34.5)	13 (21)	
Never	1 (3.4)	1 (1.6)	
What was your work shift?			
Long (a.m. to p.m.) (pm to night)	13 (46.4)	28 (45.9)	$F=12.67$ $P=0.03$
Night rotation	0 (0)	12 (19.7)	
Afternoon (pm)	2 (7.1)	4 (6.6)	
Morning	13 (46.4)	17 (27.9)	
Using leave in the last 3 months			
Always	19 (65.5)	32 (51.6)	$F=2.84$
Never	10 (34.5)	30 (48.4)	$P=0.21$
How tired were you after work?			
Always	12 (41.3)	31 (50)	$F=11.09$
Often	1 (3.4)	15 (24.2)	$P<0.01$
Sometimes	8 (27.6)	14 (22.6)	
Seldom	2 (6.9)	2 (3.2)	
Never	6 (20.7)	0 (0)	

Contd...

Table 2: Contd...

Variables	Normal n (%)	LBW n (%)	Result
Stress at workplace			
Always	2 (6.9)	18 (29)	$F=18.65$ $P<0.01$
Often	4 (13.8)	19 (30.6)	
Sometimes	7 (24.1)	20 (32.3)	
Seldom	2 (6.9)	2 (3.2)	
Never	14 (48.2)	3 (4.8)	
Satisfaction from the workplace			
Always	4 (13.8)	6 (9.7)	$F=23.8$ $P=0.01$
Sometimes	5 (17.2)	18 (29)	
Seldom	2 (6.9)	16 (25.8)	
Never	18 (62.1)	22 (35.5)	
Sympathy officials in the workplace			
Always	16 (55.1)	13 (21)	$F=15.01$ $P<0.01$
Often	4 (13.8)	33 (53.2)	
Sometimes	5 (17.2)	10 (16.1)	
Seldom	2 (6.9)	5 (8.1)	
Never	2 (6.9)	1 (1.6)	
Mothers activity (in her opinion)			
Sever	14 (48.3)	34 (54.8)	$F=16.8$ $P=0.02$
Moderate	11 (37.9)	28 (45.2)	
Low	4 (13.8)	0 (0)	
Very low	14 (48.3)	34 (54.8)	

LBW: Low birth weight, Normal: Normal birth weight

and living in a household with 4 or more people increased the chances of LBW ($P < 0.001$, OR = 1.78) [Table 3].

Discussion

The results of the study showed that occupational factors have an important role in the incidence of LBW. Working mothers are 5 times more likely to have LBW infants than a homemaker. Among factors, mothers are exposed to at work, humidity, contact with cleaning materials, prolonged standing or sitting; shift work and fatigue were related to LBW.

Based on epidemiological evidence, 5 most common occupational factors of standing and hard physical work, lifting objects, long working hours, and shift working have important roles in many pregnancy outcomes including preterm delivery, LBW, and as prenatal and infant mortality determinant,^[11] as well as in preventative factor, and adverse future complications such as growth retardation, neurological and congenital defects, hypertension, insulin-dependent diabetes, and heart diseases.^[18] Niedhammer *et al.* reported that working more than 40 h/week and shift working are associated with increased incidence of LBW, being small for gestational age, and preterm birth. They also found that occasional jobs are a preventative factor in premature births.^[9] Bonzini *et al.* also found that long working hours is associated with increased risk of preterm birth for mothers.^[18] Long working hours is also associated with a wide range of other complications such as job-related accidents and injuries, musculoskeletal disorders, fatigue, psycho-social disorders, and unhealthy behaviors.^[5]

Table 3: Relationship among LBW, occupation, and mothers' personal and social details, attending selected hospitals in Tehran, based on infant's weight (2012)

Variables	B	SE	Significant	Exp (B)	CI
Weight gain (kg)					
<5 kg	0.47	0.49	0.33	0.62	0.23-1.64
5-10 kg	0.25	0.20	0.21	0.77	0.51-1.15
11-16 kg	Reference (1)				
17-22 kg	0.36	0.24	0.13	1.43	2.29-0.89
>22 kg	0.21	0.39	0.59	0.81	0.37-1.76
BP (mmHg)					
Normal	Reference (1)				
≥ 14.9	0.94	0.23	$P<0.001$	2.56	0.24-0.61
Parity					
0	Reference (1)				
2-3	0.13	0.46	0.76	0.87	0.35-2.150
>4	0.49	0.36	0.16	0.61	0.30-1.23
Family size					
2	Reference (1)				
3	0.43	0.36	0.33	0.71	0.35-1.43
≥ 4	0.58	0.27	0.03	1.78	0.95-0.33
Educational					
Illiterate	Reference (1)				
Literate	0.56	0.66	0.39	0.56	0.15-2.10
Husbands' job					
Employed	Reference (1)				
Unemployed	0.83	0.45	0.06	0.43	0.17-1.05
Husband's support at home					
Yes	Reference (1)				
No	0.36	0.18	0.04	1.44	0.48-0.98
Working condition					
Housekeeper	0.41	0.49	0.40	0.66	0.25-1.73
Unfavorable	1.58	0.57	$P<0.01$	4.89	1.60-14.98
Favorable	Reference (1)				

LBW=1, Normal=0. LBW: Low birth weight, BP: Blood pressure, SE: Standard error, CI: Confidence interval

These consequences can be attributed to increased activity of sympathetic nervous system in muscles following activities such as long hours of standing, sitting, and working shifts; blood return to active muscles from visceral veins; increased sweating; reduced plasma volume and its consequent reduced blood flow to uterine; and placental vessels.^[7] Furthermore, there is evidence that hard work, through changes in women's diet, has a role in unfavorable pregnancy outcomes.^[19] Croteau *et al.* also found a relationship between shift working and being small for gestational age.^[20] However, Arafa *et al.* argued that there was no relationship between long working hours, fatigue, and shift working and adverse pregnancy outcomes.^[21] The reason for the difference in results can be due to the fact that in Arafa *et al.* study, women could not accurately measure durations of standing, sitting, or of any other work activity, and this could perhaps be the main reason for not finding a relationship between these factors. Another very important point is exposure of mothers to situations such as prolonged standing, sitting, and working shifts that increased fatigue in them. Other researchers also considered work-related problems

including disrupted sleep, waking rhythm during shift working, humidity, noise, cold, and exposure to chemicals as influential factors in increased fatigue. Fatigue is one of the top 10 health concerns for women.^[22] In the present study, work stress, lack of job satisfaction, and perceived understanding of officials for mothers' conditions were associated with LBW. Factors creating work stresses include poor working conditions, long hours, and poor relationship between colleagues and managers. People's responses and reactions to these stresses are usually manifested in sleep disorders, digestive system disorder, muscle cramp, shortness of breath, and job dissatisfaction. In addition, work stress can lead to hypertension.^[23,24] Work stress, especially in the second trimester of pregnancy is associated with increased level of corticotropin, which can affect LBW directly through passing the placenta or indirectly through maternal vascular function and reduction in uterine-placenta blood flow.^[25]

In the present study, mothers with unfavorable working conditions such as physical conditions (humidity), heavy activity, unsuitable psychological conditions (work stress and job dissatisfaction), and chances of having LBW infants were 5 times more compared to women with good working conditions. In other words, apart from mothers' are employed, unfavorable working conditions are also a very important factor in incidence of low weight. Hawamdeh *et al.* believe that material deprivations and economic inequities such as improper nutrition, poverty, living conditions, inadequate income due to bad working conditions, both through psycho-social factors and lifestyle-related behaviors, and physiopathological changes have important effects on the incidence of people's chronic diseases and mental health.^[5]

With regard to job and gender, World Health Organization reported women are engaged in hard physical work both at home and work, which leads to adverse pregnancy outcomes although not much information is available on women's working conditions in low-income countries.^[1]

Conclusion

The present study shows that unfavorable work conditions are associated with LBW; therefore, they need special attention.

Strength

A strength of the present study is that study groups matched for confounding factors such as pregnancy age and family income level.

Limitation

Participants in this study consisted of mothers that had attended selected hospitals. Thus, they may have only remembered information close to their delivery. Therefore, it is recommended that a prospective study be conducted in this area, so that different pregnancy months can be compared.

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Conflicts of interest

There are no conflicts of interest.

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