

Exposure to Second-hand Smoke During Pregnancy and Preterm Delivery

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ABSTRACT

Background: Prematurity is an issue related to increasing the neonatal morbidity and mortality and smoking pregnant women cause the risk of low birth weight and prematurity increase, compared to non-smoking ones.

Objectives: This study investigates second-hand smoke (SHS) exposure's effects over pregnant women on gestational age and birth weight.

Materials and Methods: In this descriptive-analytic study, 205 women referred to both public and private hospitals in the third trimester were questioned about second-hand smoke (SHS) exposure during pregnancy. In addition to birth weight and gestational age, other variables including mother's education and job and sex of the newborns were also assessed.

Results: Of all 205 women, 43 (20.97%) women exposed to SHS during pregnancy and 162 (79.02%) women did not. In SHS exposure group, 11 infant (25.6%) and in non-SHS exposure group, 17 infant (10.5%), were born prematurely (< 37 weeks) ($P = 0.01$). Also birth weight of newborn in non-SHS exposure group was 118 gram more than other group but the differences were not significant ($P = 0.09$).

Conclusions: Our findings showed that the secondhand smoke (SHS) exposure of pregnant women may be significantly associated with early preterm delivery.

Keywords: Smoke; Pregnancy; Preterm Delivery; low birth weight

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1. Background

There are many identifiable causes of preterm birth such as multi parity, placental dysfunction, bicornuate uterus, preeclampsia, low socioeconomic status, maternal under nutrition, anemia, inadequate prenatal care, obstetric complications, teenage pregnancies, short interval of pregnancy, maternal size and maternal smoking (1). Cigarette smoking often associated with intrauterine growth restriction (1). The risk of spontaneous abortion

for the heavy smoker is estimated to be as much as 1.7 times more than that of the non-smokers and the risk of congenital abnormality for babies born of smoking mothers is estimated to be as much as 2.3 times more than that of the nonsmokers (2). Heavy paternal smoking increases the risk of early pregnancy loss through maternal and/or paternal exposure (3). Mothers who smoke during pregnancy are highly likely to have a LBW infant, and LBW infants of smoking mothers weigh an average

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of 150 to 250 g less than nonsmoking mothers' infants (4). It is shown that children of nonsmoking mothers generally perform better than the two smoking groups with regard to speech and language skills, intelligence, visual / spatial abilities and rating of mother's behavior tests. Moreover, the performance of passive smokers' children, in most areas, found to be between the active smoking and nonsmoking groups (5). Studies showed the neurotoxic effects of prenatal tobacco exposure on newborn neurobehavioral (6). Second-hand smoke (SHS) exposure is the main cause of premature death and disease among women and children (7). In fact, SHS is exhaled smoke, the smoke from burning tobacco, filter or mouthpiece end of a cigarette, pipe or cigar (8). It also includes smoke fills restaurants, offices or other enclosed spaces when people burn tobacco products such as cigarettes and water pipes. There is no safe level of SHS exposure (9). Tobacco smoke contains many poisons, including nicotine (a pesticide), carbon monoxide, ammonia, formaldehyde, hydrogen cyanide, nitrogen oxides, phenol, sulfur dioxide, and others (8). More than 126 million nonsmokers are exposed to SHS in the United States, and home smoking comprises the most common site of SHS exposure (6, 8, 10). In the US, the proportion of women who reported smoking during pregnancy has decreased by 50% over the past 15 years (from 20% in 1989 to 10% in 2004); however, with regard to social undesirability of smoking during pregnancy, many experts question the accuracy of self-reported tobacco use in this regard (11). One of the significant consequences of prenatal tobacco exposure is sensitization of the fetal brain against nicotine, which results in increasing likelihood of addiction when the brain is exposed to nicotine at a later age (12). Population-based human studies have demonstrated the relationship between prenatal tobacco exposure and early tobacco experimentation and increasing likelihood of tobacco use in adolescents as well. (13). The toxins in SHS directly cause harmful effects on the fetus (14-17). Nicotine is known to be vasoactive and is thought to reduce

fetal circulation via the placenta (18-23). Cotinine, a major metabolite of nicotine, has been measured in follicular fluid and amniotic fluid. Carbon monoxide is known to deplete fetal oxygen supplies (24-27). Second-hand smoke exposure causes 600000 premature deaths per year (9).

2. Objectives

The goal of our study is to examine the association of pregnant women and secondhand smoke exposure (or passive smoking), during the first and second trimester of pregnancy, with birth weight and gestational age.

3. Materials and Methods

In this descriptive-analytic study, 205 women between 16 and 40 old years were questioned about secondhand smoke (SHS) exposure during their pregnancy. Pregnant women, referred to Sadoghi (public) and Mojibian (Private) hospitals in the third trimester from January till July, 2009 participated in the study. Non-random simple method was used as sampling procedure. Based on statistical calculations ($\alpha = 0.05$), sample size consisted of 205 people.

As recorded in the neonate's medical records, Low birth weight-less than 2,500 g at birth- was defined as a neonate and live born infants, delivered before 37 weeks from the 1st day of the last menstrual period (LMP), were termed premature. In addition to birth weight and gestational age assessment, other variables including mother's education, mother's job and sex of newborn were also evaluated. After data collection, through SPSS 16 software and using independent *t*-test, Man-Whitney and Chi-square test data analysis have shown the significant level of $P < 0.05$ in the present study.

4. Results

The mean age of women was 25.93 years (SD = 5.14 y/o); 86.9% of them reported having a high school degree and below and 13.1% possessing a bachelor degree.

Table 1. Demographic Characteristics of Pregnant Women and Their Newborn

	Number (%)
Sex of newborn	
Boy	98 (47.8)
Girl	107 (51.9)
Mother's education	
High school degree and below	179 (86.9)
Bachelor degree	27 (13.1)
Mother's Job	
House wife	193 (93.7)
Worker	13 (6.3)

Also 13 women (6.3%) were workers and others were house wives (Table 1). The mean birth weight of the neonates was 3132 g (SD = \pm 404 g). Furthermore, 47.8% of the participants had baby boys (n = 98); 32.8% had vaginal deliveries (n = 67); 67.2% had caesarean sections (n = 137); and 6.4% had LBW neonates (n = 13). In pregnant women with and without SHS exposure, 21 (48.8%) and 77 (47.5%) of offspring were male respectively (P = 0.879). 43 women

were SHS exposure during pregnancy and 162 were not. In SHS exposure group, 11 infants (25.6%) and in non-SHS exposure group, 17 (10.5%) infants were born prematurely (< 37 weeks) (P = 0.01). Mean Birth weight in the infants of mothers who had SHS exposure were 3038 ± 491 g and in non-SHS exposure were $(3156 \pm 375$ g, P value = 0.09) (Table 2).

Table 2. Gestational Age Distribution in Pregnant Women With and Without SHS Exposure

Gestational age	SHS Exposure		Total
	Yes. Count (%)	No. Count (%)	
under 38	11 (25.6)	17 (10.5)	28 (13.7)
38-40	32 (74.4)	143 (88.3)	175 (85.4)
Upper 40	0 (0)	2 (1.2)	2 (1)
Total	43 (100)	162 (100)	205 (100)

5. Discussion

The results of our study showed an adverse effect of SHS exposure on gestational age and birth weight at the time of delivery. This is consistent with the results of previous studies, in which the researchers found that maternal exposure to SHS was associated with prematurity and low birth weight (21, 24, 28-32). In Iran, 27.3% of men and 3.4% of women smoke cigarette. 29.3% of Iranian pregnant women are SHS exposure and 0.7% smoke cigarette, which is statistically less than US pregnant women (10%) (33). Although results of many studies significant relationship between smoking during pregnancy with pre-term delivery and low birth weight but results about SHS exposure is controversial (28, 34, 35).

5.1. Birth weight

In our study the mean birth weight of newborn in non-SHS exposure group was 118 g more than SHS exposure group (P = 0.09). This finding is similar to some studies which found that maternal exposure to SHS was not associated with low birth weight (19, 36, 37). However, there are various findings with regard to SHS exposure and mean birth weight, some studies reported significant decrements in birth weight (9, 38, 39). Leonardi et al. reviewed 58 studies and concluded that environmental tobacco smoke (ETS) exposure was associated with a 33 to 40 g reduction in mean birth weight (29). Hanke et al. found statistically significant negative relationship between the fetal bi-parietal diameter (BPD) and serum cotinine concentration. They found that serum cotinine levels at 20-24 weeks of gestation were inversely associated with infant birth weight. With regard to serum cotinine levels below 10 ng/mL, a borderline association (P = 0.09), with infant birth weight was found (33). Also Rebagliato et al.

showed that the mean birth weight of infants of women with cotinine levels > 1.7 ng/mL was 87.3 g less than that of infants of women with cotinine levels in the range 0.0-0.5 ng/mL (P = 0.048) (31). Shekibzadeh showed no significant correlation between pregnancy SHS exposure and head circumference and length of newborn; however birth weight was significantly lower in SHS exposure group (38).

5.2. Prematurity and Small for gestational age

As shown in Table 2 in our study, prematurity was significantly higher in SHS exposure group. Other studies of ETS exposure and Prematurity or small for gestational age have found varying results, from no effect to significant negative association. Results of many studies showed that ETS exposure during pregnancy is associated with an increased risk of term SGA (Small for Gestational Age) and prematurity (34, 36, 40-42). However; the results of a few studies showed that ETS exposure during pregnancy is not associated with an increased risk of term SGA (29, 43, 44). This is due to difficulties in precisely assessing exposure or different methodology in these studies. Dejin-Karlsson et al. showed that women exposed to passive smoking at home or in the workplace face the risk of delivering a small-for-gestational-age infant in significantly compared to non-exposure women. Also they concluded that passive smoking was not significantly related to low birth weight (< 2500 g) or preterm delivery (< 37 gestational weeks) (45). Readers should consider several limitations of our study when interpreting the results. First, we did not measure the exposure rate, patterns of exposure (husband smoking or smoking by other members of family). Second, we also did not determine whether the environment of tobacco smoke exposure change during pregnancy. Third, we did not measure a biomarker of to-

bacco smoke exposure.

Although we didn't study SHS exposure rate, there are sufficient evidences from many studies in this regard. There is a significant negative association with exposure rate and gestational age and birth weight (24, 29, 32, 34, 42). We found only one study that showed no significant association between increasing daily exposure to ETS and reducing the birth weight (46). In our study, all exposure to ETS measured only at home and even some studies showed no difference between indoor and outdoor ETS exposure effects on SGA and/or birth Weight (32, 47). Although, Fortier showed that single passive exposure to tobacco smoke at home was not related to SGA. However, small increments in risks were observed in only passive smoking women at work, and the risks increased consistently with weekly duration, number of weeks, and intensity of exposure (48). Our findings showed that the SHS exposure of pregnant women is significantly associated with preterm delivery. Fortunately there are many antismoking rules imposed over public places, offices, and mosques in Iran. Moreover, there are confining laws prohibiting cigarette ads in newspapers and media and people usually protest indoor smokers. In our province all health houses and centers are completely developed. So we suggest using this system for prenatal screening of pregnant SHS exposure.

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Author's Contribution

All of the authors contributed in this manuscript.

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References

- Kliegman R. Nelson textbook of pediatrics. Philadelphia: Saunders Elsevier; 2007.
- U.S. Department of Health and Human Services. *The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General*. Atlanta (GA): 2006.
- Ahluwalia IB, Grummer-Strawn L, Scanlon KS. Exposure to environmental tobacco smoke and birth outcome: increased effects on pregnant women aged 30 years or older. *Am J Epidemiol*. 1997;**146**(1):42-7.
- Roquer JM, Figueras J, Botet F, Jimenez R. Influence on fetal growth of exposure to tobacco smoke during pregnancy. *Acta Paediatr*. 1995;**84**(2):118-21.
- Salihu HM, Aliyu MH, Pierre-Louis BJ, Alexander GR. Levels of excess infant deaths attributable to maternal smoking during pregnancy in the United States. *Matern Child Health J*. 2003;**7**(4):219-27.
- Andres RL, Day MC. Perinatal complications associated with maternal tobacco use. *Semin Neonatol*. 2000;**5**(3):231-41.
- Best D. From the American Academy of Pediatrics: Technical report--Secondhand and prenatal tobacco smoke exposure. *Pediatrics*. 2009;**124**(5):e1017-44.
- Van Rooij IA, Groenen PM, Van Drongelen M, Te Morsche RH, Peters WH, Steegers-Theunissen RP. Orofacial clefts and spina bifida: N-acetyltransferase phenotype, maternal smoking, and medication use. *Teratology*. 2002;**66**(5):260-6.
- Wyszynski DF, Duffy DL, Beaty TH. Maternal cigarette smoking and oral clefts: a meta-analysis. *Cleft Palate Craniofac J*. 1997;**34**(3):206-10.
- Himmelberger DU, Brown BW, Jr, cohen EN. Cigarette smoking during pregnancy and the occurrence of spontaneous abortion and congenital abnormality. *Am J Epidemiol*. 1978;**108**(6):470-9.
- Law KL, Stroud LR, LaGasse LL, Niaura R, Liu J, Lester BM. Smoking during pregnancy and newborn neurobehavior. *Pediatrics*. 2003;**111**(6 Pt 1):1318-23.
- Makin J, Fried PA, Watkinson B. A comparison of active and passive smoking during pregnancy: long-term effects. *Neurotoxicol Teratol*. 1991;**13**(1):5-12.
- Hakim RB, Tielsch JM. Maternal cigarette smoking during pregnancy: A risk factor for childhood strabismus. *Arch Ophthalmol*. 1992;**110**(10):1459-62.
- Venners SA, Wang X, Chen C, Wang L, Chen D, Guang W, et al. Paternal smoking and pregnancy loss: a prospective study using a biomarker of pregnancy. *Am J Epidemiol*. 2004;**159**(10):993-1001.
- Fantuzzi G, Aggazzotti G, Righi E, Facchinetti F, Bertucci E, Kanitz S, et al. Preterm delivery and exposure to active and passive smoking during pregnancy: a case-control study from Italy. *Paediatr Perinat Epidemiol*. 2007;**21**(3):194-200.
- Windham GC, Hopkins B, Fenster L, Swan SH. Prenatal active or passive tobacco smoke exposure and the risk of preterm delivery or low birth weight. *Epidemiology*. 2000;**11**(4):427-33.
- Aagaard-Tillery KM, Porter TF, Lane RH, Varner MW, Lacoursiere DY. In utero tobacco exposure is associated with modified effects of maternal factors on fetal growth. *Am J Obstet Gynecol*. 2008;**198**(1):66 e1-6.
- Spinillo A, Capuzzo E, Nicola SE, Colonna L, Egbe TO, Zara C. Factors potentiating the smoking-related risk of fetal growth retardation. *Br J Obstet Gynaecol*. 1994;**101**(11):954-8.
- Steyn K, De Wet T, Saloojee Y, Nel H, Yach D. The influence of maternal cigarette smoking, snuff use and passive smoking on pregnancy outcomes: the Birth To Ten Study. *Paediatr Perinat Epidemiol*. 2006;**20**(2):90-9.
- Leonardi-Bee J, Smyth A, Britton J, Coleman T. Environmental tobacco smoke and fetal health: systematic review and meta-analysis. *Arch Dis Child Fetal Neonatal Ed*. 2008;**93**(5):F351-61.
- Chen LH, Petitti DB. Case-control study of passive smoking and the risk of small-for-gestational-age at term. *Am J Epidemiol*. 1995;**142**(2):158-165.
- Fortier I, Marcoux S, Brisson J. Passive smoking during pregnancy and the risk of delivering a small-for-gestational-age infant. *Am J Epidemiol*. 1994;**139**(3):294-301.
- Pogodina C, Brunner Huber LR, Racine EF, Platonova E. Smoke-free homes for smoke-free babies: the role of residential environmental tobacco smoke on low birth weight. *J Community Health*. 2009;**34**(5):376-82.
- Centers for Disease Control and Prevention. Smoking during pregnancy--United States, 1990-2002. *MMWR Morb Mortal Wkly Rep*. 2004;**53**(39):911-5.
- Goel P, Radotra A, Singh I, Aggarwal A, Dua D. Effects of passive smoking on outcome in pregnancy. *J Postgrad Med*. 2004;**50**(1):12-6.
- Blake SM, Murray KD, El-Khorazaty MN, Gantz MG, Kiely M, Best D, et al. Environmental tobacco smoke avoidance among pregnant African-American nonsmokers. *American journal of preventive medicine*. 2009;**36**(3):225.
- Dejmek J, Solansk y I, Podrazilova K, Sram RJ. The exposure of

- nonsmoking and smoking mothers to environmental tobacco smoke during different gestational phases and fetal growth. *Environ Health Perspect.* 2002;**110**(6):601-6.
28. Haug K, Irgens LM, Skjaeravn R, Markestad T, Baste V, Schreuder P. Maternal smoking and birthweight: effect modification of period, maternal age and paternal smoking. *Acta Obstet Gynecol Scand.* 2000;**79**(6):485-9.
 29. Hegaard HK, Kjaergaard H, Moller LF, Wachmann H, Ottesen B. The effect of environmental tobacco smoke during pregnancy on birth weight. *Acta Obstet Gynecol Scand.* 2006;**85**(6):675-81.
 30. Hong R, Betancourt JA, Ruiz-Beltran M. Passive smoking as a risk factor of anemia in young children aged 0-35 months in Jordan. *BMC Pediatr.* 2007;**7**:16.
 31. Hrubá D, Kachlik P. Influence of maternal active and passive smoking during pregnancy on birthweight in newborns. *Cent Europ J Public health.* 2000;**8**(4):249.
 32. Jordanov JS. Cotinine concentrations in amniotic fluid and urine of smoking, passive smoking and non-smoking pregnant women at term and in the urine of their neonates on 1st day of life. *Eur J Pediatr.* 1990;**149**(10):734-7.
 33. Andersson R, Bergstrom S. Maternal nutrition and socio-economic status as determinants of birthweight in chronically malnourished African women. *Trop Med Int Health.* 1997;**2**(11):1080-7.
 34. Werler MM. Teratogen update: smoking and reproductive outcomes. *Teratology.* 1997;**55**(6):382-8.
 35. Leonardi-Bee J, Smyth A, Britton J, Coleman T. Environmental tobacco smoke and fetal health: systematic review and meta-analysis. *Arch Dis Child Fetal Neonatal Ed.* 2008;**93**(5):F351-F361.
 36. Dejin-Karlsson E, Hanson BS, Ostergren PO, Sjoberg NO, Marsal K. Does passive smoking in early pregnancy increase the risk of small-for-gestational-age infants? *Am J Public Health.* 1998;**88**(10):1523-7.
 37. Negahban T, Rezaieaan M, Jaber AA, Asmy Z, Zarei T. Inhalation of environmental tobacco smoke during pregnancy and birth outcomes of pregnant women referred to Niknafs hospital in 2009. *Rafsanjan University of Medical Sciences.* 2011;**4**(37).
 38. Rebagliato M, Florey CV, Bolumar F. Exposure to environmental tobacco smoke in nonsmoking pregnant women in relation to birth weight. *Am J Epidemiol.* 1995;**142**(5):531-537.
 39. Abu-Baker NN, Haddad L, Savage C. The influence of secondhand smoke exposure on birth outcomes in Jordan. *Int J Environ Res Public Health.* 2010;**7**(2):616-34.
 40. Lieberman E, Gremy I, Lang JM, Cohen AP. Low birthweight at term and the timing of fetal exposure to maternal smoking. *Am J Public Health.* 1994;**84**(7):1127-31.
 41. Chan A, Keane RJ, Robinson JS. The contribution of maternal smoking to preterm birth, small for gestational age and low birthweight among Aboriginal and non-Aboriginal births in South Australia. *Med J Aust.* 2001;**174**(8):389-93.
 42. Blake SM, Murray KD, El-Khorazaty MN, Gantz MG, Kiely M, Best D, et al. Environmental tobacco smoke avoidance among pregnant African-American nonsmokers. *Am J Prev Med.* 2009;**36**(3):225-34.
 43. Han JX, Gan DK, Zhai GR, Shi Y. [Case-control study on effect of passive smoking during different pregnancy term on small-for-gestational-age infants at term]. *Wei Sheng Yan Jiu.* 2006;**35**(6):788-90.
 44. WHO. Tobacco 2010; Available from: (<http://www.who.int/media-centre/factsheets/fs339/en/index.html>).
 45. Negahban T, Rezaieaan M, Jaber AA, Asmy Z, Zarei T. Inhalation of environmental tobacco smoke during pregnancy and birth outcomes of pregnant women referred to Niknafs hospital in 2009. *J RUMS.* 2011;**4**(37).
 46. Hanke W, Sobala W, Kalinka J. Environmental tobacco smoke exposure among pregnant women: impact on fetal biometry at 20-24 weeks of gestation and newborn child's birth weight. *Int Arch Occup Environ Health.* 2004;**77**(1):47-52.
 47. Tavafian SS, Zadeh FR, Tehran I. Cigarette smoking, illicit medicine, substance and alcohol abuse among pregnant women: a cross sectional study from Iran. *Int J Fertil Steril.* 2008;**2**(1):35-38.
 48. Delaram M, Sereshti M. Correlation between passive smoker mothers and birth weight of infants. *J Qazvin Univ Med Sci.* 2006;**10**(1):67-71.