

# Impact of Second Hand Smoke Exposure on Birth Weight: A Pilot Cohort Study

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## ABSTRACT

**Objective:** to examine the associations of passive smoking during 3<sup>rd</sup> trimester of pregnancy and birth outcomes.

**Design:** prospective (cohort) study. **Setting:** this study was conducted at Ain Shams University maternity hospital between period June 2015 and May 2016.

**Study subjects:** A total of 200 women during their 3<sup>rd</sup> trimester of pregnancy were included in the study with verbal consent from each woman

**Measures:** through written (self-administered questionnaire) and exhaled carbon monoxide (CO) test

**Results:** Current SHS was significantly associated with lower gestational age at delivery, lower birth weight, lower 1-min Apgar score and higher rates of SGA neonates.

**Conclusion:** the current study showed a significant association between SHS in pregnant women and increased rates of preterm delivery, low birth weight and SGA neonates.

**Key words:** second hand smoke exposure, pregnant women in 3<sup>rd</sup> trimester of pregnancy, birth outcomes.

## INTRODUCTION

Cigarette smoking during pregnancy is one of the important modifiable causes of poor pregnancy outcomes in high income countries<sup>1</sup>. Although the prevalence of cigarette smoking is routinely monitored in high income countries, a paucity of data exists in middle and low-income countries<sup>2</sup>.

A recent report of middle and low income countries shows that a population -based prevalence of tobacco use was approximately 2.6% in middle and low income countries .In Egypt which was surveyed in 2005, the rates were 0.4% for cigarette smoking, 0.1% for smokeless tobacco, and 0.4% for any form of tobacco. Data was obtained from demographic and Health surveys, which are routinely, conducted in middle and low income countries<sup>3</sup>.

Second-hand tobacco smoke (SHS) is referred to as “environmental” tobacco smoke (ETS)<sup>4</sup>, (SHS) consists of exhaled smoke as well as side-stream smoke that is released from the burning cigarette between inhalations and it has a very similar composition<sup>5</sup>.

## AIM OF WORK

The aim of the current study was to assess the prevalence of SHS among pregnant Egyptian women, to evaluate the demographic data of these women, and to assess the

association between second hand smoke exposure and adverse perinatal outcomes.

## SUBJECTS AND METHODS

### *Study subjects*

The study was carried out at Ain Shams University maternity hospital. Study participants were recruited during their antenatal care visits at obstetric clinics during their 3<sup>rd</sup> trimester of pregnancy. After obtaining the hospitals' permission for data collection, we asked pregnant women who visited the prenatal care clinic whether they would participate in this study and those who voluntarily agreed to do were enrolled. They were reassured that their smoking status is confidential, no personal identifiers were disclosed and all the data was gathered only for research purposes and not for public use. A total of two hundred women were enrolled in this prospective cohort study

## METHODS

Assessment of exposure to passive smoking is achieved through written (self-administered questionnaire). At the time of enrollment, a questionnaire was administered to the participant and they were followed up till delivery and we obtained the birth outcomes through chart review. The questionnaire captured the sociodemographic characteristics: age, marital status, education, employment, attitude toward smoking during pregnancy,

smoking history, smoking frequency (before and during pregnancy), exposure to passive smoking, avoidance behaviors toward smoking and quitting because of current pregnancy, ever received advice to quit because of pregnancy from any person, type of tobacco products used during pregnancy, and current smoking status.

**Breathe carbon monoxid**

A carbon monoxide (CO) test is an immediate and non-invasive biochemical method for helping to assess whether or not someone smokes. However, it is unclear as to what constitutes the best cut-off point for determining smoking status. Some suggest a CO level as low as 3 parts per million (ppm), others use a cut-off point of 6–10 ppm. It is important to note that CO quickly disappears from expired breath (the level can fall by 50% in less than 4 hours). The test itself is performed using the Micro Smokerlyzer (Bedfont Instruments; Kent, UK), an inexpensive, portable CO monitor that has previously been shown to be effective.

To standardize the breath being analyzed by the Smokerlyzer, the subjects were asked to exhale completely, inhale fully, and then hold their breath for 15 seconds. If the subjects were unable to hold their breath for 15 seconds, they were asked to hold it for as long as possible

and the length of time was recorded. Following the breath hold, the subjects were asked to exhale slowly into the Smokerlyzer and were encouraged to exhale fully in order to sample the alveolar air. This test can also show whether you're inhaling harmful amounts of secondhand smoke.

If you see the results of the CO test, the reading is measured in CO PPM, which means the number of CO molecules in one million parts of air. Women with a CO test reading of 3ppm or higher may be referred to stop smoking services.

The study was approved by the Ethics Board of Ain Shams University.

**Statistical analysis**

IBM SPSS statistics (V. 24.0, IBM Corp., USA, 2016) was used for data analysis. Data were expressed as Mean ± SD for quantitative parametric measures in addition to both number and percentage for categorized data.

**RESULTS**

A total of 200 pregnant women in their 3<sup>rd</sup> trimester were included in the study.

Table 1 and figures 1-4 show the demographic characteristics of included women.

**Table (1): Demographic Characteristics of Included Women**

<b>Age (years)</b>	16 – 37
<b>Range</b>	27.07 ± 4.66
<b>Mean ± SD</b>	
<b>Residence</b>	
<b>Urban</b>	76 (38%)
<b>Suburban</b>	36 (18%)
<b>Rural</b>	88 (44%)
<b>Education</b>	
<b>Did not go to school</b>	15 (7.5%)
<b>≤ 6 years (Elementary)</b>	29 (14.5%)
<b>7-9 years (Preparatory)</b>	52 (26%)
<b>10-12 years (Secondary)</b>	44 (22%)
<b>13-17 years (University)</b>	60 (30%)
<b>Employment</b>	
<b>Employed</b>	43 (21.5%)
<b>Unemployed</b>	146 (73%)
<b>Denied Response</b>	11 (5.5%)

SD standard deviation

Data presented as range, mean ± SD; or number (percentage)

Table 2 and figures 5-6 show the exhaled CO monitoring readings in included women.

**Table (2): SHS Characteristics in Included Women**

<b>Husband Smoking</b>	<b>Yes</b> <b>Indoors smoking</b> <b>No Indoors Smoking</b> <b>No</b> <b>Don't have a spouse</b>	135 (67.5%) 120 (60%) 15 (7.5%) 61 (30.5%) 4 (2%)
<b>Type of Smoking</b>	<b>Cigarette</b> <b>Shisha</b>	119/135 (88.1%) 16/135 (11.9%)
<b>Current SHS [within the past 30 days]</b>	<b>Yes</b> <b>No</b> <b>Don't know/not sure</b>	114 (57%) 53 (26.5%) 33 (16.5%)
<b>Frequency of Indoors Exposure to SHS</b>	<b>Always</b> <b>Frequently</b> <b>Sometimes</b> <b>Rarely/Never</b>	3 (1.5%) 43 (21.5%) 87 (43.5%) 67 (33.5%)
<b>Average hours in a day of SHS anywhere</b>	<b>Range</b> <b>Median (IQR)</b>	0 – 7 3 (0 – 4)
<b>Average days in a week of SHS anywhere</b>	<b>Range</b> <b>Median (IQR)</b>	0 – 7 6 (0 – 7)
<b>Average hours in a day of Indoors SHS</b>	<b>Range</b> <b>Median (IQR)</b>	0 – 7 1 (0 – 2)

SHS second-hand smoking

IQR interquartile range

Data presented as number (percentage); or range, median (IQR)

**Table (3): Social Acceptance of Smoking in Women**

	<b>Very much Disagree</b>	<b>Disagree</b>	<b>Neither Agree or Disagree</b>	<b>Agree</b>	<b>Very Much Agree</b>
<b>Social Acceptance of Women to Smoke Cigarettes</b>	118 (59%)	17 (8.5%)	4 (2%)	6 (3%)	55 (27.5%)
<b>Social Acceptance of Women to Smoke Shisha</b>	120 (60%)	14 (7%)	3 (1.5%)	45 (22.5%)	18 (9%)
<b>Social Acceptance of Women to Smoke E-Cigarettes</b>	47 (23.5%)	35 (17.5%)	39 (19.5%)	62 (31%)	17 (8.5%)

Data presented as number (percentage)

**Table (4): How Smoking is Harmful to Pregnant Women and Her Baby**

	<b>Very much Disagree</b>	<b>Disagree</b>	<b>Neither Agree or Disagree</b>	<b>Agree</b>	<b>Very Much Agree</b>
<b>Tobacco use by pregnant woman is harmful to her or her unborn baby's health</b>	4 (2%)	6 (3%)	6 (3%)	78 (39%)	100 (50%)
<b>Tobacco exposure by pregnant woman is harmful to her or her unborn baby's health</b>	2 (1%)	17 (8.5%)	45 (22.5%)	105 (52.5%)	31 (15.5%)
<b>Tobacco exposure is harmful to newborn's health</b>	3 (1.5%)	4 (2%)	6 (3%)	73 (36.5%)	114 (57%)

Data presented as number (percentage)

**Table (5):** Association between Current SHS and Neonatal Outcomes in Included Women

	<b>Current SHS</b>	<b>Not Current SHS</b>	<b>MD/OR (95% CI)</b>	<b>P</b>
<b>Gestational age (weeks)</b>	37.7 ± 1.3	38.7 ± 1.4	1.1 (0.6 to 1.5)	<0.001*
<b>Birth weight (g)</b>	2692.98 ± 355.9	3194.3 ± 474.9	501.4 (370.9 to 631.8)	<0.001*
<b>1-min Apgar score</b>	6 (6 – 7)	7 (6 – 8)	---	0.006**
<b>5-min Apgar score</b>	8 (7 – 9)	8 (8 – 9)	---	0.562
<b>Congenital malformations</b>	5/85 (5.9%)	0 (0%)	NE	0.999
<b>SGA Neonates</b>	26/77 (33.8%)	0 (0%)	NE	0.029***
<b>SB</b>	3/72 (4.2%)	0 (0%)	NE	0.999

SD standard deviation

IQR interquartile range

SB still birth

Data presented as mean ± SD; median (IQR); or number/available total (percentage)

\* Analysis using independent student's t-test

\*\* Analysis using Mann-Whitney's U-test

\*\*\* Analysis using continuity-corrected chi-squared test

MD (95% CI) mean difference and its 95% confidence interval

OR (95% CI) odds ratio and its 95% confidence interval

NE not estimable due to nullity of one or both groups

**Table (6):** Association between Current SHS and Maternal Obstetric Complications in Included Women

	<b>Current SHS</b>	<b>Not Current SHS</b>	<b>OR (95% CI)</b>	<b>P*</b>
<b>Pre-eclampsia</b>	0 (0%)	0 (0%)	NE	NE
<b>Preterm Labor</b>	19/68 (27.9%)	1/9 (11.1%)	3.1 (0.4 to 26.5)	0.498
<b>PROM</b>	51/75 (68%)	7/13 (53.8%)	1.8 (0.6 to 6.01)	0.498
<b>Placental Abruptio</b>	2/62 (3.2%)	0 (0%)	NE	0.999
<b>Drug or Alcohol Use</b>	4/61 (6.6%)	0 (0%)	NE	0.999
<b>Maternal Mortality</b>	2/62 (3.2%)	0 (0%)	NE	0.999

PROM prelabor rupture of the membranes

Data presented as number/available total (percentage)

\* Analysis using continuity-corrected chi-squared test

OR (95% CI) odds ratio and its 95% confidence interval

NE not estimable due to nullity in one or both groups

There were significant positive correlations between exhaled CO monitoring reading and the durations of SHS.

**Table (7):** Association between Exhaled CO Monitoring Reading and Duration of SHS

		<b>Exhaled CO Monitoring Reading</b>
<b>Average hours in a day of SHS anywhere</b>	$r_s$ $P$	0.605 <0.001
<b>Average days in a week of SHS anywhere</b>	$r_s$ $P$	0.573 <0.001
<b>Average hours in a day of Indoors SHS</b>	$r_s$ $P$	0.748 <0.001

There was a significant negative correlation between exhaled CO monitoring reading and each of gestational age at delivery, birth weight and 1-min Apgar score. The association between exhaled CO monitoring reading and 5-min Apgar score was not significant.

**Table (8):** Association between Exhaled CO Monitoring Reading and Neonatal Outcomes

		<b>Exhaled CO Monitoring Reading</b>
<b>Gestational Age at Delivery</b>	$r_s$	-0.549
	$P$	<0.001
<b>Birth Weight</b>	$r_s$	-0.610
	$P$	<0.001
<b>1-min Apgar Score</b>	$r_s$	-0.266
	$P$	<0.001
<b>5-min Apgar Score</b>	$r_s$	-0.029
	$P$	0.686

The exhaled CO monitoring reading was significantly higher in women who had preterm labor, PROM, placental abruption and maternal mortality.

**Table (9)** Association between Current SHS and Maternal Outcomes in Included Women

<b>Exhaled CO Monitoring Reading (ppm)</b>	<b>Yes</b>	<b>No</b>	<b>P *</b>
<b>Preterm Labor</b>	3 (1 – 4)	1 (0 – 3)	0.023
<b>PROM</b>	3 (1 – 3)	0 (0 – 1)	<0.001
<b>Placental Abruption</b>	6 (5 – 7)	3 (0 – 3)	0.006
<b>Maternal Mortality</b>	6 (5 – 7)	3 (0 – 3)	0.006

Data presented as median (IQR) of Exhaled CO Monitoring Reading

PROM prelabor rupture of the membranes

\* Analysis using Mann-Whitney's U-test

## DISCUSSION

In the current study, the mean age of included women was  $27.07 \pm 4.66$  years (range: 16 – 37 years). Of the included 200 women, 76 (38%) lived in urban areas, 36 (18%) in suburban areas, while 88 (44%) in rural areas. Of the included 200 women, 104 (52%) received secondary or university education, and only 43 (21.5%) were employed. Of the included 200 women, 135 (67.5%) stated that their husbands smoke; of them 120/135 (88.9%) do indoors. The type of tobacco used was cigarette in 119 (88.1%) women, and shisha in 16 (11.9%) women.

The figures representing the awareness of the potential hazards of smoking and exposure to smoke on pregnant mother and her baby were quite high. Of the included 200 women, 178 (89%), 136 (68%) and 187 (93.5%) agreed or very much agreed about that tobacco use is hazardous to pregnant woman and her unborn baby's health, tobacco exposure is hazardous to pregnant woman and her unborn baby's health, and that tobacco exposure is hazardous to the newborn's health.

In a study conducted on 576 pregnant Indian women, 92.4% of the included women were

aware of the harmful effect of tobacco use; of them only 29.6% stated that it was a source of concern<sup>6</sup>.

In the present work among the 200 included women, current SHS was associated with higher rates of preterm labor [27.9% vs. 11.1%, RR 3.1, 95% CI (0.4 to 26.5),  $p=0.498$ ], PROM [68% vs. 53.5%, RR 1.8, 95% CI (0.6 to 6.01),  $p=0.498$ ], placental abruption [3.2% vs. 0%,  $p=0.999$ ] and maternal mortality [3.2% vs. 0%,  $p=0.999$ ]. The differences in maternal outcomes, however, did not reach statistical significance.

In the current study, current SHS was significantly associated with lower mean gestational age at delivery [MD 1.1 week, 95% CI (0.6 to 1.5),  $p<0.001$ ], lower mean birth weight [MD 501.4 g, 95% CI (370.9 to 631.8),  $p<0.001$ ], lower median 1-min Apgar score [median (IQR): 6 (6 – 7) vs. 7 (6 – 8),  $p=0.006$ ] and higher rates of SGA neonates [33.8% vs. 0%,  $p=0.029$ ].

The results of the current study regarding the adverse impact of SHS on birth weight and gestational age at delivery is consistent with the results of several epidemiological studies<sup>7,8</sup>.

The rates of congenital malformations and SB were slightly higher among current SHS women, but did not reach a statistical significance [5.9% vs. 0%,  $p=0.999$  and 4.2% vs. 0%,  $p=0.999$ ; respectively]. In the current study, objective quantification of the level of exposure was achieved through the exhaled CO monitoring reading.

The current study showed significant positive association between exhaled CO monitoring reading and each of indoors husband smoking and duration of exposure to SHS (Table 7), which further validates the self-reporting of exposure to SHS. Moreover, the current study showed a significant association between higher median exhaled CO monitoring reading and both adverse maternal [preterm labor, PROM, placental abruption and maternal mortality] and adverse perinatal [lower gestational age at delivery, lower birth weight, lower 1-min Apgar score] outcomes. The exact underlying mechanism of this association between smoking and adverse pregnancy outcomes is yet to be elucidated. One of the most commonly proposed mechanisms is that carbon monoxide in the smoke may bind to the fetal hemoglobin causing relative fetal hypoxia<sup>6</sup>.

## CONCLUSION

The current study showed a significant association between SHS in pregnant women and increased rates of preterm delivery, low birth weight and SGA neonates.

## RECOMMENDATIONS

Passive smoking can also affect baby health so pregnant women should ask smokers to refrain from smoking around here.

## REFERENCES

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interventions for women in low-and middle-income countries. *Acta Obstet Gynecol Scand*, 89(4): 442-53.

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## LIST OF ABBREVIATIONS

CO : carbon monoxide  
 ETS : environmental tobacco smoke  
 PPM : part per million  
 PROM : premature rupture of membrane  
 LBW : low birth weight  
 SHS : second hand smoke  
 SGA : small for gestational age