Effect of second-hand cigarette smoke exposure on neonatal birth weight and prematurity among pregnant patients in secondary hospitals in Manila: A prospective cohort study*

By Annarose L. Patupat, MD and Erlidia F. Llamas-Clark, MD, MPH, PhD, FPOGS
Department of Obstetrics and Gynecology, Philippine General Hospital, University of the Philippines-Manila

ABSTRACT

Background: Smoking is a known risk factor for many maternal and perinatal morbidities. Regrettably, as many as 69.8% of mothers, though not active smokers themselves, are exposed to second-hand cigarette smoke (SHS). No level of SHS exposure is safe. Due to the potential harmful effects to the mother and her unborn child, it is important to establish the effect of SHS exposure on neonatal outcome among our pregnant patients.

Objective: To determining the effect of second hand cigarette smoke exposure on neonatal outcomes.

Methods: Participants are patients with low risk singleton pregnancies who were going for prenatal check up and eventually delivered in secondary hospitals in Manila. Descriptive statistics was used to summarize the demographic and clinical characteristics of the patients. Null hypotheses were rejected at 0.05 α-level of significance. The computer software STATA 13.1 was used for data analysis.

Results: The husband was the most identified source of second-hand smoke. Maternal weight was also higher among the exposed group. The most significant effect of SHS exposure among newborns was a 103 grams difference in mean birth weight. There was no difference in pediatric aging, birth length, and anthropometric measurements.

Conclusion: The prevalence of smoking in Philippines remains high at 23.8% among adult population, majority being male adults. Exposure to second-hand smoke during pregnancy was noted to be as high as 69.8%. The most common source of second-hand smoke is the husband, and thus, he should be one of the targets of preventive strategies in second-hand smoke exposure.

Keywords: Second hand smoke, passive smoke, pregnancy, prematurity, low birthweight

INTRODUCTION

Maternal smoking is a well-established risk factor for poor neonatal outcomes and for harmful effects on fetal growth and development. These conditions are attributed mostly to the many carcinogenic and dangerous chemicals found in cigarettes.[1] The US Center for Disease Control reports that in 2016, 7.2% pregnant women smoked at any time during pregnancy. The age group with the highest prevalence of smoking in pregnant women are aged 20–24 (10.7%), followed by women aged 15–19 (8.5%) and then 25–29 (8.2%).[2]

In the Philippines, the overall prevalence of tobacco use among adults in 2015 was 23.8% (16.5 million adults) composed approximately of 41.9% of adult male population (~14.6 million men) and 5.8% of adult female population (~2.0 million women).[3]

Second-hand smoke (SHS), also known as passive smoke, environmental tobacco smoke or involuntary smoke, is defined by Merriam-Webster dictionary as the *"tobacco smoke, exhaled by a smoker or emitted by the burnt tobacco (as of a cigarette), that is inhaled by persons nearby"*[4]. Ostrea et al reported that in 2008, the prevalence of active maternal smoking during was only 1.8% while prevalence of passive smoking was as high as 69.8%.[5]

No level of SHS exposure is safe.[6] Due to the potential harmful effects to the mother and unborn child, it is deemed prudent to establish the effect of SHS exposure

*Finalist , Philippine Obstetrical and Gynecological Society (Foundation), Inc. (POGS) Research Paper Contest, October 17, 2019, 3rd Floor Assembly Hall, POGS Building, Malakas Street, Diliman, Quezon City

on neonatal outcome among our pregnant patients.

OBJECTIVES

A. General Objective

i. To determine the effect of second hand cigarette smoke exposure on neonatal outcomes among pregnant women

B. Specific Objectives

i. To describe the sociodemographic profile of pregnant patients with second hand cigarette smoke exposure from their household and those patients without exposure
ii. To determine the pediatric aging, birth weight, birth length, head circumference, chest circumference, abdominal circumference, APGAR score, and character of amniotic fluid among the babies of pregnant patients with second hand cigarette smoke exposure and those patients without exposure
iii. To compare the pediatric aging, birth weight, birth length, head circumference, chest circumference, abdominal circumference, APGAR score, and character of amniotic fluid among the babies of pregnant patients with second hand cigarette smoke exposure and those patients without exposure

METHODOLODY

The research sites are public secondary hospitals in Manila City which cater to a significant number of patients. A total of 534 patients, from October 2018 to January 2019, who were going for prenatal check-up at the clinic and were ≤34 weeks age of gestation, and those who were admitted for delivery were recruited to join the study. Exclusion criteria include maternal age less than 19 years old, active maternal smoking during pregnancy, presence of maternal co-morbidities, presence of fetal congenital anomalies, and multiple gestation pregnancies. Informed consent was obtained from the mothers. Maternal socioeconomic status, second-hand smoke exposure and obstetric history were established through interview during prenatal check-up or just prior to admission. Neonatal outcome were obtained through records.

Statistical analysis

Descriptive statistics was used to summarize the demographic and clinical characteristics of the patients. Frequency and proportion was used for categorical variables, median and inter quartile range for non-normally distributed continuous variables, and mean and SD for normally distributed continuous variables. Independent Sample T-test, Mann-Whitney U test and Fisher's exact test was used to determine the difference of mean, rank and frequency, respectively, between mothers exposed to secondhand smoke and those who are not exposed. All statistical tests were two tailed test. Shapiro-Wilk was used to test the normality of the continuous variables. Missing variables was neither replaced nor estimated. Null hypotheses were rejected at 0.05α-level of significance. STATA 13.1 was used for data analysis.

RESULTS

The socio-demographic profile of patients among each group was summarized in Table 1. Significant differences among the two groups were the patient's weight, height, highest educational attainment, number of household members and monthly household income. The pregnant women exposed to SHS were noted to have heavier weight, lower height, have less education, more household members, and have lower monthly household income compared to the non-exposed group.

Table 2 describes the SHS exposure among the pregnant subjects. The exposed group reported to have been exposed to an average of 4 sticks of cigarette smoke per day, and majority of them have been exposed from 2 to 5 years. Aside from cigarette smoke, the exposed group were more likely to have other sources of smoke exposure (5.84% VS 1.54%, p 0.0030) such as using "panggatong" (wood fire cooking) and "katol" (use of mosquito coil) or doing "pagsisiga" (yard burning). Maternal obstetric profiles of the patients were shown in Table 3. The exposed group was observed to have higher gravidity and parity compared to the non-exposed group. Also notable was the significant difference in the history of abortion among the exposed group (14.6%) compared to the non-exposed group (5.38%). Other parameters in maternal profiles are not significantly different among the groups.

The neonatal outcome among the different groups was compared in Table 4. Among the exposed group, the mean birth weight was 103 grams less than the non-exposed group which was statistically significant. However, there was no significant difference in the number of babies with low birth weight (defined by WHO as <2500 grams) and in the weight percentile (appropriate for gestational age, small for gestational age, or large for gestational age) among the two groups. There was no significant difference in the pediatric aging, birth length, character of amniotic fluid upon birth, and anthropometric measurements (head circumference, chest circumference, abdominal circumference). All babies were sent home with their families.

Table 1. Sociodemographic profile of the mothers

	Total (n=534)	Exposed (n=274)	Non exposed (n=260)	P-value
	Frequency (%); Mean + SD; Median (IQR)			
Age of the patient	28 (23 to 33)	28 (23 to 33)	28 (23 to 33)	0.737
Weight	62.50 + 10.45	64 + 10.83	60.92 + 9.80	<0.001
Height	153 (150 to 155)	152 (150 to 155)	154 (150 to 157)	0.001
Highest educational attainment				0.003
None	1 (0.19)	0	1 (0.38)	
Elementary	68 (12.73)	47 (17.15)	21 (8.08)	
High school	285 (53.37)	147 (53.65)	138 (53.08)	
College	141 (26.40)	59 (21.53)	82 (31.54)	
Vocational	39 (7.30)	21 (7.66)	18 (6.92)	
Age of partner	30.26 + 6.93	29.92 + 7.36	30.63 + 6.43	0.239
Monthly household income	10,000 (8,000 to 13,000)	10,000 (6,500 to 12,000)	11,500 (10,000 to 15,000)	<0.001

Table 2. Secondhand smoking exposure status of the mothers

	Total (n=534)	Exposed (n=274)	Non exposed (n=260)	P-value
	Frequency (%); Median (IQR)			
Number of Household Members	6 (4 to 7)	6 (4 to 8)	5 (4 to 7)	0.006
Number of Smokers in the Household	1 (0 to 1)	1 (1 to 2)	0	<0.001
Sticks per day	4 (3 to 7)	4 (3 to 7)	0	-
Since when are you exposed?				<0.001
None	260 (48.69)	0	260 (100)	
< 2 years	14 (2.62)	14 (5.11)	0	
2 to 5 years	140 (26.22)	140 (51.09)	0	
> 5 years	120 (22.47)	120 (43.80)	0	
Other smoke exposure				0.030
None	514 (96.25)	258 (94.16)	256 (98.46)	
Panggatong (wood fire cooking)	10 (1.87)	8 (2.92)	2 (0.77)	
Siga (yard burning)	2 (0.37)	1 (0.36)	1 (0.38)	
Katol (use of mosquito coil)	7 (2.55)	7 (2.55)	1 (0.38)	

DISCUSSION

This study shows significant differences in the sociodemographic data among the exposed and non-exposed groups. The pregnant women exposed to second hand smoke were noted to have heavier weight (64 + 10.83 kg VS 60.92 + 9.80 kg, p <0.001), lower height (152 cm VS 154 cm, p 0.001), less educational attainment (p 0.003), more household members (6 VS 5, p 0.006), lower monthly household income (P10,000 VS P11,500, p <0.001), higher gravidity (41.24% VS 27.31% with 3 or more gravidity, p 0.003), higher parity (38.32% VS 26.15% with 2 or more parity, p 0.010) compared to the pregnant patients in the non-exposed group. Several studies have shown that women who were younger, less educated, with higher parity, and unemployed are more likely to have second-hand smoke exposure.[7] Though in this study, there was no significant difference in age of the patients.

The partner is the main source of second hand smoke, identified by 226 out of 274 exposed patients (82.48%). This finding is consistent with most studies on second hand smoke exposure done both local and abroad.[5,7] The average use is 4 sticks per day (3 to 7 sticks) and majority of the women have been exposed for 2 to 5 years already (n = 140, 51%).

For the maternal obstetric profile, the only significant difference noted was a positive history of abortion in the exposed group. According to Brown et. al in 2008, women with one, two and three or more previous abortions were 2.8 (95% CI 2.48 to 3.07), 4.6 (95% CI 3.94 to 5.46)

Table 3. Maternal Obstetric profile of the mothers

	Total (n=534)	Exposed (n=274)	Non exposed (n=260)	P-value
	Frequency (%); Mean + SD; Median (IQR)			
Gravidity 1 Gravidity 2 Gravidity 3 or more gravidity	2 (1 to 3) 208 (38.95) 142 (26.59) 184 (34.46)	2 (1 to 3) 97 (35.40) 64 (23.36) 113 (41.24)	2 (1 to 3) 111 (42.69) 78 (30) 71 (27.31)	0.002 0.003
Parity 0 parity 1 parity 2 or more parity	1 (0 to 2) 222 (41.57) 139 (26.03) 173 (32.40)	1 (0 to 2) 106 (38.69) 63 (22.99) 105 (38.32)	1 (0 to 2) 116 (44.62) 76 (29.23) 68 (26.15)	0.009 0.010
History of abortion	54 (10.11)	40 (14.60)	14 (5.38)	<0.001
History of preterm delivery	14 (2.62)	10 (3.65)	4 (1.54)	0.176
History of low birth weight	2 (0.37)	0	2 (0.77)	0.237
Number of prenatal check-ups	7 (5 to 8)	6 (1 to 9)	7 (1 to 10)	0.406
Where None Local hospital Lying in clinic Local health center	 1 (0.19) 201 (37.64) 129 (24.16) 203 (38.10)	 1 (0.36) 116 (42.34) 63 (22.99) 94 (34.31)	 0 85 (32.69) 66 (25.38) 109 (41.92)	0.061
Age of gestation on delivery	38.16 + 1.04	38.11 + 0.83	38.23 + 1.21	0.183

Table 4. Neonatal record

	Total (n=534)	Exposed (n=274)	Non exposed (n=260)	P-value
	Frequency (%); Mean + SD			
Pediatric aging	38.43 + 0.89	38.46 + 0.75	38.39 + 1.03	0.333
Sex Male Female	 232 (45.31) 280 (54.69)	 116 (42.34) 158 (57.66)	 116 (48.74) 112 (51.26)	0.155
Mean birth weight	2955 + 333	2905 + 330	3008 + 239	<0.001
Birth weight < 2500 grams ≥ 2500 grams	 31 (5.81) 305 (94.19)	 19 (6.93) 255 (93.07)	 12 (4.62) 248 (95.38)	0.252
Birth length	48.76 + 2.70	48.82 + 2.88	48.70 + 2.47	0.595
Head circumference	31.95 + 2.16	31.89 + 2.55	32.03 + 1.65	0.449
Chest circumference	31.13 + 1.83	31.18 + 1.86	31.07 + 1.81	0.479
Abdominal circumference	29.03 + 1.76	29 + 1.77	29.07 + 1.76	0.599
APGAR score 1 minute 5 minutes	 9 (8 to 9) 9 (9 to 9)	 8 (4 to 9) 9 (9 to 9)	 9 (7 to 9) 9 (9 to 9)	 0.017 0.955
Weight percentile SGA AGA LGA	 11 (2.06) 519 (97.19) 4 (0.75)	 8 (2.92) 265 (96.72) 1 (0.36)	 3 (1.15) 254 (97.69) 3 (1.15)	0.236
Character of amniotic fluid Clear Thinly Thickly	 527 (98.69) 7 (1.31) 0	 269 (98.18) 5 (1.82) 0	 258 (99.23) 2 (0.77) 0	0.451
Disposition Home THOC Expired	 534 (100) 0 0	 274 (100) 0 0	 260 (100) 0 0	-

and 9.5 (95% CI 7.72 to 11.67) times likely to give birth to babies with low birth weight, respectively.[8] There was no significant difference in the history of preterm delivery and history of low birth weight among the groups. Health seeking behaviour was determined to be similar between the groups, with no difference in the number of their prenatal check-ups and where they were being seen.

Kermah et al. showed in their study that second hand smokers had higher adjusted levels of body mass index (BMI), fasting plasma glucose, and Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) compared to non-smokers.[9] Higher maternal BMI is a known risk factor for macrosomia and large for gestational age babies. In our study, the maternal weight is significantly higher compared to non-exposed group (64 + 10.83 kg VS 60.92 + 9.80 kg, p <0.001). However, instead of macrosomia or large for gestational age babies, we reported a 103 gram difference among the mean birth weight of our exposed versus our non-exposed cohort, which was statistically significant (p<0.001).

Neonatal disposition refers to whether the newborn was sent home, transferred to another facility, or expired. The 1st minute APGAR score was also significantly lower at 8 among exposed neonates compared to score of 9 among non-exposed neonates but did not have an effect on neonatal disposition, because all babies in the study were sent home with their families. Other neonatal outcomes were similar such as pediatric aging (38.46 VS 38.39 weeks, p 0.333), birth length (48.82 VS 48.70 cm, p 0.595), head circumference (31.89 + 2.55 VS 32.03 + 1.65 cm, p 0.449), chest circumference (31.18 + 1.86 VS 31.07 + 1.81, p 0.479) and abdominal circumference (29 + 1.77 VS 29.07 + 1.76, p 0.599). The outcomes were also similar in terms of having low birth weight, defined as <2500 grams (6.93% VS 4.62%, p 0.252), weight percentiles (p 0.236) and the character of the amniotic fluid upon birth (p 0.451).

Several Western studies have been done involving in-utero smoking exposure and neonatal outcome. A systematic review and meta-analysis done by Leonardi-Bee J et al. in United Kingdom last 2008 suggested that SHS exposure among non-smoking pregnant women decreased the mean birth weight by 33 grams (40 grams in retrospective studies), and increased the risk by 22% of having birth weight below 2500 grams. However, SHS exposure has no established effect on risk for prematurity and risk for small for gestational age babies.[10] Another systematic review and meta-analysis by Salmasi G et al. last 2008 concluded almost the same results as our study. SHS exposed neonates weighed 60 grams less (95% confidence interval (CI) -80 to -39 g), had a non statistically significant increased risk (RR 1.16; 95% CI 0.99-1.36) for low birth weight (<2500 grams), and had no difference in preterm delivery compared to non-exposed neonates (mean difference 0.02 weeks, 95% CI -0.09 to 0.12 weeks). However, in addition, the review showed that SHS exposure resulted in longer birth lengths (1.75 cm; 95% CI 1.37-2.12 cm), an increased risk (OR 1.17; 95% CI 1.03-1.34) for congenital anomalies and a non conclusive increased trend towards smaller head circumferences (-0.11 cm; 95% CI -0.22 to 0.01 cm).[11] This pattern was not seen in our study.

Among the studies done in Asia, it also showed that SHS exposure caused significant decrease in mean birth weight, and higher incidence of premature delivery.[12,13,14,15]

CONCLUSION

The prevalence of smoking in Philippines remains high at 23.8% among adult population, majority being male adults. Among pregnant women, prevalence of active smoking is estimated to be low. However, exposure to second-hand smoke during pregnancy was noted to be as high as 69.8%. The most common source of second-hand smoke is the husband, and thus, he should be one of the targets of preventive strategies in second-hand smoke exposure.

The most significant effect of SHS exposure among pregnant women is a decrease in mean birth weight. Although a difference of 103 grams may not drastically change the disposition of a term baby. However, this notable effect on birth weight of SHS exposure when applied to preterm neonates may spell the difference between survival and demise. Other association noted was an increase in maternal weight among the exposed group, which could lead to more harm on both the mother and subsequently, the baby.

There was no difference seen in prematurity, birth length, and anthropometric measurements. We recommend conducting the study in a tertiary hospital that can admit and cater to premature neonates so that actual effect on prematurity can be established in the future.

ACKNOWLEDGEMENT

We would like to acknowledge the administration and staff of the two public secondary hospitals in Manila for their cooperation and contribution to the data collection of this paper. ■

REFERENCES

1. Vardavas et al. Factors Associated with Active Smoking, Quitting, and Secondhand Smoke Exposure among Pregnant Women in Greece. *J Epidemiol.* 2010; 20(5):355-362

2. Drake P, Driscoll AK, Matthews TJ. Cigarette smoking during pregnancy: United States, 2016. NCHS Data Brief, no 305. Hyattsville, MD: National Center for Health Statistics, 2018.

3. Global Adult Tobacco Survey: Country report 2015 [Online] Available from https://www.doh.gov.ph/sites/default/files/publications/2015GATSCountryReport_0.pdf

4. "Secondhand Smoke." Merriam-Webster.com. Merriam-Webster, n.d. Web. 4 Nov. 2016.

5. Ostrea EM, Jr, Villanueva-Uy E, Ngerncham S, et al. An epidemiologic study comparing fetal exposure to tobacco smoke in three Southeast Asian Countries. *Int J Occup Environ Health*. 2008; 14:257-262.

6. Potera, Carol. Study Finds No Level of SHS Exposure Free of Effects. *Environmental Health Perspectives.* November 2010; 118(11):A474

7. Norsa'adah, Bachok and Salinah, Omar. The Effect of Second-Hand Smoke Exposure during Pregnancy on the Newborn Weight in Malaysia. *Malays J Med Sci*. Mar-Apr 2014; 21(2): 44-53.

8. Brown JS Jr1, Adera T, Masho SW.. Previous abortion and the risk of low birth weight and preterm births. *J Epidemiol Community Health*. 2008 Jan; 62(1):16-22.

9. Kermah D, Shaheen M, Pan D, et al Association between secondhand smoke and obesity and glucose abnormalities: data from the National Health and Nutrition Examination Survey (NHANES 1999-2010). *BMJ Open Diabetes Research and Care.* 2017; 5:e000324. Doi: 10.1136/bmjdrc-2016-000324.

10. 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 Sep; 93(5):F351-61

11. Salmasi G1, Grady R, Jones J, McDonald SD; Knowledge Synthesis Group. Environmental tobacco smoke exposure and perinatal outcomes: a systematic review and meta-analyses. *Acta Obstet Gynecol Scand*. 2010; 89(4):423-41

12. Norsa'adah, Bachok and Salinah, Omar. The Effect of Second-Hand Smoke Exposure during Pregnancy on the Newborn Weight in Malaysia. *Malays J Med Sci*. Mar-Apr 2014; 21(2): 44-53.

13. Mojibyan M, Karimi M, Bidaki R, Rafiee P, Zare A. Exposure to Second-hand Smoke During Pregnancy and Preterm Delivery. *Int J High Risk Behav Addict*. 2013; 1(4):149-53. DOI: 10.5812/ijhrba.7630

14. Khader, Y.S., Al-Akour, N., AlZubi, I.M. et al. The Association Between Second Hand Smoke and Low Birth Weight and Preterm Delivery. *Matern Child Health J* (2011) 15:453. doi:10.1007/s10995-010-0599-2.

15. Goel P, Radotra A, Singh I, Aggarwal A, Dua D. Effects of passive smoking on outcome in pregnancy. *J Postgrad Med*. 2004; 50(1):12-16.