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ScienceDirect

Journal of the Chinese Medical Association xx (2017) 1−7

www.jcma-online.com

Original Article

The effects of maternal smoking exposure during pregnancy on postnatal outcomes: A cross sectional study

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Received November 30, 2016; accepted January 14, 2017

Abstract

Background: The purpose of this article was to evaluate the effect of maternal smoking exposure during pregnancy on postnatal outcomes.
Methods: This prospective study enrolled 278 pregnant women in the third trimester, who were asked to complete a questionnaire which included inquires about the nature and extent of smoking exposure during their pregnancy. In addition to the questionnaire, each study subject provided urine sample for the measurement of cotinine. Using data generated from this inquiry, we analyzed the association between maternal smoking exposure and birth outcomes.
Results: From the 278 enrollees in this study, a minority of subjects (7.2%) smoked, while 40.6% of the study subjects were exposed to environmental tobacco smoke during pregnancy. There was significantly higher birth weight (3205.2 ± 373.1 vs 3089.7 ± 363.0 vs 2959.0 ± 403.7 g, $p = 0.004$), larger chest size (33.1 ± 1.7 cm vs 32.7 ± 1.5 cm vs 32.0 ± 1.7 cm, $p = 0.009$), higher bilirubin on postnatal day 3 (8.9 ± 1.6 vs 8.6 ± 1.5 vs 7.8 ± 1.4 mg/dL, $p = 0.015$), but lower maternal urinary cotinine level (83.7 ± 132.4 vs 153.2 ± 96.0 vs 800.5 ± 1027.8 μg/g creatinine, $p < 0.001$) in smoking-free status than in passive or active smoking status. Significant risks of birth weight < 2500 g (AOR 3.93 (95% CI 1.61−9.59), $p = 0.003$) and maternal urinary cotinine ≥ 143 μg/g creatinine (AOR 3.38 (95% CI 2.02−5.66), $p < 0.001$) were observed as smoking exposure increased. There was significantly higher birth weight ($p = 0.048$), larger chest size ($p = 0.045$), and higher bilirubin level on postnatal day 3 ($p < 0.001$) in the group with cotinine <143 μg/g creatinine than in the group with cotinine ≥ 143 μg/g creatinine.
Conclusion: Our results demonstrated that maternal smoking exposure during pregnancy is associated with low birth weight and small chest circumference. Although the incidence of active smoking in Taiwanese pregnant women is low, most of them are exposed to passive smoking environment. Further studies are required to evaluate useful interventions to enhance a smoking-free environment during pregnancy.

Keywords: Birth outcome; Cotinine; Pregnant women; Smoking

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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http://dx.doi.org/10.1016/j.jcma.2017.01.007

1. Introduction

It is well documented that smoking exposure during pregnancy is associated with multiple adverse effects on the fetus. Active maternal smoking increases the risks of perinatal mortality, preterm delivery, miscarriage, ectopic pregnancy, antepartum hemorrhage, placenta previa, placental abruption, fetal growth restriction, low birth weight (LBW) and sudden infant death syndrome.[1−4] However, the effects of passive maternal smoking, also known as environmental tobacco exposure (ETS), have been less well studied and thus have generated less consistency in the literature. It can also cause harmful effects to the fetus, including LBW, fetal death, preterm delivery and spontaneous abortion.[5−7]

In Taiwan, the prevalence of male and female adult smokers in 2010 is 35.0% and 4.1%, respectively.[8] Lin et al. reported the prevalence of smoking in young military conscripts even exceeds 50%.[9,10] There are some Taiwanese studies about the effect of smoking exposure during pregnancy.[8,11−14] Chen et al.'s study suggests that clinicians can target interventions designed to increase pregnant women's self-efficacy, advising women to try to establish their own smoking policy at home.[11] Wang et al. reported that smoke exposure during pregnancy might increase the risk of atopic dermatitis in children.[12] Lai et al. found that most women stop smoking during pregnancy; however, most women continue to be exposed to passive-smoking environments.[13] Ko et al.'s study demonstrated that maternal smoking is responsible for increased incidences of LBW and preterm delivery of babies.[8] Lai et al.'s study showed that understanding the risk factors associated with smoking and exposure to second-hand smoke during pregnancy may help in the development of strategies to reduce such exposure.[14] Most of the previous researches only measured smoke exposure by patient survey recall, which may be more likely to be subject to misclassification of exposure.[15] Cotinine is a major metabolite of nicotine with a longer half-life and thus a more accurate measure of total exposure than questionnaire methods.[16,17]

The purpose of this prospective study was to evaluate the effect of smoking exposure on the fetus by both questionnaire assessment and urinary cotinine measurement in southern Taiwan.

2. Methods

2.1. Subjects

This prospective study was conducted from March 2009 to February 2010 at the department of Obstetrics and Gynecology at Fooyin University Hospital. Three hundred pregnant women during their third-trimester prenatal checkups (after 24 weeks) were screened for study. Eighteen subjects were excluded because of chronic diseases (diabetes mellitus, hypertension), infectious diseases, twins, and stillbirth leaving 282 eligible candidates. Four of these women did not want to participate in the study, leaving 278 subjects, all of whom signed written consent forms. The final enrolled subjects thereafter each completed questionnaires, which inquired about the nature and extent of their smoking, and their smoking exposure during pregnancy. Each subject provided a urine sample for the measurement of cotinine, and the medical records of all neonates were reviewed. More specifically, the medical records were reviewed for age, sex, birth weight, body length, head and chest circumference, and bilirubin level. They were divided into three groups: active smoking status (smoking or smoking & ETS), passive smoking status (non-smoking & ETS), and smoking-free status (non-smoking & non-ETS).

2.2. Research ethics

This study was approved by the Institutional Review Board of Fooyin University Hospital (FYH-IRB-97006). Written informed consents were obtained from all adult women and from guardians on behalf of subjects less than 20 years of age who were involved in this study.

2.3. Questionnaire

A questionnaire was modified from similar templates in the previous literatures on smoking during pregnancy.[5−7] Content validity of the questionnaire was assessed by an expert panel consisting of 6 experts in nursing, health education, and smoking cessation. After gathering opinions from the experts, those questions without precise contents were excluded. Thereafter, well-trained interviewers administered the questionnaires, collecting demographic and smoking habits and self-reported ETS exposure at different locations during pregnancy. The questionnaire consisted of several sections, including demographics, health status, household smoking habits and self-reported ETS exposure at different locations, alcohol drinking, areca use, etc. Demographic questions included age, body weight, body length, ethnicity, marital status, education level, employment status, and last menstrual period. The questions about smoke exposure included: (1) Do you smoke during pregnancy? (2) Does your husband smoke? (3) Do your family smoke? (4) Are you exposed to other ETS in home or workplace etc. The definition of “smoking” exposure for the purpose of this study was derived from the subject's responses to the above-mentioned smoking questionnaire. During the period of pregnancy, three groups of smoking exposure were created, namely: (1) “active smoking” (reported being a smoker during pregnancy with/without ETS), (2) “passive smoking” (reported being a non-smoker during pregnancy with ETS at home or workplace), and (3) “smoking-free” (reported being a non-smoker during pregnancy without ETS), respectively.

2.4. Urine cotinine measurement

The urine samples of the participating subjects were collected, centrifuged, and the supernatant was stored at −30 °C until it was analyzed within 6 months. The enzyme immunoassay (EIA) kit for cortinine was (DRI® Cotinine,

Please cite this article in press as: Huang S-H, et al., The effects of maternal smoking exposure during pregnancy on postnatal outcomes: A cross sectional study, Journal of the Chinese Medical Association (2017), http://dx.doi.org/10.1016/j.jcma.2017.01.007