



The association between second-hand smoke exposure and depressive symptoms among pregnant women



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ABSTRACT

Tobacco smoking and depression are strongly associated, but the possible association between second-hand smoke (SHS) exposure and depression is unclear. This study aimed to examine the possible relation between SHS exposure and depressive symptoms among pregnant women. A cross-sectional survey was conducted in Shenzhen, China, using a multistage sampling method. The univariable and multivariable logistic regression models were used to explore the associations between SHS exposure and depressive symptoms. Among 2176 pregnant women, 10.5% and 2.0% were classified as having probable and severe depressive symptoms. Both binary and multinomial logistic regression revealed that there were significantly increased risks of severe depressive symptoms corresponding to SHS exposure in homes or regular SHS exposure in workplaces using no exposure as reference. In addition, greater frequency of SHS exposure was significantly associated with the increased risk of severe depressive symptoms. Our findings suggest that SHS exposure is positively associated with depressive symptoms in a dose-response manner among the pregnant women.

1. Introduction

It is well established that inhaling second-hand smoke (SHS) is harmful and that no scientific evidence establishes a risk-free level of exposure. An estimated one third to one half of nonsmoking pregnant women are involuntarily exposed to SHS (Tan et al., 2011; Khan et al., 2015), which is a major public health concern. Epidemiological studies have linked SHS exposure during pregnancy to adverse maternal conditions and poor pregnancy outcomes such as neonatal mortality and stillbirth, low birthweight, preterm delivery and sudden infant death syndrome (Ernst et al., 2001; Roelands et al., 2009; Salmasi et al., 2010). But there is limited information in published reports regarding the relation between SHS exposure and maternal mental health (including depressive symptoms or depression) during pregnancy.

Knowledge about the associations between SHS exposure and depressive symptoms has been reported mainly among the general population, and current evidence is inconsistent. A few studies demon-

strated a significant association in a population of adults, workers, and adolescents (Nakata et al., 2008; Bandiera et al., 2010; Lee, 2014; Kim et al., 2016), while a non-significant association was found in a report from the Netherlands (Bot et al., 2013). Among the pregnant women, previous epidemiological studies have indicated that antenatal depression plays a very important role during pregnancy with the prevalence around 10–20% (Ryan et al., 2005). Compared to the general population, few studies report on relations between SHS exposure and depressive symptoms in the perinatal population (Tan et al., 2011). SHS exposure occurs in varying amounts in homes, workplaces, and other indoor or outdoor spaces, but it was unclear whether there are setting-specific and dose-response relations between SHS exposure and depressive symptoms. Therefore, in order to bridge this knowledge gap, the present study aimed to examine the possible setting-specific and dose-response relationships between SHS exposure and depressive symptoms among pregnant women.

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2. Methods

2.1. Ethics statement

The study was approved by the Ethics Committee of Guangdong Pharmaceutical University, and it was performed in accordance with the approved guidelines. Before participating, all participants signed an informed consent form regarding the goals of the study and the willingness to participate.

2.2. Study sample and procedures

This cross-sectional study was conducted in Shenzhen, China, between July and November 2015. Since almost all of pregnant women were required to seek prenatal testing in the hospital where they decided to give birth, the target population was pregnant women attending hospitals for routine prenatal testing. A multistage stratified sampling process was employed to obtain a representative sample. First, all the districts were divided into two categories according to geographical representations and levels of economic development, which are urban (three districts) and rural (three districts) areas. One district was randomly sampled from each of the two categories. Second, in each of the two districts, three largest public hospitals having conditions for delivering a baby were included in the sampling frame, and one hospital was randomly drawn from these hospitals. Third, within selected hospitals, pregnant women at ≥ 28 weeks' gestation were recruited from the sampled hospitals. Eligible women were asked to complete a face-to-face survey after having given a verbal informed. A total of 2186 individuals were interviewed, of whom 2182 (99.9%) were willing to participate in this survey and only 4 (0.1%) refused to participate.

2.3. Data collection and quality control

Interviewers were enrolled voluntarily from undergraduate students and graduate students in the School of Public Health of Guangdong Pharmaceutical University, China. All interviewers were trained to ensure that the survey was carried out according to the protocol and that operation procedures were identical across all areas. After obtaining informed consent, eligible respondents were asked to complete a face-to-face survey by the trained interviewers. In order to evaluate the feasibility of investigation, a pilot study was carried out before formal investigation. Data quality was assured by using double data entry procedures and a system to automatically detect data entry errors (EpiData version 3.1 database, The EpiData Association, Odense Denmark). Any potential errors were verified using the original questionnaires.

2.4. Study variables

The main outcome variable was self-reported depressive symptoms measured by a Chinese version of the Center for Epidemiologic Studies Depression (CES-D) scale (Radloff, 1977). The 20-item depressive symptom scale measures the levels of depressive symptoms experienced in the past week. The scores of CES-D range from 0 to 60 and higher scores indicate higher levels of depressive symptoms. The cutoffs of 16 and 24 represented the thresholds for probable and severe depressive symptoms, respectively (Julian et al., 2011), so the outcome variable of depressive symptom was binary (CES-D ≥ 16 defined as probable depressive symptoms, CES-D ≥ 24 defined as severe depressive symptoms) or categorized (CES-D: < 16 , 16–23, ≥ 24). Cronbach's alpha for the CES-D scale in this study sample was 0.802, which indicated a good internal consistency of the questionnaire.

The main independent variable was self-reported SHS exposure. Self-reported SHS exposure was defined as non-smokers' inhalation of the smoke exhaled from smokers on at least one day a week for at least

the last 12 months (Wang et al., 2009). One day listed above means that smokers smoke totally up to 15 min or longer. Participants were asked if they had smoked over 100 cigarettes in their lifetime, and those responding “no” were defined as non-smokers. The non-smoking participants were asked about the frequency of SHS exposure (days/week) in homes and in workplaces, respectively. Frequency of SHS exposure was reported as a continuous variable (days/week), and was also categorized into three groups: no exposure (less than one day a week), occasional exposure (1–3 days a week), and regular exposure (4–7 days a week). Covariates including potential mediators and confounders were chosen a priori on the basis of literature review. Covariates in our study were age (≤ 25 , 26–30, 31–35, 36–40, or ≥ 41 years), employment (yes or no), education (junior high school and below, senior high school, or college and above), per capita family monthly income ($< ¥3000$, ¥3000–4000, or $\geq ¥4001$), history of abnormal pregnancy (yes or no), number of gestational diseases (0, 1, or ≥ 2), social support from friends (yes or no) and negative life events in the last month (yes or no). For the question of number of gestational diseases, participants were asked if they were under treatment for any of the following diseases: hypertension, cardiomyopathy, anemia, thalassemia, diabetes, hepatitis, abortion, urinary system infection, vaginitis, sexually transmitted disease (STD), or other diseases. Negative life events referred to responding ‘yes’ to any of the following events occurred in the past month in participants' families: financial problems, theft, poor housing, violent/suicidal/criminal behaviors of family members, accident/disaster, separation from parents, severe medical problems of the participants, or death of extended family members.

2.5. Data analysis

The univariable and multivariable logistic regression models were fitted to calculate the odds ratios (ORs) and 95% confidence interval (CIs) for evaluating the frequency-risk relations between SHS exposure and depressive symptoms (including binary logistic regression for binary probable or severe depressive symptoms and multinomial logistic regression for categorized depressive symptoms). Linear trends were assessed by modeling exposures as ordinal variables in logistic regression models. Potential confounders were controlled by a review of putative risk factors for depressive symptoms and a 10% or greater change in the β coefficients for SHS exposure between the crude and the adjusted models. The likelihood ratio tests were used to assess the effect modification by comparing nested models. We defined a two-sided p -value of ≤ 0.05 as being of statistical significance. All statistical analyses were conducted with STATA version 14.0 (StataCorp LP, College Station, Texas, USA). For this study, only non-smokers were included in the analyses.

3. Results

3.1. Characteristics of the sample

Table 1 shows sample characteristics. A total of 2176 non-smokers were analyzed in this study. As for depressive symptoms, 228 (10.5%) were classified as having probable depressive symptoms (CES-D score ≥ 16) and 44 (2.0%) had severe depressive symptoms (CES-D score ≥ 24). The prevalence of SHS exposure in general was 44.6%, and was significantly higher in homes (40.0%) than in workplaces (20.3%) ($\chi^2 = 155.57$, $p < 0.001$).

3.2. Relation between SHS exposure and probable depressive symptoms

Table 2 presents the relation between SHS exposure and probable depressive symptoms. SHS exposure in general was not significantly associated with probable depressive symptoms (OR = 1.05, 95% CI 0.77–1.43), and no significant associations were found in pregnant women with SHS exposure in homes (OR = 1.08, 95% CI 0.79–1.49), in

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