PreCEE (Pregnancy and Combined Environmental Exposure), a research program in two middle-sized cities - Part 1, Population and methods

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PreCEE (PREGNANCY AND COMBINED ENVIRONMENTAL EXPOSURE), A RESEARCH PROGRAM IN TWO MIDDLE-SIZED CITIES - PART 1, POPULATION AND METHODS

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ABSTRACT

The PreCEE (Pregnancy And Combined Environmental Exposure) research program aims to assess the relationships between environmental exposure to noise and air pollution and the occurrence of adverse pregnancy outcomes. It has been conducted since 2012 in the region of Bourgogne-Franche-Comté. Nearly 11,000 deliveries that occurred between 2005 and 2009 at the Besançon or Dijon University Hospital were included. Delivery data, medical and obstetrical history, socio-economic conditions and living environment were collected from medical records. Environmental prediction models were used to assess outdoor pollutant exposures using MITHRA-SIG, COPERT IV and ADMS-Urban software. Air pollution, proximity to green spaces and noise were quantified at the living neighbourhood scale of each building. Furthermore, noise levels were also calculated in front of the entire façade and in front of the most exposed façade of each building. A deprivation index was calculated for the two cities. Logistic regression analyses were performed using classical and multilevel models. Many sensitivity analyses were conducted to explore the potential influence of the retained definition of exposure (pollutant, living area, time exposure window), adverse pregnancy outcomes (birth weight standards...) and missing data treatment. Technical, legal, and ethic parts of the project had also to be cautiously considered in the program.

1. INTRODUCTION

The occurrence of complications during pregnancy - such as hypertensive disorders, premature delivery, fetal growth disorders - can have serious consequences on the health of the mother and / or the newborn, in particular on children's physical and intellectual development [1-2]. Adverse pregnancy outcomes (APO) are associated with many and various factors related to the course of pregnancy, the mother's characteristics, and her socio-economic and professional conditions [3]. Beyond the well-known risk factors, additional environmental factors, such as air pollution or noise, are suspected to play a role.

In urban areas, the density of pollution sources combined with a high number of residents, constitute the optimal conditions for simultaneous exposure of pregnant women to many environmental pollutants. The link between environment and pregnancy outcome has been highlighted over the past 10 years. Most of studies on air pollution exposure to carbon monoxide (CO), nitrogen dioxide (NO_2) or particulate matter (PM_{10}, $PM_{2.5}$) reported a higher risk of fetal growth restriction [4–7]. Effects on preterm birth appear to be more discussed [4–6,8]. Recent studies have suspected adverse associations with environmental noise, especially for low birth weight [9,10]. A benefic effect of maternal proximity to green spaces on birth weight was highlighted by few studies [11,12].

The aim of the PreCEE (Pregnancy And Combined Environmental Exposure) research program is to study the influence of environmental exposures to noise and air pollution on the occurrence of APO. More specifically, preterm birth, fetal growth disorders (fetal growth restriction / small for gestational age), hypertensive disorders of pregnancy, and gestational diabetes will be investigated.

2. POPULATION AND METHODS

2.1 Population

This epidemiological observational retrospective study included all adult women, living in Besançon or in the urban unit of Dijon, having given birth at the Dijon or

Besançon University Hospital between 1 January 2005 and 31 December 2009 (11,000 deliveries).

Besançon (120 000 inhabitants) and Dijon (155 000 inhabitants) are two medium-sized French cities located in the Burgundy-Franche-Comté region. The urban unit of Dijon has 238 000 inhabitants (INSEE, 2007).

Both stillborn and liveborn infants newborns whose birth occurred after 22 completed weeks of gestation and/or with a birthweight of 500 g or above were included. Induced abortions, pregnancies with missing or invalid data for delivery date or address of residence at the baby's birth were excluded.

2.2 Methods

2.2.1 Individual data

Address of the women, medical and socio-demographic data were obtained from the computerized obstetrical record of each university Hospital.

2.2.2 Socio-economic data

A neighborhood deprivation index was calculated according to the approach developed by Lalloué et al. [13], at the IRIS scale (statistical unit of approximately 2000 individuals with relatively homogeneous social characteristics) provide by the French National Institute of Statistics and Economic Studies for population censuses (INSEE). Variables related to family and household characteristics, immigration and mobility, employment and income, education and housing were extracted from the 2008 INSEE database.

2.2.3 Noise exposure assessment

The noise prediction model MITHRA-SIG (Géomod / CSTB) was used to assess outdoor noise level in front of each residential building (address of the women at the date of delivery). Noise sources included in the model were road traffic, rail traffic and pedestrian streets [8]. Road and railway traffics were the main noise and air pollution sources of these medium-sized cities. Five A-weighted noise levels indicators were calculated: daily L_{Aeq} (L_{24h}), $L_{Aeq,day}$ (06:00-18:00), $L_{Aeq,evening}$ (18:00-22:00), $L_{Aeq,night}$ (22:00-06:00), and the combined day-evening-night index (L_{den}).

2.2.4 Air pollution exposure assessment

Two pollutants related to road traffic and residential heating were studied: NO_2 and particulate matters PM_{10} using a two-step emission and diffusion modeling [8]. The CIRCUL'AIR software, developed and used by each approved French Air Quality Monitoring Agencies was used to calculate road traffic emission. The ADMS-Urban (CERC) was used to assess air pollution diffusion.

Air pollution indices were calculated considering a 50m radius buffer centered on each mother's residential building. To account for the temporal variability of weather conditions and the seasonal variations in concentrations of pollutants in the air, monthly maps have been calculated. For each woman, monthly NO_2 and PM_{10} exposure levels during pregnancy have been considered.

2.2.5 Green spaces proximity

Two green space proximity indices were calculated using the vegetation data identified by the French National Geographic Institut (BDTOPO®): a lack of wooded space within a 100 m buffer around the residential building and a distance home - public green space greater or equal to 500 m.

3. RESULTS

The results of this study are presented in the next presentation.

4. REFERENCES

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