PreCEE (Pregnancy and Combined Environmental Exposure), a research program in two middle-sized cities - Part 2, Results and discussion

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PreCEE (PREGNANCY AND COMBINED ENVIRONMENTAL EXPOSURE) A RESEARCH PROGRAM IN TWO MIDDLE-SIZED CITIES - PART 2, RESULTS AND DISCUSSION

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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 (APO). Data from nearly 11000 deliveries that occurred between 2005 and 2009 at the Besançon or Dijon (France) were collected, including medical, obstetrical, socio-economic and environmental conditions. Air pollution, proximity to green spaces and noise exposure were quantified at the living neighbourhood scale of each residential building. A deprivation index was calculated for the two cities. Several approaches were conducted to investigate the relationships between the occurrence of APO (preterm birth, fetal growth disorders, hypertensive disorders) and the urban environment of two middle-sized cities. The relationship between APO and the accumulation of vulnerability markers during pregnancy (medico-obstetrical, demographic, behavioral and environmental dimensions) was also investigated.
The risk of APO increased significantly with the cumulative number of vulnerabilities.
In women with uncomplicated pregnancy, no significant differences in pollutant exposure levels were found between cases and controls.
In pregnancies with associated comorbidities, low levels of air pollution do not seem to affect preterm delivery. However, moderate noise exposure could potentially affect pregnancy when associated with vulnerability factors.

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

This section is described in the previous paper (FA2020/1106): PreCEE (Pregnancy and Combined Environmental Exposure), a research program in two middle-sized cities - Part 1, Population and methods.
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.

2.1 Vulnerability accumulation during pregnancy

A first approach based on the accumulation of vulnerability markers during pregnancy was conducted. Fifteen vulnerability markers regrouped in six dimensions (maternal age, smoking, body mass index, socio-economic, medico-obstetrical and environmental vulnerabilities) were analyzed in comparison with two APO (preterm birth, low birth weight) and two pregnancy complications (preeclampsia and vaginal bleeding during the second and third pregnancy trimesters).

2.2 Preterm birth

Two case-control studies were conducted on preterm delivery on single pregnancies.
First, only pregnancies without any associated comorbidities were considered (N=1511).
Secondly, only pregnancies with associated comorbidities were considered (N=2503).

3. RESULTS

3.1 Vulnerability accumulation during pregnancy

Among the 3686 women included in this approach, 21% were not exposed to any marker and 19% accumulated three or more markers among the six dimensions. The risk of APO increased significantly with the cumulative number of vulnerabilities.

3.2 Case-control studies

3.2.1 Pregnancies without any associated comorbidities

The correlation between noise and NO_2 indices ranged from 0.41 to 0.59. The mean NO_2 level ranged between 24 and 25 $\mu g/m^3$ and the mean L_{night} ranged between 51 and 52 dB(A). No significant differences in pollutant exposure levels were found between cases and controls in this study. The adjusted odds ratios (OR) ranged between 0.96 and 1.08. Sensitivity analysis conducted using different temporal and spatial exposure windows demonstrated the same results.

3.2.2 Pregnancies with associated comorbidities

The OR associated with $NO_2 > 40\mu g/m^3$ was 0.83 (95%CI: 0.61-1.13) and the OR associated with $L_{night} \geq 55$dB(A) was 1.23 (95%CI: 0.97-1.56). A strong and monotonic association between the cumulative number of comorbidities during pregnancy and preterm delivery was also identified.

4. DISCUSSION

By combining medical, behavioral, socio-economic and environmental markers, this study shows that vulnerabilities tend to accumulate in a part of the pregnant women. This accumulation seems to represent a particular risk of adverse pregnancy outcome or complication during pregnancy. This study confirms the need to identify vulnerable women as early as possible during pregnancy to adapt their pregnancy monitoring to avoid complications.

Low levels of air pollution do not seem to affect preterm delivery. However, moderate noise exposure could potentially affect pregnancy when associated with vulnerability factors.

5. REFERENCES

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