**Title:** Maternal exposure to urban environmental stressors and depression in the postnatal period: evidence from the EU Child Cohort Network

**Summary:** Maternal postnatal depression is characterised by symptoms of depressed mood, anxiety and anhedonia in the year following birth and is estimated to affect 6 – 38% of women in high income countries.(1, 2) Not only is it by nature distressing, postnatal depression may interfere with the mother’s ability to care for the baby and handle other daily tasks and is a risk factor for child mental health problems.(3) It is vital therefore to identify potentially modifiable risk factors to inform policy and interventions.

With an ever-increasing proportion of EU citizens living in cities, increasing attention is turning to the role of urban environmental stressors such as ambient air pollution, road traffic noise and lack of access to natural spaces on mental health. (4-8) These stressors could impact maternal mental health through biological routes (e.g. neurotoxic effects of air pollution), (9) or as psychosocial stressors (e.g. disrupted sleep due to noise, annoyance, limited natural spaces to relax, exercise and socialise). (10, 11)

Whilst experimental studies provide evidence in support of the mechanisms through which environmental stressors could cause maternal depression, the epidemiological evidence is very limited. One small study reported a positive association between exposure to particulate matter during pregnancy and postnatal depression at 6 months, (12) whilst a second reported associations close to null. (13) To our knowledge only one study has examined the association between residential noise and postnatal depression, finding an increased risk of hospitalisation. (14) The evidence for the association between exposure to natural spaces and depression *during pregnancy* is mixed; (15, 16) however to our knowledge no studies have examined associations between exposure to natural spaces and depression in the postnatal period. Whilst evidence is emerging for the role of the urban environment in depression in other periods of life, (17-20) it is essential to look specifically at the perinatal period given the heightened vulnerability to stressors at this time.

In this project we will use data from nine cohorts in the EU Child Cohort Network to study associations between exposure to urban environmental stressors in the perinatal period and maternal postnatal depression. Single and joint effects of ambient air pollution, road traffic noise and natural space will be studied along with interactions between these stressors and socioeconomic position. This project will generate new data needed to inform EU policy aiming to improve maternal and child mental health.

**Key objective:** To study the association between maternal exposure to urban environmental stressors and postnatal depression in nine EU birth cohorts.

**Relevance to LifeCycle Network:** This project addresses the central aim of LifeCycle: to provide evidence on the influence of early life stressors on subsequent health. It makes use of the EU Child Network and DataSHIELD as a method of federated analysis. It uses environmental exposures derived in WP3.1.3 and contributes towards the WP6 objective to study the influence of early life stressors on mental health.

**Research Design.** Eligibility: Analysis will be restricted to singleton pregnancies of women without pre-existing depression giving birth to liveborn children. The following nine cohorts will be invited to participate as they have data on environmental exposures and maternal postnatal depression: ALSPAC, BiB, DNBC, EDEN, GenR, INMA, NINFEA, MoBa and RHEA. Exposures: Ambient air pollution will be indicated by Nitrogen dioxide (NO2) and the inhalable fraction of particulate matter (PM2.5). Long-term exposure to noise from road traffic is averaged over the day, evening and night (Lden). Exposure to natural spaces is captured by Normalized Difference Vegetation Index (NDVI) and distance to nearest green and blue spaces >5000m2. (21) Three periods of exposure have been identified *a priori*: (i) perinatal (pre and post), ii) prenatal (LMP to birth) and iii) postnatal (birth to child age 1). Outcome: Binary variable indicating the presence of postnatal depression based on validated questionnaires or linked registry data. Confounders: Whilst many variables are associated with postnatal depression, few are also associated with exposure to environmental stressors. We will adjust for maternal socioeconomic position (SEP) as indicated by maternal education and areas-specific SEP. We will also adjust for child sex to improve statistical precision. In sensitivity analyses we will repeat analyses restricting the sample to pregnancies free of comorbidities (gestational diabetes, hypertensive disorders and preterm deliveries). Statistical analysis: Logistic regression will be used to estimate separate and combined associations between the three environmental exposures (noise, air pollution and natural spaces) during (i) pregnancy and (ii) the postnatal period with maternal postnatal depression. Previous studies have reported effect modification by socioeconomic position so we will additionally test for this by comparing nested models with and without interactions terms between SEP and the exposures. Analysis will be conducted using the “ds.glm” and “ds.glmSLMA” in DataSHIELD. Cross-cohort analysis will be done by individual participant data (IPD) meta-analysis with study-level meta-analysis (SLMA) used as a sensitivity analysis. Feasibility. All functionality to perform the analyses is available within DataSHIELD. I have successfully completed analyses using DataSHIELD (WP4 ‘proof of concept’ project) and I am delivering regular webinars training LifeCycle researchers on using DataSHIELD. The project brings together the complementary experience of myself (mental health, DataSHIELD analysis), Ass. Prof. Strandberg-Larsen (mental health) and Ass. Prof. Pedersen (urban environment and health).

**Relevance for Science and for Junior Researcher**

This is an innovative project which makes use of environmental exposures newly derived within LifeCycle. To our knowledge it will be the first multi-cohort study to examine the associations between urban environmental stressors and maternal mental health. This fellowship will provide me with experience working in different research environments and develop collaborations for future projects and funding applications. It will enhance my competitiveness for a Marie Curie fellowship application being prepared in conjuncture with UCPH and IS Global. It will also develop my theoretical knowledge of environmental stressors and experience using these exposures in analyses. It will enable knowledge transfer between researchers at Bristol, UCPH and the wider LifeCycle network. To UCPH: whilst on the fellowship I will provide training on data analysis and trajectory modelling using DataSHIELD. To UNIV Bristol: by sharing my experiences and presenting findings on return from the fellowship; Across LifeCycle network: At the first GA following completion of the fellowship I will present findings from this project and describe my experiences at UCPH.

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