INTERNSHIP PROPOSAL, year 2026-2027

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Duration: 6 months

The internship will be located in (city, country): Paris, France

Description of the internship topic

Maternal plant-based diet during pregnancy and child language development: analyses in French mother-child cohorts

Background:

Reducing the consumption of animal-source foods is a major environmental and public health challenge, and a shift towards plant-based diets has been estimated to bring substantial health and environmental benefits[1]. However, plant-based diets may provide lower intakes of several nutrients involved in fetal brain development, such as vitamin B12, iron, zinc, iodine and long-chain omega-3 fatty acids (DHA)[2]. Pregnancy is a period of rapid brain development, and maternal diet quality during pregnancy has been associated with offspring cognitive and behavioural outcomes[3].

Evidence on plant-based diets during pregnancy and child neurodevelopment remains scarce and is mostly limited to comparisons of vegetarian and non-vegetarian mothers. Studies in the United Kingdom and Denmark did not report associations between maternal vegetarianism and child cognitive performance or neurodevelopment[4,5]. However, vegetarian status concerns a small proportion of women and captures neither the gradient of plant-food consumption in the general population nor the nutritional quality of the plant foods consumed. Plant-based diet indices address both limitations: the overall plant-based diet index (PDI) reflects the degree of plant-based eating, while the healthful (hPDI) and unhealthful (uPDI) indices distinguish healthy plant foods (e.g. whole grains, fruits, vegetables, legumes, nuts) from less healthy ones (e.g. refined grains, sweets, sugar-sweetened beverages)[6].

Language is a relevant developmental domain in this context. Early language skills can be assessed with validated parent-report instruments from the second year of life onwards and are associated with later cognitive and academic outcomes. In the nationwide ELFE cohort, maternal dietary patterns during pregnancy have been associated with child neurodevelopment up to 3.5 years[7], but the specific role of plant-based eating, and language outcomes in particular, has not yet been examined. As language development is strongly socially patterned, careful control for family socioeconomic characteristics and the home language environment is required.

This internship is part of the ANR-funded VegPregnancy project (coordinator: B. de Lauzon-Guillain, CRESS), in which our team leads the work package on maternal mental health and child neurodevelopment.

Objectives: The main objective is to examine the associations between maternal plant-based diet during pregnancy (PDI, hPDI, uPDI) and child language development at 2 years. Secondary objectives are to (i) examine whether associations differ by child sex, and (ii) if time allows, describe associations with language development across early childhood (1 to 3.5 years).

Methods: The research questions will be addressed using data from three French mother-child cohorts: ELFE, a nationally representative birth cohort (n=18,329 children born in 2011)[8], EDEN (n=2,002, recruited in 2003-2006)[9] and SEPAGES (n=484, recruited in 2014-2017). In all three cohorts, maternal diet was assessed with the same food frequency questionnaire, developed for the ELFE study[10], completed at delivery (covering the last trimester of pregnancy) and, in EDEN and SEPAGES, also in the first trimester. Following the VegPregnancy harmonisation procedure, the PDI, hPDI and uPDI are computed from 18 food groups using quintile cut-offs derived in ELFE, which enables comparison and pooling across cohorts.

Child language will be assessed primarily with the short French version of the MacArthur-Bates Communicative Development Inventory at 2 years, available in all three cohorts[11]. Secondary outcomes include the language-expression and language-comprehension scales of the Child Development Inventory at 1, 2 and 3.5 years in ELFE[12].

Associations will be estimated using multivariable linear regression (continuous scores) and logistic regression (low scores, e.g. below the 10th percentile). Confounders will be selected using a directed acyclic graph informed by the literature. Analyses will first be conducted in ELFE and replicated in EDEN and SEPAGES; where measures are harmonised, data will be pooled and heterogeneity across cohorts tested. Effect modification by child sex will be tested using interaction terms.

Activities to be conducted:

- Literature research in international bibliographic databases and development of a conceptual framework (including a directed acyclic graph) to organize thinking, analysis and writing.
- Writing a data analysis plan
- Management and analysis of the ELFE, EDEN and SEPAGES data (including variable construction, identification of relevant covariates, handling of missing data)
- Implementation of statistical approaches such as multivariable linear and logistic regression, multiple imputation, inverse probability weighting and pooled analyses across cohorts
- Presentation of the results at VegPregnancy project meetings
- Writing of the dissertation according to the modalities defined by the university

A scientific publication of the results is possible.

Requested Competences/qualities:

- Capacity to work independently, sense of organization
- Familiarity with statistical analysis in R (or equivalent statistical software)

- Knowledge of basic statistical modelling, and affinity with/interest in applying more complex methods
- Interest in nutritional epidemiology and/or child development
- Good knowledge of English

Selected literature

1. Springmann, M. *et al.* Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *Lancet Planet Health* **2**, e451–e461 (2018).
2. Neufingerl, N. & Eilander, A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: a systematic review. *Nutrients* **14**, 29 (2021).
3. Borge, T. C., Aase, H., Brantsæter, A. L. & Biele, G. The importance of maternal diet quality during pregnancy on cognitive and behavioural outcomes in children: a systematic review and meta-analysis. *BMJ Open* **7**, e016777 (2017).
4. Crozier, S. R. *et al.* Vegetarian diet during pregnancy is not associated with poorer cognitive performance in children at age 6–7 years. *Nutrients* **11** (2019).
5. Larsen, P. S. *et al.* Maternal vegetarianism and neurodevelopment of children enrolled in the Danish National Birth Cohort. *Acta Paediatr* **103**, e507–e509 (2014).
6. Satija, A. *et al.* Healthful and unhealthful plant-based diets and the risk of coronary heart disease in U.S. adults. *J Am Coll Cardiol* **70**, 411–422 (2017).
7. de Lauzon-Guillain, B. *et al.* Maternal diet during pregnancy and child neurodevelopment up to age 3.5 years: the nationwide Étude Longitudinale Française depuis l'Enfance (ELFE) birth cohort. *Am J Clin Nutr* **116**, 1101–1111 (2022).
8. Charles, M. A. *et al.* Cohort profile: the French national cohort of children (ELFE): birth to 5 years. *Int J Epidemiol* **49**, 368–369j (2020).
9. Heude, B. *et al.* Cohort profile: the EDEN mother-child cohort on the prenatal and early postnatal determinants of child health and development. *Int J Epidemiol* **45**, 353–363 (2016).
10. Kadawathagedara, M. *et al.* Diet during pregnancy: influence of social characteristics and migration in the ELFE cohort. *Matern Child Nutr* **17**, e13140 (2021).