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Socioeconomic issues of global public health concerns: an empirical investigation

Pierre Levasseur

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Ecole Doctorale d'Économie Panthéon-Sorbonne
[ED 465]

SOCIOECONOMIC ISSUES OF GLOBAL PUBLIC HEALTH CONCERNS
-AN EMPIRICAL INVESTIGATION-

Pierre Levasseur

Research report to obtain a post-doctoral degree
(*Habilitation à diriger des recherches – HDR*)

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PRODUCTIONS AND PROJECTS CITED IN THE REPORT

Selected publications

- The impacts of school starting age on nutrition: The case of emerging countries (2022), *Economics & Human Biology* vol.45, IF=1.64.
- Is overweight still a problem of rich in sub-Saharan Africa? Insights based on female oriented demographic and health surveys (2022), with Bertille Daran (PhD student), *World Development Perspectives* vol.25, IF=1.22.
- Does pollution perception lead to risk avoidance behaviour? A mixed methods analysis, with Katrin Erdlenbruch, Christelle Gramaglia, et al. (2022), *Review of Social Economy*, IF=0.38.
- Health and social costs induced by exposure to soil pollution: Evidence from a comparative study (2021), with Katrin Erdlenbruch and Christelle Gramaglia, *Journal of Public Health*, IF=1.00.
- Why do people continue to live in polluted areas? Empirical evidence from Southwestern Europe (2021), with Katrin Erdlenbruch and Christelle Gramaglia, *Environmental Modeling and Assessment* vol.26, p.631-654, IF=2.33.
- Does inequality have a silver lining? Municipal income inequality and obesity in Mexico (2021), with Matthieu Clement, Suneha Seetahul and Lucie Piaser (PhD student). *Social Science & Medicine* vol.272, IF=4.39.
- Why conditional cash transfers programs fail to target the poor? The case of urban Mexico (2021), *CEPAL Review* 133, IF=0.66.
- Do junk food bans in school really reduce childhood overweight? Evidence from Brazil (2020), *Food Policy* vol.99, IF=4.55.
- Is excess weight penalised or rewarded in middle-income countries' labour markets? Comparative evidence from China, India and Mexico (2020), with Matthieu Clément and Suneha Seetahul, *Kyklos* vol.73(2), p.161-195, IF=1.89.
- Educational penalties of childhood obesity in an emerging country (2020), *Public Health Nutrition* vol.23(18), p.3394-3408, IF=4.02.
- Dynamics of the bodyweight-wage relationship in emerging countries: Evidence from Mexico (2020), *Revue d'Economie du Développement* vol.28(2), p.105-148, IF=0.19.
- Can social programs break the vicious cycle between poverty and obesity? Evidence from urban Mexico (2019), *World Development* vol.113, p.143-156, IF=5.28.
- Implementing a regression discontinuity design to explore the heterogeneous effects of obesity on labour income: The case of Mexico (2019), *Journal of Public Health* vol.27, p.89-101, IF=1.00.
- How does childhood obesity affect school achievement? Contributions from a qualitative analysis implemented in Mexico City (2017), with Luis Ortiz-Hernandez, *Autrepart* vol. 83, p.51-72.
- Causal effects of socioeconomic status on central adiposity risks: Evidence using panel data from urban Mexico (2015), *Social Science & Medicine* vol.136-137, p.165-174, IF=4.39.

Working papers

- The role of gender inequality in the obesity epidemic: the case of India, with Valentina Alvarez-Saavedra (PhD student) and Suneha Seetahul, in revision in *Journal of Development Studies*, IF=1.99.
- Meat consumption, socioeconomic status, and body mass, with Olga Davidenko, Isabelle Denis and François Mariotti, in revision in *PLOS ONE*, IF=3.04.
- ‘Mother’s milk’: Is there a social reversal in breastfeeding practices along with economic development?, with Matthieu Clément and Elodie Rossi (PhD student), presented to international conferences (European Association for Population Economics, Cosenza, June 2022; International Conference of Development Economics, Clermont-Ferrand, July 2022).

Ongoing projects (as coordinator)

- *SubMeat* (2022-2026): Poverty as a major constraint to the ongoing protein transition: investigating unhealthy meat substitutions, co-coordinator with Olga Davidenko (AgroParisTech), 560k€; including 500k€ by the French Research Agency, 20k€ by AgroParisTech, 40k€ by Region Ile-de-France.
- *Obes’ Islands* (2022-2023), Effects of clean water accessibility on soda consumption and obesity in Kiribati, with Suneha Seetahul (University of Sydney), 5kAUD by the Academy of Social Sciences and the French Embassy in Australia.
- *ObeCity*: Area determinants of risky food behaviors and obesity in developing countries: the case of Mexico, with Matthieu Clément (Université de Bordeaux), Lucie Piasser (Université de Bordeaux), Baptiste Girault (INRAE), Luis Ortiz-Hernandez (Universidad Autonoma Metropolitana) and Mishel Unar-Munguia (Mexican Institute of Public Health), fundraising phase.
- *Green Wellbeing*: Assessments of local greening interventions on individual and collective wellbeing, with Christine Aubry (INRAE), Maia David (AgroParisTech), and Baptiste Girault (INRAE), under construction.

RESEARCH REPORT

Introduction

To address emergent global public health and ecological issues and achieve sustainable development paths, structural changes in production and consumption habits are urgently needed, as argued by the United Nations.¹ Although the COVID-19 pandemic exposed everyone to the existence of links between health and ecological concerns, other hidden diseases have even more devastating effects on human mortality. For instance, according to the World Health Organization (WHO), the overweight and obesity epidemic kills 2.6 million people per year, resulting in around 5.2 million deaths in the last two years,² which is just a bit less than the 6.3 million deaths caused by COVID-19 in the last two years, from March 2020 to May 2022 (Ritchie et al., 2020).³ Even more critically, exposure to air, soil, and water pollution kills around 9 million people per year (Fuller et al., 2022).⁴ It is noteworthy that there are different trends if we compare mortality curves between infectious diseases such as COVID-19 and chronic, so-called ‘man-made’ or ‘non-communicable’ diseases resulting from factors such as obesity or pollution exposure (e.g. cancers, diabetes, and heart attacks). Infectious diseases are characterized by mortality peaks that decrease over time thanks to progressive immunity in the host population, whereas mortality due to chronic diseases is amplified by our ways of life and tends to increase over time (Perlman, 2013). Regarding chronic diseases, projections for the coming decades are alarming. According to estimates based on current trends, half of the worldwide adult population will be overweight by 2025, and half will be obese by 2050 (Lobstein and Jackson Leach, 2007 ; NCD-Risk Factor Collaboration, 2016). Likewise, the amount of chemical manufacturing, which is known to be highly detrimental to the health of populations living near manufacturing sites, is on track to double by 2030 worldwide (Fuller et al., 2022).

To respond to these emerging global concerns, researchers aim to explore transition pathways toward more virtuous and environmentally friendly economies by identifying potential barriers and levers. This is the principal research objective of the French Research Institute for Agriculture, Food, and Environment (INRAE), and especially that of its department of Action

¹ <https://www.un.org/sustainabledevelopment/>

² <https://www.who.int/news-room/facts-in-pictures/detail/6-facts-on-obesity>

³ <https://ourworldindata.org/covid-deaths>

⁴ [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)
<https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>

and Transitions (ACT),⁵ to which I was recruited in 2019. The transitions studied in the ACT department rely on all aspects of production and consumption habits that are harmful to humans, animals, and the planet (based on the concept of one health), which non-exhaustively include the ecological transition (towards cleaner and sustainable production), the food transition (towards a sustainable and healthy diet), the nutrition transition (towards better nutritional and health status), and the epidemiological transition (towards control of chronic diseases and zoonosis).

All these transitions are of interest to economists insofar as they imply macroeconomic and microeconomic challenges. Indeed, it is important to note the North–South heterogeneity in the stage of advancement of all the transitions. For instance, although high-income countries are responsible for 79% of historical carbon emissions that occurred from 1850 to 2011 (Center for Global Development)⁶, there is evidence of an environmental Kuznets curve (i.e. a reversal in the association between GDP per capita and pollution emissions once a certain level of national income is reached) conditioned by the implementation of ambitious regulatory policies to limit emissions (Dinda, 2004). Similarly, the food and nutrition transitions strongly depend on the level of economic development, as the prevalence of overweight status and obesity (and related chronic diseases) increases along with the processes of urbanization, globalization, and tertiarization. However, although the prevalence of obesity continues to increase in all countries worldwide, this increase is mitigated in high-income countries that have massively invested in public health policy, leading to the premise of Kuznets curves for obesity and chronic diseases (Nagano et al., 2020 ; Windarti, Hlaing and Kakinaka, 2019). Despite this relative progress, high-income countries remain trapped in inefficient stages of ecological, food, and nutrition transitions (in absolute terms) and seem to still be far from overcoming them. In fact, rich countries appear to be caught in a socio-ecological trap characterized by high emissions of residuals in air, soil, and water; high soil erosion; and a substantial decline in biodiversity (Mills and Waite, 2009). Similarly, these countries are caught in food and nutritional traps characterized by unhealthy and unsustainable diets based on processed and meat-based foods with high carbon footprints (Béné et al., 2020 ; Ulijaszek, Mann and Elton, 2012). Consequently, in addition to analyses of the ongoing transitions occurring in the developing world, analyses are needed of the barriers that stall these transitions at inefficient stages in more advanced economies.

⁵ <https://www.inrae.fr/en/about-us>; <https://www.inrae.fr/en/divisions/act>

⁶ <https://www.cgdev.org/media/who-caused-climate-change-historically>

There is strong microeconomic (or within-country) heterogeneity in the negative health externalities resulting from food, nutritional, and ecological issues. Indeed, all countries are concerned with food and nutritional inequalities, although the form and intensity of these inequalities depend on the level of economic development and advancement in the respective transitions (Sobal and Stunkard, 1989 ; Dinsa et al., 2012). Moreover, the last few decades have been marked by an increase in environmental inequality within most countries, whereby groups with low socioeconomic status (SES) are more likely to be exposed to nuisances, pollution, and effects of climate change than groups with higher SES (Carmin and Agyeman, 2011 ; Shao, Liu and Tian, 2021; Barbier and Hochard, 2019 ; Chancel, 2020).

My research aims to use an empirical approach to better understand the dynamics and interactions that exist between microeconomic and macroeconomic heterogeneities and food and ecological vulnerabilities. Specifically, one part of my work examines the relationships between household SES, risky behaviors, and health outcomes while systematically accounting for the national level of economic development and cultural specificities. I also lead research to assess public policy that aims to reduce food and ecological vulnerabilities. My research contributes to the scientific community and society in several ways. First, it provides insights into the complex and changing associations between poverty, public health, and economic development to enable more efficient allocations of public funds and international aid. Second, it highlights potential constraints that impede the transitions toward sustainable development paths. Identifying such potential constraints is important in a diagnostic sense since it helps define hypothesis that can then be tested by experimental or quasi-experimental approaches to identify causality. Third, by describing the role of public policies as a potential lever to accelerate ongoing transitions, my results inform concrete recommendations to decision-makers.

In this research report, I succinctly present my previous, ongoing, and future works, which take the form of publications, working papers, and research projects (listed on pages 7 and 8). In Section 1, I describe studies to analyze issues associated with food and nutritional inequalities. In Section 2, I list works and projects to investigate issues related to environmental inequalities, including ecological inequalities and inequalities in the built and sociodemographic living environment. In Section 3, I report some of my results that have direct and indirect implications for public policy. Finally, after a short concluding section about the main contributions of my previous and current work, I present some future research avenues I plan to develop in the next five years.

Section 1: Food and nutritional inequality

1.1. Social class, inequality, and weight gain

In my first research article, developed during my Ph.D. studies and published in *Social Science & Medicine* (2015), I used panel data from Mexico, a middle-income country, to perform an econometric investigation of how social class, as previously measured in 2002 using a clustering approach, was associated with adult weight gain between 2002 and 2012. Contrary to high-income and low-income countries where the association tends to be linear (negative for the former and positive for the latter) (Sobal and Stunkard, 1989 ; Templin et al., 2019), I found that the association in Mexico is nonlinear, highlighting the overexposure of a lower-middle class (emerging from poverty) to excess weight. This result suggests that gaining an additional income might be a risk factor when the level of education (including nutritional knowledge) remains unchanged and relatively low. Those nonlinear results are in accordance with the theory that a social reversal in obesity burden coincides with economic development and the nutrition transition, shifting from the rich to the poor and transiting via the middle classes (Monteiro, Conde, et al., 2004a ; Monteiro, Moura, et al., 2004).⁷ To further investigate this social shift in obesity burden during economic development, I managed a short-term project funded by the INRAE Global Food Security program. With these funds, I recruited Bertille Daran (Ph.D. student since 2022, INRAE) as an intern to help merge and analyze all demographic and health surveys (DHS) that were available for sub-Saharan Africa. This work combined linear regression models and an instrumental variables strategy⁸ to compare the SES–obesity relationship between low-income and middle-income countries in sub-Saharan Africa. Published in *World Development Perspectives* (2022), the results updated the global knowledge

⁷ Theorized by Popkin (1993), the nutrition transition refers to changes in the composition of diet (more specifically called food transition) and related nutritional status. In the stage of food/nutrition transition where most of countries are currently blocked, diet becomes more saturated with fat, sugar, carbohydrates and processed foods, and less consistent in fibers and fresh products. This increase in calorie intakes is accompanied with a reduction of energy expenditures due to the adoption of more sedentary lifestyles. Because of this increasing calorie imbalance, people tend to gain weight. Generally, these nutritional changes occur with economic development, urbanization, globalization and tertiarization of the economy. According to Monteiro et al. (2004a), overweight and obesity significantly emerge when a country moves from low national income to lower middle income (considering the World Bank classification). In fact, when national income increases, the lack of food stops to be a common problem for the majority of the population and physical-intensive jobs gradually delocalize in poorer economies; explaining why excess weight gradually affects lower SES groups (a lower middle class first). Simultaneously, the spread of westernized ideals of thinness together with healthy dietary recommendations through improved access to ITC and the media encourage higher SES groups to reject stoutness and adopt healthier behaviors.

⁸ Several instruments were tested: (i) proportion per locality (at the PSU level) of houses fitted with a processed floor (i.e., made of wood planks, parquet, vinyl, ceramic tiles, cement, or carpet) compared to floors left in their original states (i.e., made of earth, sand, or dung); (ii) an individual's religious affiliation; and (iii) the country specific micro-ethnic rank of individuals in society. Each instrument provided consistent results.

regarding the form of the SES–obesity relationship in sub-Saharan Africa (traditionally assumed to be positive), emphasizing a nonlinear U-inverted association in economically more advanced countries. Indeed, we observed an ongoing social reversal of overweight status among lower-middle-income African countries that dated to the end of the 1990s.

In the same vein, a funded project that I am undertaking with Suneha Seetahul (University of Sydney) will explore underexplored causes of weight gain in societies where most of the population is classified as overweight or obese, like in Pacific Islands (the *Obes'Islands* project). Specifically, an intern will be recruited in the spring of 2023 to work on the Kiribati 2019 household survey and investigate how a better access to drinking water (thanks to governmental investments since 2019) may change consumption patterns (focusing on soda intakes and expenditures) and nutritional status. Here, the partial application of water purification measures across communities in 2019 will be treated as exogenous and used in our identification strategy to infer causality.

My interest in identifying potential socioeconomic drivers of obesity in the developing world led me to collaborate with my Ph.D. mentor Matthieu Clément (Université de Bordeaux), Suneha Seetahul (University of Sydney), and Lucie Piaser (Ph.D. student, Université de Bordeaux) to investigate the impacts of municipal income inequality on overweight status and obesity in Mexico. This investigation used an instrumental variables strategy and an original database that combined a household health survey, robust municipal income-inequality measures generated by small area estimation (based on census data and household surveys), and climate data measured at meteorological stations.⁹ Our results, published in *Social Science & Medicine* (2021), showed that income inequality had a different association than absolute SES (i.e. poverty) did with obesity. The risk of obesity was higher for inhabitants in more-equal Mexican municipalities than for those in less-equal municipalities. Further empirical explorations of potential pathways allowed us to better understand these unexpected results by showing that 1) more-unequal municipalities in Mexico may have a low fiscal capacity to fund public services and infrastructures providing basic facilities such as daily water accessibility (helping reduce the risk of infections and weight loss); 2) increased social interactions in more-equal municipalities may increase the frequency of risky outings associated with weight gain (e.g. fast-food consumption or bar attendance); 3) chronic stress among inhabitants in less-equal municipalities may decrease sleep quality and BMI. In addition, a fourth (not tested)

⁹ In the study context, we used precipitation and temperature data as instrument for area income inequality.

explanation might be that variability in body weight is lower in more-equal municipalities where individuals tend to have similar figures, which may impede peer effects, namely, the imitation of the lifestyles of dominant (and healthy) social groups by the poorest social groups.

Another form of inequality involves the violation of women's rights. Indeed, cross-country evidence showed that the gap in obesity prevalence between men and women is higher in countries where women's freedoms are the most restricted (Wells et al., 2012). There are three obese women for each obese man worldwide. Struck by this appraisal, I launched a short-term project with Suneha Seetahul (University of Sydney) and recruited Valentina Alvarez-Saavedra (currently my Ph.D. student), as an intern first and then as a research assistant, to empirically analyze the link between gender-based discrimination and the rise of female overweight status in India. This project was funded by the INRAE Global Food Security program. Fixed-effect estimates, currently in revision for the *Journal of Development Studies* (2022), showed that the direction of the association between gender-based discrimination and female weight depends strongly on the indicator of female discrimination used. Indeed, some forms of mistreatment of women (such as perceived community violence and age difference with a husband) increase the risk of female weight gain and overweight, whereas (assumed) more severe forms of abuse such as child marriage increase the risk of female weight loss and underweight. Moreover, we found that higher decision-making power and autonomy about outings are risk factors for female weight gain and obesity, especially in urban settings; perhaps indicating a higher exposure to urban obesogenic lifestyles among empowered women. Consequently, our results suggested that although improving the status of women in society may be a key action to address the epidemic of obesity, policies must also target risky habits that emancipation may enable in urban (obesogenic) environments.

Currently, I am involved in collaborative research to investigate the social gradient of specific components of the food and nutrition transition, focusing on the last stage of transition (i.e. the speculative adoption of a sustainable and healthier diet and behaviors). For instance, I recently finalized a working paper with Elodie Rossi (Ph.D. student, BSE) and Matthieu Clément (BSE) in which we analyzed a presumed shift in the tradeoff between breastfeeding and the use of formula milk in developing Asian countries during the last three decades. In that study, we merged all Asian DHS rounds to analyze the dynamics of the SES–breastfeeding association across time and levels of economic development. Our results highlighted the occurrence of a breastfeeding transition, and, specifically, a social reversal coinciding with economic development. Indeed, whereas recommended breastfeeding behaviors increased among wealthy

women when countries developed and became richer, such behaviors tended to decrease among underprivileged women who gained better access to formula milk. In the summer of 2022, we presented these results at the 35th Conference of the European Association of Population Economics (Calabria, Italy) and the 2nd Conference of the French Association of Development Economics (Clermont-Ferrand, France, presented by Elodie Rossi).

In another ongoing collaborative research project, I aim to identify potential socioeconomic constraints in the ongoing protein transition (a specific component of the food transition for a healthier and more sustainable diet). This multi-disciplinary project, entitled *SubMeat*, includes a nutrition-behavioral scientist (Olga Davidenko, AgroParisTech), an epidemiologist (François Mariotti, AgroParisTech), a nutritionist (Isabelle Denis, INRAE), colleagues in economics (Emmanuel Raynaud and Emmanuel Paroissien, INRAE), and a project manager in action research programs (Aurélien Zunino, ANCA Chair). First focusing on the French population, this innovative research questions the scientific consensus and political advocacy to progressively reduce meat in the diet (for ecological fairness and health reasons). In the middle run (and even in the short run since the invasion of Ukraine by Russia), the price of meat is expected to increase because of the introduction of tax and quality norms in the meat market and the implementation of meat bans in public catering services. Without additional education campaigns and social transfers for healthy and sustainable food purchases, we assume that an increase in meat prices will have negative health impacts in some situations and subpopulations. Even if it is true that lower meat consumption reduces the risks of obesity and chronic diseases in laboratory experiments and epidemiological studies based on general populations (Mariotti, 2017), this may not be the case for underprivileged subpopulations with income restrictions and low levels of education. Indeed, meat might be hardly substitutable for poor subpopulations within rich countries, at least with everything else being equal. Our preliminary cross-sectional results for France, currently in revision for *Plos One* (2022), showed that poverty might be a potential constraint for the protein transition because reducing meat consumption in the diet is associated with risky food behaviors and weight gain among low-SES individuals, whereas the opposite is true among individuals with middle- or high-SES. Hence, everything else being equal, in rich countries such as France, price-based (e.g. taxes or quality labels) or banning (e.g. exclusively vegetarian meals in collective catering) policies to reduce meat in the diet are likely to worsen health outcomes among underprivileged individuals. As a next step, we plan to test the causality of the relationship in France and examine different substitution pathways and individual motivations. For this, we will use several complementary approaches including: (i)

panel econometric analyses of secondhand household surveys using instrumental variables identification strategy relying on meat price variations relative to other food items; (ii) collection of a firsthand quasi-experimental survey in a university catering setting using “the vegetarian Mondays” as an exogenous intervention forcing students to compose meal-trays without meat; (iii) nutritional experiments with paid participants; and (iv) a randomized controlled trial that will take place in the new experimental university restaurant at Paris-Saclay AgroCampus. From a comparative perspective, we are also applying this research question to India, which is traditionally vegetarian but rapidly increasing in its meat consumption. We assume that the historic skill in preparing vegetarian meals may make the relationship between SES, meat consumption, and health outcomes substantially different in India compared with France. For poor Indians, especially children, higher meat consumption might be associated with better overall health, improved height, and reduced nutritional deprivations (Khusun et al., 2022). By contrast, for richer Indians, higher meat consumption might be associated with risky weight gain due to a shift from a complete and diversified vegetarian diet to an omnivore diet with higher calorie and fat contents, depending on whether meat is used as a complement or a substitute for vegetarian fat and proteins. To implement the *SubMeat* project, we are going to recruit from 2023 a Ph.D. student in economics (under my supervision) and another in nutrition sciences, as well as a research assistant (under my supervision) and several interns.

1.2. Consequences to human capital accumulation and labor market outcomes

During my Ph.D., I studied how obesity status may represent a constraint in social climbing opportunities, with a focus on educational and labor market outputs. One can assume not only that obesity-related diseases may reduce the level of productivity among students and workers, but also that body weight that is “abnormal” for a given society and time may be socially rejected and discriminated against at school and work. With the help of Luis Ortiz-Hernandez (Universidad Autonoma Metropolitana), I conducted a field study that used semi-structured interviews of primary and secondary schoolers in Mexico City to explore the forms of weight-based discrimination and understand the mechanisms that transit from these discriminations to educational failure. This qualitative work, published in *Autrepart* (2017), identified three main transmission mechanisms: a loss of productivity due to weight-based illness and fatigue, a direct social stigmatization taking the form of material aggressions and exclusion by peers, and an indirect social stigmatization referring to psycho-sociological troubles that stigmatized people may express. In addition, this qualitative research suggested important heterogeneity regarding the risk of weight-based discrimination, namely according to fat distribution and body-mass

category. While a moderate excess weight with fat located in “aesthetical parts” (chest, buttocks and hips for young women, but arms and legs for young men) was often socially accepted by participants, and sometimes even preferred, a high excess weight located around the abdomen was often socially rejected. In further research based on quantitative panel data, I subsequently tested the hypothesis that educational failure was higher among students previously classified as being obese and with a concentration of fat around the abdomen (central adiposity). In this study published in *Public Health Nutrition* (2020), I consistently found that childhood obesity and central adiposity were significantly associated with lower school attainment 10 years later (measured by years of schooling and having obtained a high school grade), compared to overweight and normal-weight students (with no significant difference between these two groups). These latter findings crystallized the relative social acceptance of childhood excess weight in Mexico when fat is concentrated around body parts perceived by the majority as aesthetical. The results also showed that the educational penalty of childhood obesity is stronger for girls, high-SES groups, and urban students.

Focusing on the Mexican labor market, I discovered the same trends. Results based on complementary estimation designs (a difference-in-difference approach and a regression discontinuity design) and published in the *Journal of Public Health* (2019) and *Revue d’Economie du Développement* (2020) indicated that overweight status is not particularly penalized in the Mexican labor market, whereas obese status is significantly associated with lower hourly wages, especially for women, individuals in service jobs, and urban workers. These results suggest a co-occurrence of pro-fat and anti-fat social norms in the labor market of emerging countries like Mexico, depending on the levels of economic development, urbanization, and advancement in the nutrition transition (i.e. the prevalence of hunger, overweight, and obesity in the community). Whereas anti-fat norms may particularly concern female, service and urban workers who are more exposed to Western beauty ideals, pro-fat norms may persist among male, manual and rural workers. As a next step to better understand how economic development is related to weight norms and weight-based wage gaps, I collaborated with Matthieu Clément (BSE) and Suneha Seetahul (University of Sydney) on a comparative study of middle-income countries that were at different stages of the nutrition transition in 2011–2012, including India (early stage), China (intermediate stage), and Mexico (advanced stage). Our results, published in *Kyklos* (2020), highlighted country-specific wage penalties of overweight status and obesity. In India, we observed a wage penalty for underweight status together with a wage reward for overweight status, pointing towards the

persistence of pro-fat social norms in a country where hunger is still highly prevalent. Conversely, we observed significant wage penalties for overweight status and obesity in China, especially in non-manual jobs, probably due to a large diffusion of anti-fat social norms in a country where hunger is residual and normal weight is predominant. In Mexico, we observed a wage premium for overweight status in manual jobs but no association between overweight status and wages in non-manual jobs. We speculate that a high prevalence of overweight status (more than 2/3 of the population) may lead to greater social acceptance (i.e. 'new' pro-fat norms). Finally, we explored potential transmission channels through which bodyweight may affect wages. We found evidence of potential anti-fat discrimination in China and pro-fat discrimination in India and Mexico.

Section 2: Environmental inequality and health issues

After defending my Ph.D. thesis in November 2017, I decided to integrate new topics into my research framework by investigating environmental inequality and related public health issues. I use an extended definition of environmental inequality that includes unequal residential exposure to risky ecological environments (e.g. those characterized by high levels of air, soil, and water pollution and high vulnerability to climate change) and also risky social and built environments (e.g. those that are highly obesogenic or have high levels of violence and criminality).

2.1. Inequality in exposure to pollution and climate change

During my postdoctoral fellowship, funded by a European project called Soil Take Care and under the supervision of Katrin Erdlenbruch and Christelle Gramaglia (INRAE), I was in charge of implementing a multi-country household survey standardized for highly polluted (industrial soil pollution) and less-highly polluted neighboring areas (n=1200 households) in France, Spain, and Portugal and then providing an econometric analysis of the current state of environmental injustice in Southern Europe. Part of the results were published in *Environmental Modeling and Assessment* (2021). We found that low levels of education, wealth, and income are the main reasons for living in polluted areas in Southern Europe; however, there was also an important proportion of intermediate social groups (especially young couples) who lived in polluted areas, probably because of place attachment and affordable housing (i.e. large houses with attractive price and presence of urban amenities). Similarly, middle-income households had lower move-out intentions than other income groups, contrasting with the linear vision of environmental inequalities found in the U.S. (Banzhaf and Walsh, 2008 ; Banzhaf, Ma and Timmins, 2019). Notwithstanding the advantages of affordability, the fact that hazardous polluted areas tend to become economically attractive for lower-SES groups may be an important public health issue that necessitates urgent soil remediation and targeted prevention campaigns. Using data from the same survey, a later analysis published in the *Journal of Public Health* (2021) showed that low-SES groups living in polluted areas had a higher risk of some chronic diseases and low health status compared with populations living in less-polluted control areas. Specifically, individuals in polluted areas had lower birth weight and lower childhood health status, as well as higher risks of chronic disease in adulthood and premature mortality. We also found specific socioeconomic costs of living in polluted areas, including higher rates of school absenteeism and health service demand.

I am also involved in research on socioeconomic issues related to climate change. Together with Matthieu Clément (Université de Bordeaux), I am co-supervising the Ph.D. work of Valentina Alvarez-Saavedra (Université de Bordeaux) to investigate some of these issues in Chile. This doctoral work aims to empirically identify the potential impacts of climate change exposure on income inequality, mental health outcomes, and food security by combining meteorological measurements (annual mean temperature and precipitation), census data, longitudinal household surveys, and small area estimation to guarantee representativeness at the municipality level. We expect to find that populations that are disproportionately exposed to climate change are more prone to fall into poverty and mental depression and less likely to consume fresh and nutrient-rich food because of supply-side constraints. The results of this work will inform public policy recommendations to not only mitigate climate change impacts but also reduce the vulnerability of the poorest populations.

2.2. Inequality in living environments

I am currently coordinating the *ObeCity* and *Green Wellbeing* projects, which are respectively in fundraising phase and under construction. They include economists (Matthieu Clément and Lucie Piaser, Université de Bordeaux; Maia David, AgroParisTech), a geomatician (Baptiste Girault, INRAE), an urban agricultural engineer (Christine Aubry, INRAE), and a nutritionist (Luis Ortiz-Hernández, Universidad Autónoma Metropolitana). The *Green Wellbeing* project aims to identify potential positive externalities of exposure to green areas on mental health and violence reduction, assuming that daily contacts with plants and nature have tranquilizing and relaxing effects on inhabitants (Bertram and Rehdanz, 2015 ; de Vries et al., 2003). Similarly, in the *ObeCity* project, we are interested in exploring how the introduction of some urban amenities in the living area such as parks, places, and footpaths may change individual behaviors associated with obesity (i.e. physical activity and consumption patterns) (Mayne, Auchincloss and Michael, 2015). For both projects, a focus on Mexico seems relevant for several aspects: urban inequalities are high, obesity and criminality are major public health issues, and original data are available. In partnership with the Mexican institute of statistics (INEGI), we requested access to identification data allowing to merge census data (2010-2020) on urban amenities with several household surveys (relying on health, nutrition, perceived wellbeing and social cohesion) at the neighborhood level. In addition to control for neighborhood characteristics (e.g. house price, average income, and average years of education), one possible identification strategy will be to exploit the time dimension of Mexican censuses (2010 and 2020) comparing residents living in neighborhoods where an urban amenity

k changed on the period (i.e. considered as treatment units) to residents from neighboring neighborhoods where this amenity remained unchanged (i.e. considered as control units), assuming that residents from neighboring neighborhoods with similar socioeconomic characteristics are comparable. A second objective is to compare different urbanization models in developing countries such as Mexico and rich countries such as France. We plan to propose these projects to funders such as the AgroParisTech research program (call in November 2022) and the Benjamin Dellessert institute (call in September 2022). If our early results are promising, we will mix both projects to apply to other high-capacity funders, such as European and national research agencies.

Section 3: Investing in human capital and poverty-targeted programs to improve health

A substantial part of my previous findings suggests that major public health issues related to food behaviors, nutrition, pollution, climate change, or living area characteristics are overrepresented in underprivileged socioeconomic settings. Therefore, another part of my work is focused on the role of public policy to mitigate such inequalities and deleterious health effects.

3.1. Assessment of social safety nets

In my Ph.D. thesis, after showing that poverty is both a cause and a consequence of obesity in Mexico, I assessed the impact of social safety nets on obesity reduction. In an article published in *World Development* (2019), I analyzed how social interventions offer a concrete solution to counteract the spread of overweight status among the poor in developing countries. In that analysis, I used a triple difference approach to compare non-participants, short-term participants (leavers), and long-term participants (stayers) in the Mexican conditional cash transfers program. I found that the expansion of this program to urban areas had a beneficial effect on adult body weight among long-term participants, limiting the risks of weight gain and obesity. However, the global impact of the program on obesity was halved because of a low rate of participation in Mexican cities. As shown in a different study published in *CEPAL Review* (2021), the Mexican government should expend more effort to persuade the urban poor to enroll and stay enrolled in the program. Indeed, I found that the program did not successfully retain the poorest households, because the cash incentives were too small in urban settings.

3.2. Assessment of school-based interventions

Childhood obesity is another major public health concern that needs to be mitigated by public interventions, particularly in middle-income countries like Brazil, Mexico, and China where the rates are alarming. School-based interventions appear to be a particularly appropriate way to target children for health improvement. Several states and governments have introduced restrictions on the sales of high-calorie, low-nutrient-density foods and beverages in schools. However, most school canteens around the world continue to offer such unhealthy products. A lack of clear evidence for the impacts of junk food/beverage availability on childhood overweight status has potentially contributed to delays in the application of regulatory policies. In fact, sales of junk food are an important source of revenue for schools, especially in the context of budgetary pressure (Anderson and Butcher, 2006). Therefore, using a representative sample of Brazilian middle school students, I investigated the effect of a junk food ban in

Brazilian schools on childhood overweight status and obesity. This study, published in *Food Policy* (2020), took advantage of local initiatives that began in 2001 and aimed to ban sales of junk food and beverages in schools. By instrumenting junk food availability by the schools' grade span (i.e. exclusive middle school vs. combined middle and high schools), I showed that, among other effects, soft-drink availability in schools increases male BMI and risk of overweight status.

Similarly, school starting age is considered to be an important public policy instrument for investment in human capital (Ryu, Helfand and Moreira, 2020). Recent studies reported that the age of primary school enrolment is a major driver of educational achievement and adult income; however, its impacts on childhood health and nutrition remained largely unknown, particularly in developing countries where childhood stunting and overweight status coexist (Bahrs and Schumann, 2020). Using a database of middle school students in Brazil based on a 2015 survey, I implemented an instrumental variables strategy using quasi-exogenous variations in students' birthdates to isolate the impact of late (i.e. older than 6 years) primary school enrolment on height-for-age and body mass-for-age indicators. This study was published in *Economics & Human Biology* (2022). I observed that late enrolment had protective effects against risky weight gain, at least for children in privileged settings. By contrast, for children in underprivileged settings, delayed school enrolment was significantly detrimental, increasing the risk of stunting and reducing body mass-for-age. I assumed that early enrolment had health benefits (e.g. reduced household food insecurity) for children in underprivileged settings insofar as delayed enrolment may involve extra costs related to longer childcare and parental unemployment. Likewise, one could assume that late enrolment delays access to free and dietetic school meals and thus impairs child growth in underprivileged households because of nutritional deficiencies. In terms of public policy, rather than changing school starting age, this study highlighted the importance of focusing on pathways to fight both stunting and overweight status in Brazilian children.

3.3. Investigating the role of prevention campaigns

Investment in preventive health is assumed to have various advantages in terms of reducing the economic and health costs of diseases. By changing daily behaviors to promote healthier ways of life, this type of action aims to reduce the prevalence of chronic illness. Part of my postdoctoral research focused on the behavioral effects of a prevention campaign against soil pollution exposure among inhabitants living near industrial and mining sites in Southwestern Europe. This mixed study with Katrin Erdlenbruch (INRAE), Christelle Gramaglia (INRAE),

and other colleagues combined qualitative interviews and econometric estimates and was published in *Review of Social Economy* (2022). By comparing answers to a quantitative household survey between polluted areas and less-polluted neighboring areas, we showed that avoidance behavior (to protect against pollution) was mainly explained by residential location and socioeconomic characteristics. Pollution perception was not statistically correlated with most avoidance behaviors, however, which casts doubt on the efficacy of current public advisory communications. From in-depth qualitative interviews, we learned more about people's risk perception and whether and why people adopt avoidance behaviors, which led to the discovery of some inventive solutions.

As part of the *SubMeat* project described in Section 1.1, we are also interested in assessing innovative prevention campaigns to improve food behaviors. Specifically, to alleviate the risks of unhealthy dietary strategies adopted in cases of meat reduction by low-SES populations, we will develop and assess a digital prevention campaign that will be experimentally implemented in French university restaurants (CROUS). The content of the prevention campaign will be designed in collaboration with ANCA chair, a think&do tank carried out by AgroParisTech that uses social media to promote healthy and ecologically sound food behaviors among young people (through Aurélie Zunino, project manager in communication and nutrition). The main outcome indicators will be the proportion of meatless choices made in university restaurants and the dietary quality (energy density and nutrient content) of these choices among low-SES students. Using a random rule, we will conduct a meal-tray survey in treated restaurants and control restaurants (where action research did not take place) one month before the start of the program, during the last week of the program, and one month after the end of the program. We will use a difference-in-difference estimation model to assess the program's impacts on meal composition. During the program, we will monitor digital content use to measure its outreach (number of connections, engagement rates, and user comments). At the end of the program, we will conduct a satisfaction survey and qualitatively assess the intervention using semi-structured interviews with a randomly recruited sample of low-SES students (n=15) to gauge how the program was perceived, how it impacted attitudes towards meat reduction, and whether it led to behavioral changes when students ate in university restaurants and also in other contexts.

Conclusion and future research avenues

To conclude, after briefly describing the main contributions of my work to the scientific community and policymakers, I will present some further career perspectives and research avenues I plan to develop in the next five years.

By empirically exploring social and economic issues associated with ongoing global food, nutrition, and ecological transitions, my research has three main contributions to the social sciences and society. First, by focusing on obesity, breastfeeding, meat intake, and exposure to climate change and pollution, I help provide a better understanding of the socioeconomic distribution of these ongoing major public health concerns in a dynamic and heterogeneous world. Specifically, identifying potential socioeconomic constraints that impede the adoption of healthier behaviors, some of my work provide a first diagnosis of rarely tested associations. This diagnosis is important, in particular when major confounders are controlled for, insofar as it helps define hypothesis that can then be tested using experimental or quasi-experimental approaches to identify causality. Second, by analyzing the potential impacts of such concerns on educational attainment and labor market outcomes, I help emphasize the existence of heterogeneous effects according to professional and socio-cultural backgrounds and the baseline health panorama. Third, by assessing public policy and social programs, I help demonstrate the responsibility of decision-makers for public health concerns and provide concrete recommendations to improve the current trends.

In the next five years, I plan to develop new research avenues, collaborations, and collect additional funds to launch and supervise Ph.D. and postdoctoral projects. I also plan to apply for a long-term (1–2 years) international mobility in a research unit abroad to complete my profile and integrate new research dynamics and analytical tools. Below, I briefly describe some research topics that I plan to develop in the near future.

- i) Together with Matthieu Clément (Université de Bordeaux) and Suneha Seetahul (University of Sydney), I am interested in exploring potential long-term effects of the missing women phenomenon (due to past birth control policies such as those in India or China) on current female and collective wellbeing. We hypothesize that a low proportion of women at the local level, especially young women aged from 15 to 29, can have mental health effects at the individual level, leading to consequences for violence and criminality at the community level. We also hypothesize that the scarcity of women in society may increase her “social value”, and thus contribute to

reduce gender inequality and female mistreatments and empower women in terms of decision-making power and autonomy. This future collaborative project will merge census data on the urban-rural demography and fertility with household surveys from India, at the district level, to investigate the link between the scarcity of women at the district level (i.e. rural or urban localities with a high men/women ratio) and socioeconomic and behavioral outcomes related to violence, criminality, gender inequality, and women' rights. To infer causality, placebo tests will be executed on outcomes that are assumed unrelated to the current gender ratio, such as current height (determined at birth and perhaps some years later) and religious affiliation (often determined before age 15). The implementation of past birth control measures in some Indian states might also represent a way to deal with potential endogeneity in an instrumental variables framework.

- ii) Together with Matthieu Clément (Université de Bordeaux) and Valentina Alvarez-Saavedra (Université de Bordeaux, INRAE), I am interested in using census and survey datasets and small area estimation to analyze the influence of municipal income inequality and poverty concentration on individual ecological behaviors and perceptions in Chile. Following Chancel (2020), we assume that inequality and poverty reduce the levels of interest in and preoccupation with the ecological environment, causing households to have non-ecological behaviors (as determined by the type of energy used for cooking and heating, waste management, carbon footprint indices, and other factors). Conversely, we assume that people in more-equal municipalities with low poverty rates have a greater interest in the environment, leading to more ecological behaviors.
- iii) I am also interested in expanding my network through new collaborations with urbanists and geographers to study the associations among land-use planning policy, health outcomes, and violence. For instance, I would like to study the urban gentrification of historically poor neighborhoods by analyzing the effects of neighborhood building characteristics and rehabilitation programs on mental and physical health outcomes and violence indicators. The underlying idea would be to collect household surveys to compare these outcomes across different periods of time (i.e. before and after the rehabilitation of a historically poor neighborhood in a metropolitan area). Within this context of neighborhood gentrification, a comparison of indigenous residents and new residents can be also employed. Such

a project supposes the participation of an urban geographer to provide information about future neighborhood rehabilitation programs in a given city.

- iv) Finally, in a future research project, or perhaps within the framework of a scientific expertise for the Health Ministry, I am interested in investigating the socioeconomic consequences of emergent public health issues such as natural birth and breastfeeding behaviors. Economics studies showed a positive association between breastfeeding and cognitive and/or non-cognitive abilities (Belfield and Kelly, 2012), particularly in children from disadvantaged backgrounds (Borra, Iacovou and Sevilla, 2012) or children with the lowest test scores (Koh, 2017). By contrast, studies that did not account for differences in children's social backgrounds failed to find a significant effect of breastfeeding (Rothstein, 2013). Rippeyoung (2013) observed that breastfeeding reduces the cognitive inequalities between rich and poor children insofar as the beneficial effects of breastfeeding are stronger among the poor. My contribution would be to study how the mother's SES change the relationships between breastfeeding behaviors (and eventually natural birth) and educational attainment, testing the hypothesis that recommended behaviors disproportionately improve the mental health of individuals from poor families, especially through the improvement of non-cognitive skills (e.g. self-confidence measurements). Previous studies have already investigated the effects of breastfeeding on academic achievement and labor market outcomes. Using sibling data, Rees and Sabia (2009) observed better academic achievements thanks to higher cognitive abilities and health status, and Cesur et al. (2017) observed a positive association with first wages, although there were no significant effects after adjustment for endogeneity. However, no previous study looked for heterogeneous effects according to socioeconomic backgrounds, nor has any study been conducted in the particular context of developing countries where poverty and inequality are exacerbated and the detrimental effects of not breastfeeding might be greater. To address the identification challenge, the use of sibling data seems necessary.

INTERNSHIP AND DOCTORAL MONITORING

Since my recruitment to INRAE in December 2019, I have supervised two interns, Bertille Daran (spring of 2020) and Valentina Alvarez-Saavedra (spring of 2021). Both internships were very scientifically productive. Bertille's internship involved the construction of a large multi-country database that combined all available DHS for sub-Saharan Africa, which led to a literature review currently in revision at *Obesity Reviews* and a research article published in *World Development Perspectives*. Today, Bertille is starting a Ph.D. with colleagues from another INRAE unit (PSAE). Valentina's internship led to the writing of two research articles (one being published in *Mondes en Développement* in a special issue and another in revision at the *Journal of Development Studies*). After a short-term contract as a research assistant that I coordinated, Valentina started her Ph.D. studies in September 2021 under my supervision and that of Matthieu Clément, obtaining a public doctoral contract from the Université de Bordeaux. Next year, I will recruit and supervise an additional Ph.D. student in economics to work on the *SubMeat* project (funded by the French Agency for Research, see subsection 1.1 pages 15–16 for further information about the project).

In addition to co-supervising Valentina's Ph.D. work, I am contributing to doctoral training in other ways. Since 2020, I have provided regular methodological check-ups for the Ph.D. project of Ana Carolina Ferreira de Siquiera (supervised by Emmanuel Raynaud, INRAE). Furthermore, I am a member of the follow-up Ph.D. committee of Jessica Meyer (supervised by Julie Lochard, Université Paris-Est Créteil, and Philippe Delacotte, INRAE).

Finally, I often involve Ph.D. students in my research projects, as demonstrated by the articles I co-authored and published with Valentina Alvarez-Saavedra, Bertille Daran, Lucie Piasser (Université de Bordeaux), and Elodie Rossi (Université de Bordeaux). I also have another work in progress that includes Ana Carolina Ferreira de Siquiera but is not presented in this report.

SCIENTIFIC COORDINATION AND INVOLVEMENT

I have supervised three funded research projects since my recruitment to INRAE.

- *TransNut*—Nutritional transition in low-income countries (2020–2021, 17k€ funded by the INRAE program Global Food Security, see pages 12 and 14 for further details).
- *Obes'Islands*—Socioeconomic drivers of the normalization of overweight status in Pacific Islands (2023, 5kAUD funded by the Embassy of France in Australia and the Academy of Social Sciences in Australia, see page 13 for further details).
- *SubMeat*—Poverty as a risk factor in the protein transition (2022–2026, co-supervised with Olga Davidenko, AgroParisTech, 560k€ co-funded by AgroParisTech, region Île-de-France, and the French Agency for Research in the category of collaborative research programs). Note that this project plans to recruit two Ph.D. candidates, one supervised by myself and another supervised by Olga Davidenko, see pages 15–16 for further details).

I am also participating in several other funded research projects.

- *FAARC*—Sustainable agricultural and food sectors in collective catering (2023–2026, coordinated by Emmanuel Raynaud, INRAE, 300k€ co-funded by the INRAE regional program TRETRAÉ and region Île-de-France).
- *AGRICOMPET*—Governing the agrifood supply chain: how to improve smallholders' competitiveness (2022–2025, coordinated by Manuel Gonzalez-Diaz, University of Oviedo, 1400k€ funded by Horizon Europe in the PRIMA category).
- *BIODET and A4BIO*—Local determinants of organic and sustainable food in school canteens (2021–2023, coordinated by Emmanuel Raynaud, INRAE, 40k€ funded by the INRAE transversal program METABIO and APP).

In other scientific activities, I supervise one of the research lines carried out by my department, ACT, and will continue to do so for the next five years. Specially, I monitor the research group focusing on food inequality and accessibility. I am also involved in further valorization and dissemination activities. First, I am co-editor in chief of the French scientific journal *Economie Rurale*. This multi-disciplinary journal referenced by the French Center of Scientific Research (CNRS) publishes research articles focusing on current agricultural, food, and environmental issues occurring in rural areas worldwide. Second, I have been appointed as a scientific expert to the *Haut Conseil de Santé Publique* (French Council of Public Health) within the commission

of health and non-communicable disease determinants. This national council provides decision-making support to the Health Ministry by producing health reports and making policy recommendations. Third, I have been invited to join the scientific expert committee of ANCA chair, a sponsorship organization hosted by AgroParisTech that specializes in developing innovative, digital, and playful programs to raise awareness and promote sustainable and healthy food habits in target audiences.¹⁰

¹⁰ <https://chaire-anca.org/>

RÉSUMÉ EN FRANÇAIS

En raison de l'émergence d'importants problèmes de santé publique mais aussi écologiques au niveau mondial, des changements structurels dans les habitudes de production et de consommation sont attendus de toute urgence pour parvenir à des sentiers de développement plus durables. Alors que la pandémie de covid 19 a fait apparaître aux yeux de tous les liens qui existent entre les préoccupations sanitaires et écologiques, d'autres maladies dites sociétales, plus cachées, sont pourtant plus dévastatrices. Par exemple, selon l'Organisation Mondiale de la Santé (OMS), l'épidémie de surpoids et d'obésité a tué 2,6 millions de personnes par an ces dernières années (soit environ 5,2 millions de décès au cours des deux dernières années), ce qui est un peu inférieur à l'infection de covid 19 qui est responsable d'environ 6,3 millions de décès les deux dernières années, de mars 2020 à mai 2022. Plus grave encore, l'exposition à la pollution de l'air, du sol et de l'eau tuerait environ 9 millions de personnes par an ; cette tendance restant inchangée depuis 2015. Il convient également de noter qu'il existe des différences notables en termes de tendance si l'on compare les courbes de mortalité entre l'infection au covid 19 et les maladies chroniques liées au surpoids et à la pollution. Alors que les maladies infectieuses se caractérisent par des pics de mortalité diminuant avec le temps (grâce à une immunité progressive des populations), les maladies chroniques sont amplifiées par nos modes de vie et la mortalité associée tend à augmenter avec le temps. Concernant les maladies chroniques, les projections pour les prochaines décennies sont alarmantes. Selon des estimations basées sur les tendances actuelles, 50% de la population adulte mondiale sera en surpoids d'ici 2025. En 2050, 50% de la population adulte mondiale sera obèse. De même, le nombre d'usines chimiques (connues pour être très préjudiciables pour la santé des populations vivant aux alentours) dans le monde est en passe de doubler d'ici à 2030.

Pour répondre à ces nouvelles préoccupations mondiales, plusieurs chercheurs visent à explorer des voies de transition vers des économies plus vertueuses et plus respectueuses de l'environnement, en identifiant les freins et leviers potentiels. C'est l'objectif de recherche principal de l'Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement (INRAE), et en particulier celui du département Action et Transitions (ACT) au sein duquel j'ai été recruté en 2019 en tant que chargé de recherche. Les transitions étudiées par le département ACT reposent sur tous les aspects des habitudes de production et de consommation supposées néfastes pour l'homme, les animaux et la planète ; et incluent de manière non exhaustive, la transition écologique (vers des productions plus propres et durables),

la transition alimentaire (vers une alimentation plus durable et saine accessible à toutes et tous), la transition nutritionnelle (vers une meilleure santé nutritionnelle) et la transition épidémiologique (vers un contrôle des maladies chroniques et maladies infectieuses réémergentes telles que les zoonoses).

Toutes ces transitions intéressent au premier chef les économistes dans la mesure où elles impliquent simultanément des enjeux macro et micro-économiques. Premièrement, il existe des différences notables entre les pays en ce qui concerne le stade d'avancement de ces transitions ; opposant souvent les pays du Nord et les pays du Sud. Par exemple, alors que les pays à revenu élevé sont responsables de près de 80 % des émissions de carbone entre 1850 et 2011 au niveau mondial, des résultats mettent en évidence l'existence d'une courbe environnementale de Kuznet (c'est-à-dire une inversion de l'association entre le PIB et les émissions de gaz à effet de serre quand un pays atteint un certain niveau de richesse) ; du moins lorsque des politiques réglementaires sont mises en œuvre pour limiter les émissions. De même façon, les transitions alimentaire et nutritionnelle dépendent fortement du niveau de développement économique d'un pays donné, les prévalences de surpoids et d'obésité (et des maladies chroniques associées) tendant à augmenter au rythme où un pays s'urbanise, se mondialise et se tertiarise. Cependant, bien que les taux de surpoids et d'obésité continuent de croître dans tous les pays du monde, cette augmentation tend à s'atténuer dans les pays à revenu élevé qui ont fait le choix d'investir massivement dans des programmes de santé publique et de prévention ambitieux ; révélant les prémises d'une courbe de Kuznet de l'obésité et des maladies chroniques. Malgré ces quelques progrès relatifs sur le plan sanitaire et environnemental, les pays à revenu élevé restent néanmoins piégés à des stades de transitions inefficients dans l'absolu et semblent encore loin de les surmonter. En effet, les pays riches apparaissent comme bloqués dans un piège socio-écologique caractérisé par de fortes émissions de résidus toxiques dans l'air, le sol et l'eau, une forte érosion des sols et un fort déclin de la biodiversité. En parallèle, ces pays sont bloqués dans un piège alimentaire et nutritionnel caractérisé par une alimentation non saine, riche en gras et en sucres, et non durable, basée sur des aliments transformés riches en viande et à forte empreinte carbone. Par conséquent, en plus d'analyser les transitions en cours qui se produisent dans le monde en développement, il est aussi nécessaire d'étudier les obstacles qui freinent ces transitions à des stades plus avancés – mais restant inefficients – en se concentrant également sur des pays plus riches.

Deuxièmement, il existe une forte hétérogénéité microéconomique (au sein même des pays) concernant la vulnérabilité des populations face aux externalités sanitaires résultant de ces

transitions. En effet, tous les pays sont concernés par des inégalités alimentaires et nutritionnelles, même si leur forme et leur intensité dépendent du niveau de développement économique et du niveau d'avancement dans les transitions correspondantes. De plus, ces dernières décennies ont été marquées par un accroissement des inégalités environnementales au sein de la plupart des pays, les groupes socioéconomiques et démographiques plus vulnérables étant plus susceptibles d'être exposés aux nuisances, aux pollutions et au changement climatique, et donc plus à risque de contracter des maladies chroniques associées.

En utilisant une approche empirique, mes recherches visent à mieux comprendre les dynamiques et les interactions qui existent entre l'hétérogénéité microéconomique et macroéconomique en matière de vulnérabilités alimentaires et environnementales. Plus spécifiquement, une partie de mon travail vise à examiner les relations entre le statut socio-économique (SSE) des ménages, les comportements à risque et des indicateurs de santé associés, en tenant systématiquement compte du niveau de développement économique et des spécificités culturelles des pays étudiés. Je mène également des recherches sur l'évaluation des politiques publiques pour limiter le niveau de vulnérabilité de certaines catégories de la population et réduire ainsi les inégalités alimentaires, environnementales et de santé.

De ce fait, mes travaux ont plusieurs contributions pour la communauté scientifique et la société de façon plus générale. Premièrement, certains de mes résultats permettent de mieux appréhender les associations complexes et dynamiques qui existent entre la pauvreté, les problèmes de santé publique et le niveau de développement économique des pays ; pouvant ainsi contribuer à une meilleure allocation des politiques publiques et des aides internationales en direction des plus nécessiteux. Deuxièmement, d'autres de mes résultats mettent en évidence les potentiels freins micro-économiques qui entravent les transitions vers des sentiers de développement durable. Troisièmement, en évaluant le rôle des politiques publiques comme potentiel levier d'accélération des transitions en cours, mes résultats donnent des recommandations concrètes aux pouvoirs publics.

Dans le rapport de recherche ci-joint (rédigé en anglais), je présente plus en détail mes travaux antérieurs, en cours et à venir. Dans la section 1, je décris des études analysant les enjeux associés aux inégalités alimentaires et nutritionnelles. La section 2 énumère les travaux et projets qui étudient les enjeux associés aux inégalités environnementales, incluant les caractéristiques écologiques mais aussi les caractéristiques physiques (bâti) et sociales (criminalité) du lieu de résidence. La section 3 met en relief les travaux ayant de fortes implications en matière de politiques publiques, avant de dresser une courte conclusion sur les

principaux apports de mes travaux et les pistes de recherche futures que je souhaiterais développer dans les cinq prochaines années.

Pour terminer, ce document relate successivement mes différentes expériences dans l'animation doctorale, la gestion de projets de recherche et mon implication dans des activités de valorisation et de diffusion scientifique. En termes d'animation doctorale, je co-encadre actuellement une thèse (et prochainement une seconde), contribue au soutien méthodologique d'une deuxième thèse, et fait partie du comité de suivi d'une troisième thèse. En termes de gestion de projets de recherche, je coordonne actuellement deux programmes de recherche, dont un de grande ampleur (>500k€) ; en ai coordonné un autre par le passé (2020-2021) et participe à trois autres projets portés par des collègues. En termes d'implication dans des activités de valorisation et diffusion scientifique, j'ai été nommé expert pour la 4^e mandature du Haut Conseil de Santé Publique (2022-2027) au sein de la commission « déterminants de la santé et des maladies non-transmissibles » ; je suis également expert au sein du comité de suivi scientifique de la Chaire ANCA, un organisme porté par AgroParisTech visant à fournir des conseils de prévention pour une alimentation durable ; et je suis corédacteur en chef de la revue francophone *Economie Rurale*.

REFERENCES

- ANDERSON P. M., BUTCHER K. F., 2006, “Reading, Writing, and Refreshments Are School Finances Contributing to Children’s Obesity?”, *Journal of Human Resources*, XLI(3), pp. 467–494. doi:10.3368/jhr.XLI.3.467
- BAHRS M., SCHUMANN M., 2020, “Unlucky to be young? The long-term effects of school starting age on smoking behavior and health”, *Journal of Population Economics*, 33(2), pp. 555–600. doi:10.1007/s00148-019-00745-6
- BANZHAF H. S., WALSH R. P., 2008, “Do People Vote with Their Feet? An Empirical Test of Tiebout”, *American Economic Review*, 98(3), pp. 843–863. doi:10.1257/aer.98.3.843
- BANZHAF S., MA L., TIMMINS C., 2019, “Environmental Justice: the Economics of Race, Place, and Pollution”, *The Journal of Economic Perspectives: A Journal of the American Economic Association*, 33(1), pp. 185–208.
- BARBIER E. B., HOCHARD J. P., 2019, “Poverty-Environment Traps”, *Environmental and Resource Economics*, 74(3), pp. 1239–1271. doi:10.1007/s10640-019-00366-3
- BELFIELD C. R., KELLY I. R., 2012, “The Benefits of Breast Feeding across the Early Years of Childhood”, *Journal of Human Capital*, 6(3), pp. 251–277. doi:10.1086/667415
- BÉNÉ C., FANZO J., PRAGER S. D., ACHICANOY H. A., MAPES B. R., TORO P. A., CEDREZ C. B., 2020, “Global drivers of food system (un)sustainability: A multi-country correlation analysis”, *PLOS ONE*, 15(4), p. e0231071. doi:10.1371/journal.pone.0231071
- BERTRAM C., REHDANZ K., 2015, “The role of urban green space for human well-being”, *Ecological Economics*, 120, pp. 139–152. doi:10.1016/j.ecolecon.2015.10.013
- BORRA C., IACOVOU M., SEVILLA A., 2012, “The Effect of Breastfeeding on Children’s Cognitive and Noncognitive Development”, IZA Discussion Paper, 6697, Institute of Labor Economics (IZA).
- CARMIN J., AGYEMAN J., 2011, *Environmental Inequalities Beyond Borders: Local Perspectives on Global Injustices*, MIT Press, 315 p.
- CESUR R., SABIA J. J., KELLY I. R., YANG M., 2017, “The effect of breastfeeding on young adult wages: new evidence from the add health”, *Review of Economics of the Household*, 15(1), pp. 25–51.
- CHANCEL L., 2020, *Unsustainable Inequalities*, Harvard University Press.
- DE VRIES S., VERHEIJ R. A., GROENEWEGEN P. P., SPREEUWENBERG P., 2003, “Natural Environments—Healthy Environments? An Exploratory Analysis of the Relationship between Greenspace and Health”, *Environment and Planning A: Economy and Space*, 35(10), pp. 1717–1731. doi:10.1068/a35111
- DINDA S., 2004, “Environmental Kuznets Curve Hypothesis: A Survey”, *Ecological Economics*, 49(4), pp. 431–455. doi:10.1016/j.ecolecon.2004.02.011

DINSA G. D., GORYAKIN Y., FUMAGALLI E., SUHRCKE M., 2012, “Obesity and socioeconomic status in developing countries: a systematic review”, *Obesity Reviews*, 13(11), pp. 1067–1079. doi:10.1111/j.1467-789X.2012.01017.x

FULLER R., LANDRIGAN P. J., BALAKRISHNAN K., BATHAN G., BOSE-O'REILLY S., BRAUER M., CARAVANOS J., CHILES T., COHEN A., CORRA L., CROPPER M., FERRARO G., HANNA J., HANRAHAN D., HU H., HUNTER D., JANATA G., KUPKA R., LANPHEAR B., LICHTVELD M., MARTIN K., MUSTAPHA A., SANCHEZ-TRIANA E., SANDILYA K., SCHAEFLI L., SHAW J., SEDDON J., SUK W., TÉLLEZ-ROJO M. M., YAN C., 2022, “Pollution and health: a progress update”, *The Lancet Planetary Health*, 0(0). doi:10.1016/S2542-5196(22)00090-0

KHUSUN H., FEBRUHARTANTY J., ANGGRAINI R., MOGNARD E., ALEM Y., NOOR M. I., KARIM N., LAPORTE C., POULAIN J.-P., MONSIVAIS P., DREWNOWSKI A., 2022, “Animal and Plant Protein Food Sources in Indonesia Differ Across Socio-Demographic Groups: Socio-Cultural Research in Protein Transition in Indonesia and Malaysia”, *Frontiers in Nutrition*, 9.

KOH K., 2017, “Maternal breastfeeding and children’s cognitive development”, *Social Science & Medicine*, 187(C), pp. 101–108.

LOBSTEIN T., JACKSON LEACH R., 2007, “Tackling Obesities: Future Choices – International Comparisons of obesity trends, determinants and responses – Evidence Review”, UK, Government Office for Science.

MARIOTTI F., 2017, *Vegetarian and plant-based diets in health and disease prevention*.

MAYNE S. L., AUCHINCLOSS A. H., MICHAEL Y. L., 2015, “Impact of policy and built environment changes on obesity-related outcomes: a systematic review of naturally occurring experiments”, *Obesity Reviews*, 16(5), pp. 362–375. doi:10.1111/obr.12269

MILLS J. H., WAITE T. A., 2009, “Economic prosperity, biodiversity conservation, and the environmental Kuznets curve”, *Ecological Economics*, 68(7), pp. 2087–2095. doi:10.1016/j.ecolecon.2009.01.017

MONTEIRO C. A., CONDE W. L., LU B., POPKIN B. M., 2004a, “Obesity and inequities in health in the developing world”, *International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity*, 28(9), pp. 1181–1186. doi:10.1038/sj.ijo.0802716

MONTEIRO C. A., CONDE W. L., LU B., POPKIN B. M., 2004b, “Obesity and inequities in health in the developing world”, *International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity*, 28(9), pp. 1181–1186. doi:10.1038/sj.ijo.0802716

MONTEIRO C. A., MOURA E. C., CONDE W. L., POPKIN B. M., 2004, “Socioeconomic status and obesity in adult populations of developing countries: a review”, *Bulletin of the World Health Organization*, 82(12), pp. 940–946. doi:/S0042-96862004001200011

NAGANO H., PUPPIM DE OLIVEIRA J. A., BARROS A. K., COSTA JUNIOR A. da S., 2020, “The ‘Heart Kuznets Curve’? Understanding the relations between economic development

and cardiac conditions”, *World Development*, 132, p. 104953.
doi:10.1016/j.worlddev.2020.104953

NCD-RISK FACTOR COLLABORATION, 2016, “Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19·2 million participants”, *The Lancet*, 387(10026), pp. 1377–1396.
doi:10.1016/S0140-6736(16)30054-X

PERLMAN R. L., 2013, “Man-made diseases”, in *Evolution and Medicine*, Oxford, Oxford University Press. doi:10.1093/acprof:oso/9780199661718.003.0011

POPKIN B. M., 1993, “Nutritional Patterns and Transitions”, *Population and Development Review*, 19(1), pp. 138–157. doi:10.2307/2938388

REES D. I., SABIA J. J., 2009, “The Effect of Breast Feeding on Educational Attainment: Evidence from Sibling Data”, *Journal of Human Capital*, 3(1), pp. 43–72.
doi:10.1086/599861

RIPPEYOUNG P. L. F., 2013, “Can Breastfeeding Solve Inequality? The Relative Mediating Impact of Breastfeeding and Home Environment on Poverty Gaps in Canadian Child Cognitive Skills”, *The Canadian Journal of Sociology / Cahiers canadiens de sociologie*, 38(1), pp. 65–85.

RITCHIE H., MATHIEU E., RODÉS-GUIRAO L., APPEL C., GIATTINO C., ORTIZ-OSPINA E., HASELL J., MACDONALD B., BELTEKIAN D., ROSER M., 2020, “Coronavirus Pandemic (COVID-19)”, *Our World in Data*.

ROTHSTEIN D. S., 2013, “Breastfeeding and Children’s Early Cognitive Outcomes”, *The Review of Economics and Statistics*, 95(3), pp. 919–931. doi:10.1162/REST_a_00282

RYU H., HELFAND S. M., MOREIRA R. B., 2020, “Starting early and staying longer: The effects of a Brazilian primary schooling reform on student performance”, *World Development*, 130, p. 104924. doi:10.1016/j.worlddev.2020.104924

SHAO S., LIU L., TIAN Z., 2021, “Does the environmental inequality matter? A literature review”, *Environmental Geochemistry and Health*. doi:10.1007/s10653-021-00921-2

SOBAL J., STUNKARD A. J., 1989, “Socioeconomic status and obesity: a review of the literature”, *Psychological bulletin*, 105(2), pp. 260–275.

TEMPLIN T., HASHIGUCHI T. C. O., THOMSON B., DIELEMAN J., BENDAVID E., 2019, “The overweight and obesity transition from the wealthy to the poor in low- and middle-income countries: A survey of household data from 103 countries”, *PLOS Medicine*, 16(11), p. e1002968. doi:10.1371/journal.pmed.1002968

ULJASZEK S. J., MANN N., ELTON S., 2012, *Evolving Human Nutrition: Implications for Public Health*, Cambridge, Cambridge University Press, Cambridge Studies in Biological and Evolutionary Anthropology. doi:10.1017/CBO9781139046794

WELLS J. C. K., MARPHATIA A. A., COLE T. J., MCCOY D., 2012, “Associations of economic and gender inequality with global obesity prevalence: Understanding the female

excess”, *Social Science & Medicine*, 75(3), pp. 482–490.
doi:10.1016/j.socscimed.2012.03.029

WINDARTI N., HLAING S. W., KAKINAKA M., 2019, “Obesity Kuznets curve: international evidence”, *Public Health*, 169, pp. 26–35. doi:10.1016/j.puhe.2019.01.004