Climate change, environmental problems, and population dynamics

Strand organisers: Dr. Risto Conte Keivabu (Max Planck Institute of Demographic Research), Dr. Tobias Rüttenauer (UCL) and Dr. Dermot Grenham

Environment and health in a global perspective session organiser: Dr. Aashish Gupta (University of Oxford)

9:00 - 10:30 Tuesday 12 September: Session 1: Climate change and population dynamics

Climate change and sex ratios at birth

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While there is a need to better understand the impact of climate change on population composition and demographic outcomes, human sex ratios at birth (SRBs) have received little attention in this context. We examine the effect of temperatures during conception and pregnancy on SRBs by linking Demographic Health Survey (DHS) data on 3.4 million births in 33 sub-Saharan African countries and India with high resolution daily temperature data. To identify causal effects, we isolate the quasi-random temperature fluctuations that occur year-to-year, within subnational region and calendar month. We show that in sub-Saharan Africa, extreme temperatures around the time of conception and during pregnancy reduce the SRB, suggesting higher intra-uterine male mortality. This finding points to a differential response to in-utero temperature exposure by the child's sex. In contrast, we find that in India, heat exposure reduces the SRB at around 3 months into pregnancy. Here, the biophysical mechanism identified in sub-Saharan Africa seems to be overridden by a behavioral response on sex-selective abortion, likely driven by restricted mobility under heat at a time when sex detection could take place. We further investigate heterogeneity in the temperature-SRB relationship to identify vulnerable subpopulations. These findings have important consequences for population composition, maternal health and healthcare access, and reproductive inequalities in the context of global warming.

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Heat waves and thermal injustice in India

Arpit Shah - IIM Bangalore, Sneha Thapliyal - National Law School, Anish Sugathan - IIM Ahmedabad, Vimal Mishra - IIT Gandhinagar and Deepak Malghan - IIM Bangalore

Climate change induced rise in global temperatures is producing more frequent and more severe heat waves. It is also well-recognized that any adaptation and mitigation of exposure to extreme heat must account for social and economic inequities that modulate heat exposure as a public health problem. India is a hotspot for extreme heat waves and social inequality rooted in its caste system. We study the association between caste identity and occupational exposure to stressful heat conditions for the Indian summer heat wave of 2022. We combine high spatio-temporal resolution temperature and humidity information from satellite imagery with a large nationally and regionally representative labor force survey with rich socio-economic and demographic information (n ≈ 0.4 million individuals) to estimate the occupational exposure dose from environmental heat stress during the 2022 Indian summer heat wave. At a 30◦C Environmental Stress Index (ESI) threshold, the outdoor work-hours elasticity of exposure dose for marginalized caste groups — Scheduled Castes (SC) and Other Backward Classes (OBC) — is over 10% higher than that for upper caste groups, and this difference rises to over 35% for an ESI threshold of 34◦C. Our models control for other economic-demographic confounders including age, gender, education, and economic status besides political-geographic controls and fixed effects. These results hold for both rural and urban sub-samples. Any public health response to increasing heat wave exposure must also address underlying social and economic inequities. Heat action plans in India must account for the hierarchical social order characterized by the "division of laborers" along caste lines.

Temperature related deaths in Europe
Risto Conte - Max Planck Institute for Demographic research; Rosanna Gualdi - University of Bologna

Climate change-induced increases in summer temperatures present new health risks for affected populations. Over the past decade, Europe has experienced record-breaking heatwaves, most notably in 2018, 2020, and 2022. These extreme heat events pose significant public health risks, contributing to excess mortality, particularly among the elderly. Additionally, rising summer temperatures and falling winter temperatures may alter seasonal mortality patterns in some countries due to a harvesting effect. In this article, we use recently published Eurostat data on weekly mortality by age and sex from 2014 to 2020 at the NUTS 3 level for 30 European countries. We then connect this mortality data with precise daily meteorological information supplied by E-OBS in the Copernicus Data Store. Our primary analysis reveals that both cold and hot days contribute to increased mortality rates across the pooled sample of European countries. However, we also observe heterogeneous patterns in the effects of cold and heat based on gender, age, and national climate conditions. Furthermore, we examine how elevated summer mortality rates, driven by unanticipated heatwaves, impact cold-related mortality in the subsequent winter. In conclusion, extreme temperatures pose a considerable public health threat to European citizens, and the escalation of summer heat has the potential to transform future seasonal mortality trends.

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Human Motivations and Environmental Development in two Hungarian Manors
Gábor Koloh - ELKH Research Centre for the Humanities, Budapest

In my presentation, I would like to present some general conclusions about human and community motivations and the use of the natural environment by examining two communities in Hungary in the 18th and 19th centuries. The Habsburg Empire liberated the territory of Hungary from Turkish occupation in the last decades of the 17th century. In the unfolding international trade, several heavy losses were suffered during the 18th century, exemplified by the Spanish and Austrian War of Succession. The Habsburg Empire became interested in making the best economic use of the newly conquered territory, so it settled the depopulated areas in a more or less organised way and encouraged the population to increase production. A comparison of the farming practices of Hungarian and German settlers in Southern Transdanubia allows us to draw a number of conclusions about the cycle and sustainability. Their analysis shows that culturally based farming traditions have led to significant differences in the extent to which the environment is used and transformed. In my presentation I will also examine the demographic implications of farming characteristics. I will also analyse fertility and mortality trends through a family reconstitution study of the inhabitants of two settlements. Indeed, my results show that intensive farming and unrestricted childbearing among Germans resulted in poor mortality rates. In contrast, Hungarian farmers, who had more traditional farming and were less open to innovation, and also practised conscious birth control, lived longer. The conclusions thus also examine the long-term costs of different farming practices.

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11:30 - 1:00 Wednesday 13 September: Environmental context and health

Association between household air pollution due to solid fuel use and mental health of older adults in Ghana
Ritu Rani, Géraldine Duthé and Valerie Golaz - Institut national d'études démographiques (INED)

Air pollution is a significant global health risk, particularly affecting countries in the Global South. Biomass and coal combustion, known as solid fuels, are major sources of household air pollution, which can have detrimental effects on health and mortality. Older adults, with their lower immune system and comorbid conditions and comorbid conditions as compared to other age-groups but also due to their sedentary lifestyle, may be particularly vulnerable. However, little is known about the association between household air pollution and mental health, especially in Ghana. This study aimed to fill this research gap by examining the relationship between household air pollution due to solid fuel use and mental health, assessed through cognitive function and depression, among older adults in Ghana. Data from two waves of the WHO-SAGE (2007-2015) survey were

analysed. The findings revealed a strong association between household air pollution and mental health in older adults, with significant links to poor cognitive functioning and higher odds of depressive symptoms, with notable gender differences. The study suggests that household air pollution may be a potential risk factor influencing mental health in older adults, particularly for women. Given Ghana's ageing population and high prevalence of solid fuel use, there is an urgent need for further research and policy efforts in this area.

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Breathing unequal air: Environmental disadvantage and residential sorting of immigrant minorities in England and Germany

Tobias Rüttenauer - University College London, Felix Bader - Berlin Institute for Social Research (BIS), Henning Best - RPTU Kaiserslautern-Landau, Ingmar Ehler - RPTU Kaiserslautern-Landau

Despite ongoing debates on environmental justice, the causal mechanisms linking selective residential migration to environmental inequality remain unclear. Analyses of causal mechanisms have been restricted to spatially aggregated data and a single context. We address this gap using longitudinal household-level data from the UK Household Longitudinal Study and German Socio-Economic Panel linked to air pollution estimates such as NO2, PM2.5, and SO2. In both countries, immigrant minorities are exposed to higher levels of air pollution in their places of residence. While we would expect immigrant minorities to experience greater improvements from relocations over time given their initial disadvantage, household fixed effects models controlling for initial pollution levels show that this is not the case. If native households started in a similar situation as immigrants do -- the relevant counterfactual -- they would experience much higher relocation gains. This process is similar in England and Germany, but the general disadvantage and the differences in returns of residential mobility are stronger in England. Furthermore, socio-economic conditions cannot explain the disadvantage in both countries. Our study contributes to the understanding of environmental inequality by highlighting the importance of selective migration in shaping environmental disadvantage among immigrant minorities in England and Germany.

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Long-term exposure to air pollution and hospital admissions in Scotland: A 16-years register-based study (2002-2017)

Mary Abed Al Ahad, Urška Demšar, Frank Sullivan, Hill Kulu - University of St Andrews

Background: Despite the well-documented research on the impact of air pollution on health, limitations in data, study designs, health outcomes selection, spatial considerations, and assessments of long-term exposures exist. In this study, we assessed the association of 16-years exposure to air pollution with all-cause and cause-specific hospital admissions in Scotland. Methods: We followed a “Scottish-Longitudinal-Study (SLS)” cohort of 202,237 individuals aged 17+ for 16 years (2002-2017; N=2,810,414 observations). The SLS dataset was linked to yearly concentrations of four pollutants (NO2, SO2, and particulate-matter PM10 and PM2.5) at 1 Km2 spatial resolution using the individual’s residential postcode. Multilevel mixed-effects negative binomial regression was used to examine the association between air pollution and all-cause, cardiovascular, respiratory, infectious, mental/behavioural disorders, and other-causes hospital admissions. Results: Higher rates of all-cause, cardiovascular, infectious, mental/behavioural disorders, and other-causes hospital admissions were observed with increasing concentrations of NO2, PM10, and PM2.5 pollutants. Hospital admissions for respiratory diseases were associated with higher exposure to all the four pollutants including SO2. For example, the incidence-rate for respiratory hospital admissions increased by 12.5% (95%CI=9.7%-15.5%), 6.8% (95%CI=5.1%-8.5%), 2.2% (95%CI=0.5%-4.0%), and 1.9% (95%CI=1.5%-2.4%) per 1 µg/m3 increase in average cumulative exposure to PM2.5, PM10, SO2 and NO2 pollutants, respectively. Conclusion: By linking large register-based longitudinal data to air pollution at a fine spatial resolution over a period of 16 years, this study highlights the harmful effect of air pollution on health manifested in higher rates of hospital admissions for various disease outcomes. Thus, interventions on air pollution through stricter environmental regulations could help ease the hospital-care burden.

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Estimating population exposure to the differential environmental burden: the case of Kenya

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Environmental burden is an umbrella term that presents threatening levels of key environmental parameters: such as extreme temperature and rainfall, hazardous pollutants in the air, water, and soil, changing land use patterns, and others. It is the major constraint for the overall sustainable development of the Global South countries and acts as a multi-faced health risk worldwide. Kenya and Uganda are among the countries of the Global South where environmental challenges are huge, and resources are limited. In such situations, directly or indirectly, mobilities occur with a noticeable impact on the size, structure, and growth of the population of a particular place. This study aims to estimate environmental burden by categorizing key environmental parameters such as temperature, rainfall, air pollution (PM2.5), and green cover using a wide range of remotely sensed data. Then, a corresponding population change (size, structure, growth) will be analysed using gridded population data from the Worldpop data. The analysis will be conducted from 2000 to 2019. The results will be instrumental in understanding linkages between population change and environmental burden and will highlight the areas where research and policy attention are needed.