Diverse approaches to health and mortality

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Cardiac AI: Heart Disease Prediction with Deep Learning
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Background: Coronary heart disease (CHD) remains one of the most burdensome health conditions straining health systems across the globe, necessitating accessible and accurate risk prediction tools to enable swift intervention. Leveraging sociodemographic and health features, we propose Cardiac AI, a novel AI-driven framework that combines conditional energy-based models with the potential integration of large language models (LLMs) to predict CHD and provide interpretable health insights. Methods: The study employs publicly available, synthetic demographic and health data and Conditional deep Boltzmann machines (undirected random Markov fields) (DBM) to predict body composition and CHD risk. Specifically, the study uses weight, height, age, sex, occupation and other biomarkers and anthropometric indices as inputs for a Gaussian-Bernoulli-softmax-conditional deep Boltzmann machine model. Gaussian stochastic units (linear activation with Gaussian noise) use numerical data, while Bernoulli stochastic units (sigmoid activation) and softmax units (stochastic activation) are applied to categorical data. These functions and the features generate body fat percentage, metabolic equivalent of task, CHD risk and CHD risk score. Furthermore, the model includes robust measures to control miscalibration and is formulated (using prompts and responses categories) to support the integration of Hippocrates (Hippo LLMs) and produce human-readable explanations of predictions (e.g., “Elevated CHD risk due to low METS and high BFD”). Results: The preliminary experiments on synthetic and public datasets (e.g., NHANES) demonstrate Cardiac AI’s ability to achieve competitive performance in CHD risk prediction.

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Historical Precedents and Current Patterns of Life Expectancy Slowdowns and Stalls in Low-Mortality Populations
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Over the past century, low-mortality countries have experienced continuous increases in life expectancy at birth (e_0). However, since 2010, some English-speaking countries, such as the U.S., U.K., and Canada, have seen significant slowdowns or stagnation in life expectancy gains. This study investigates whether these recent slowdowns are historically unprecedented or part of recurring patterns observed in other periods or countries. Despite increasing attention to this phenomenon, few studies have applied consistent analytical criteria across time and geography to systematically detect and compare episodes of deceleration or stagnation. This methodological gap limits our ability to distinguish between structural breaks and cyclical fluctuations in mortality trends.

Using data from the Human Mortality Database (HMD), we analyse long-term trends in life expectancy for a selection of low-mortality countries, applying methods such as moving averages, spline-based models for non-linear trends, and changepoint detection techniques (e.g., Bai-Perron method). We focus on comparing English-speaking countries (U.S., U.K., Canada, Australia, New Zealand) with high-income benchmark countries (France, Italy, Sweden, Japan), known for maintaining stable or continuing gains in longevity. This comparison helps assess whether recent slowdowns represent a break from historical trends or a recurrence of past fluctuations.

This research aims to place current life expectancy slowdowns in a broader historical context, improve our understanding of potential causal mechanisms, and offer comparative insights for future mortality projections and public health strategies.

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Social mobility and health: Evidence from the 1958 British birth cohort

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A classic claim in social mobility theory holds that moving between social classes is inherently detrimental to health and wellbeing. However, empirical research on the association between social mobility and health has yielded inconsistent findings. Drawing on data from the 1958 British National Child Development Study and applying Diagonal Reference Models, this paper examines the association between intergenerational and intragenerational mobility with multiple mental, physical, and behavioural health outcomes. We find compelling evidence for acculturation processes: socially mobile individuals' health outcomes are largely shaped by both their class of origin and destination, with limited evidence of additional, independent mobility effects. The only exception is women experiencing upward intragenerational mobility, who benefit from improved self-rated health beyond what is explained by their origin and destination class (0.10 higher, 95% CI: 0.01, 0.20). Across outcomes, psychological wellbeing, psychological distress, and life satisfaction are strongly tied to destination class, whereas physical health and health behaviours remain closely tied to origin class. We also observe gendered effects: women's health is more consistently shaped by early life class than men's. Overall, our empirical findings challenge the theoretical notion that movement between social classes necessarily undermines health.

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Uncovering Seasonal Dynamics in Neonatal Mortality: A Decade of Evidence from Million Death Study using Time Series Modelling in India

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India has accomplished considerable advancements in reducing child mortality, with both under-five and neonatal mortality ratios diminishing markedly. While progress has been considerable, the nation still encounters obstacles in attaining the Sustainable Development Goal (SDG) objective of eliminating avoidable fatalities among children under 5. These excess deaths could be reduced if the correct information regarding seasonality has been known. The Million Death Study monitored nearly 14 million people in 2.4 million nationally representative households in India between 1998-2014. The total sample were 53,509. Using the Generalized Additive Model (GAM) with a Poisson response and a log link, the study attempts to identify any seasonal and long-term trends affecting neonatal deaths by the inclusion of harmonic regression terms and a non-parametric smooth function of time. The model accounts for both annual and semi-annual seasonal components using sine and cosine functions. Also, a smoothing spline term, $s(t)$, captures nonlinear trends over time other than the seasonal variation. The evidence of a seasonal variation in neonatal death rates is strong, with all the harmonic terms (sin1, cos1, sin2, cos2) proving significant ($p < 0.05$). The presence of both annual and semi-annual cycles implies a complex interplay among seasonal factors with probable influences from climate, environment, or health sphere. The smooth term $s(t)$ is highly significant, with effective degree of freedom of about 19 and with a chi-square statistic greater than 3000 ($p < 0.0001$), evidencing the complex non-linear variation in mortality rate over time. The model explains good variation, achieving approximately 89.7% in deviance and an adjusted R-squared value of 0.876. It can thus be concluded that there exists strong and consistent seasonality in neonatal mortality rates. Such identified patterns become very important to design and plan appropriate public health interventions and, therefore, proper resource allocation when incidents increase in season periods of risk.

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