# Scaling Prosperity: A Hierarchical Bayesian Map of Population Size and Global GDP Through 2100

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**Background :** Population size is a contested driver of macroeconomic output. Because GDP is strongly associated with population health—spanning life expectancy, mortality, and health system capacity—credible GDP trajectories directly inform public health planning. Yet robust, uncertainty-aware projections linking demographic pathways to GDP remain limited.

**Methods :** We assembled panel data for 210 countries and territories (1960–2023) and fit a hierarchical Bayesian model with region- and country-level random effects. Centered log-population entered as a restricted cubic spline (natural spline with linear tails). Model adequacy was assessed via posterior predictive checks and out-of-sample information criteria. For 2024–2100, we combined posterior draws with eight UN WPP-2024 variants using an anchor-and-delta approach that fixes each country's base-year GDP and projects population-driven changes; training knots were reused, with light long-horizon regularization (post-2085 taper and plausibility envelopes). Variant medians were synthesized on the log scale with random-effects pooling.

**Results :** The association between centered log-population and log-GDP was positive with mild nonlinearity. Residuals showed no material misfit (MAE ≈ 1.01 log units). Versus a linear model, the spline showed comparable predictive performance (WAIC ΔELPD ≈ 6.4, SE 163.7). Scenario-pooled forecasts indicate world GDP will grow by 38% (95% HDI 35–40%) from 2025 to 2040, with the United States, China, and the United Kingdom remaining the three largest economies in 2040. Between-variant heterogeneity explained ~38% of global forecast variance.

**Conclusions :** Population is positively associated with GDP across countries, with tapering gains and regional heterogeneity. A hierarchical RCS model with base-year anchoring yields transparent, probabilistic GDP projections; estimates beyond 2050 are best interpreted as regularized envelopes rather than unconstrained forecasts.

# Cultural Well-being as an Outcome in Epidemiologic Research: A Conceptual Review

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**Background** : WHO defines health as physical, mental, and social well-being, yet omits cultural well-being. Because culture shapes what is desirable, it underpins evaluation across health domains; thus, the components and nature of health vary by cultural context. Alongside this latent potential, cultural well-being has an expressive form grounded in the unexchangeability of being, a value affirmed across cultures. It entails outcomes such as human dignity and harmony with nature that are critical to health and merit conceptual study in epidemiology.

**Methods** : We conducted a conceptual review, synthesizing public health, anthropology, social theory, philosophy, religion, and indigenous worldviews.

**Results** : The grounding of cultural well-being in the unexchangeability of being accords with Hannah Arendt and others who argue that culture follows a principle distinct from governance or economic exchange and is salient in art and care. For example, the tea ceremony creates inclusive spaces beyond status; person-centered care stresses each individual's irreplaceability; Buddhism emphasizes non-discrimination; Christianity affirms unconditional love. This principle gives rise to three properties. First, its human expression is dignity, exemplified by the Japanese Constitution's right to a cultured living. Second, its ecological expression is relations with nature and non-human beings, central to Shinto, Daoist thought, and animistic worldviews. Third, its temporal expression is recognizing each moment as unique and irreplaceable, embodied in Zen Buddhism's ichi-go ichi-e and mindfulness practices.

**Discussion** : Recognizing cultural well-being as an epidemiologic outcome extends the WHO framework and aligns with the SDGs' pledge to leave no one behind. This concept opens pathways toward more equitable, inclusive public health grounded in plural values, dignity, and connection with nature.

# Effects of Extreme Heat on Dementia Onset and All-Cause Mortality in Japan

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**Background :** Older adults are vulnerable to extreme heat, but its association with dementia remains unclear.

**Methods :** We analyzed 57,178 dementia-free and independent adults (≥65), residing ≥30 years in the same municipality, from the 2016 Japan Gerontological Evaluation Study. Dementia and mortality during the 3-year follow-up period were identified through public long-term care insurance records. Extreme heat exposure one to three years prior was determined using Japan Meteorological Agency data relative to each municipality's normal climate (1981-2010).Three-level mixed-effects logistic regression was applied.

**Findings :** Each week above the 90th percentile in a prior year was associated with 8.1% (95%CI: 4.3–12.2) and 13.5% (95%CI: 9.6–17.4) higher odds of dementia onset and mortality. Each day above the 99th percentile was associated with 1.6% (95%CI: 0.7–2.6) and 3.0% (95%CI: 2.1–3.9) higher odds, respectively. Effects were strongest one-year prior; cumulative effect was unclear.

**Interpretation :** Extreme heat may accelerate dementia and increase mortality. Health adaptation policies for older people are warranted.

# EDC+LFIA/FMP enable ultra-sensitive HPV E6/E7 mRNA detection, high specificity, and accurate typing.

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**Objective** : Cervical cancer is the fourth most common malignancy in women, with >660,000 new cases and >350,000 deaths worldwide annually; China accounts for 22.7% of cases. To meet the 2023–2030 national goal of 50% screening by 2025 and 70% by 2030, there is an urgent need for sensitive, rapid, and low-cost HPV detection methods.

**Methods** : We developed a single-molecule amplification strategy for high-risk HPV E6/E7 mRNA using improved entropy-driven chain replacement (EDC) technology. Probe optimization and dNTP regulation minimized background leakage and improved sensitivity. A dual platform combining lateral flow immunoassay (LFIA) for rapid screening and fluorescent microarray (FMP) for high-throughput analysis was constructed. Multiplex detection of 13 high-risk HPV types enabled accurate identification of single and multiple infections, meeting large-scale screening needs.

**Results** : The optimized EDC system achieved 100 amol sensitivity with a high signal-to-noise ratio. LFIA offered >90% sensitivity and near 100% specificity with short assay time. FMP enabled simultaneous detection of 13 HPV types with >90% sensitivity and specificity and accurately distinguished complex co-infections (e.g., HPV16+58, HPV52+58) without cross-reactivity. Compared with DNA testing, E6/E7 mRNA detection better reflected viral transcriptional activity, reducing transient infection misclassification and improving clinical relevance.

**Conclusion** : This EDC-based dual-platform provides a sensitive, specific, and convenient method for HPV E6/E7 mRNA detection, especially in low viral load samples. It outperforms traditional DNA assays, supporting accurate cervical cancer screening and diagnosis in diverse settings.

# Association of Maternal Dietary Patterns During Pregnancy with Children's Behavioral Problems.

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**Background** : There is limited evidence on the association between maternal dietary patterns during pregnancy and children's behavioral problems. The purpose of this study was to evaluate the association of maternal dietary patterns during pregnancy with children's behavioral problems using date from the Kyushu-Okinawa Maternal and Child Health Study (KOMCHS), a prebirth cohort study.

**Method** : Study subjects were 1,199 mother-child pairs. Maternal dietary patterns during pregnancy were assessed using a self-administered diet history questionnaire (DHQ). Behavioral problems in 5-year-old children were assessed using a Japanese version of the Strengths and Difficulties Questionnaire (SDQ). Adjustment was made for maternal age at baseline, gestation, region of residence, number of older siblings at baseline, family structure, maternal depressive symptoms during pregnancy, job type, family income, maternal and paternal education levels, maternal body mass index, birth weight, child's sex, breastfeeding duration, maternal smoking during pregnancy, and household smoking during the first year of life.

**Results** : The healthy pattern during pregnancy significantly was associated with a reduced risk of hyperactivity and low prosocial behavior in children: the adjusted odds ratio (OR) (95% confidence interval [CI]) was 0.58 (0.35-0.97) (p for trend = 0.04) and 0.47 (0.32-0.69) (p for trend= <0.0001), respectively. The Japanese pattern was significantly related to an increased risk of hyperactivity in children: the adjusted OR (95% CI) was 1.64 (0.99-2.74) (p for trend = 0.04).

**Conclusion** : This study revealed that the healthy dietary pattern during pregnancy may be inversely associated with the risk of hyperactivity and low prosocial behavior in children. On the other hand, the Japanese dietary pattern during pregnancy may be positively related to the risk of hyperactivity in children.