

Climate, Migration, and Sodium Sensitivity: A Systems-Level Hypothesis for Hypertension Risk in Migrant Populations

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Abstract: Emerging evidence suggests that thermoregulatory mechanisms, particularly sweat-mediated sodium excretion, play a critical role in modulating blood pressure among salt-sensitive individuals. This paper proposes a novel hypothesis: that migration from hot to cooler climates may inadvertently elevate hypertension risk in salt-sensitive populations due to reduced sweat output and consequent sodium retention. Drawing on physiological, behavioural, and epidemiological insights, we explore how climate-driven changes in sodium metabolism intersect with ethnicity, dietary patterns, and public health screening protocols. The hypothesis is situated within a broader framework of migration health equity, highlighting the need for culturally and environmentally responsive interventions. We argue for the integration of climate-adjusted risk modelling into NHS screening strategies and propose targeted behavioural insight trials to assess the impact of thermoregulatory shifts on cardiovascular outcomes. This systems-level perspective reframes hypertension not merely as a clinical condition, but as a governance challenge shaped by climate, culture, and physiology.

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I. INTRODUCTION

Hypertension remains one of the leading modifiable risk factors for cardiovascular disease globally, with disproportionate prevalence and outcomes observed across ethnic and geographic populations. While dietary sodium intake is a well-established contributor to elevated blood pressure, emerging evidence suggests that ambient temperature and thermoregulatory physiology, specifically sweat-mediated sodium excretion, play a critical but underexplored role in modulating individual risk.

Sweating is a primary mechanism for sodium loss, particularly in hot climates where thermoregulation demands higher sweat output. Individuals living in these environments may naturally offset high dietary sodium intake through increased dermal excretion. However, when such individuals migrate to cooler climates, their sweat output decreases, potentially leading to sodium retention and elevated blood pressure, especially among those with salt-sensitive hypertension, a trait more prevalent in populations of African, Caribbean, and South Asian descent.

This hypothesis gains traction when viewed through the lens of migration health equity. Migrants from hot regions

relocating to temperate zones may experience a physiological shift that subtly increases their cardiovascular risk, independent of socioeconomic or behavioural factors. The interplay between climate, ethnicity, and sodium metabolism is rarely considered in public health screening protocols, yet it may hold explanatory power for observed disparities in hypertension prevalence and control.

Recent studies have begun to explore the role of ambient temperature as a confounding variable in sodium-related hypertension. For example, Naser et al. (2024) argue that high ambient temperatures influence sodium intake, urinary excretion, and blood pressure, particularly in coastal populations affected by saltwater intrusion. Similarly, Mueller et al. (2024) modelled climate-driven salinity risks and their implications for hypertension across vulnerable geographies. These findings underscore the need to integrate environmental physiology into cardiovascular risk modelling.

This paper proposes a systems-level hypothesis: that migration from hot to cooler climates may elevate hypertension risk in salt-sensitive individuals due to reduced sweat-mediated sodium excretion. We explore the physiological basis for this hypothesis, its implications for public health governance, and the potential for climate-

adjusted screening and intervention strategies. By reframing hypertension through the intersecting lenses of climate, migration, and physiology, we aim to advance a more equitable and responsive model of cardiovascular prevention.

II. METHODOLOGY

➤ Study Design

This paper presents a hypothesis-driven conceptual analysis, integrating physiological, epidemiological, and behavioural science literature to explore the relationship between ambient temperature, sweat-mediated sodium excretion, and hypertension risk in salt-sensitive migrant populations. The study adopts a systems-level approach, drawing on interdisciplinary sources to construct a testable framework for future empirical validation.

➤ Conceptual Framework Development

We synthesised findings from:

- Thermoregulatory physiology and sodium metabolism
- Ethnic variation in salt sensitivity and hypertension prevalence
- Climate adaptation and migration health equity literature
- Behavioural insight and public health screening protocols

Key sources included peer-reviewed articles from *Nature Scientific Reports*, *Wellcome Open Research*, and WHO/ESC guidelines on sodium intake and cardiovascular risk.

➤ Population Focus

The conceptual model focuses on individuals of African, Caribbean, and South Asian descent who have migrated from hot climates (e.g. Sub-Saharan Africa, South Asia) to temperate regions (e.g. Northern Europe). These populations are known to exhibit higher salt sensitivity and disproportionate hypertension burden.

➤ Hypothesis Construction

We propose that:

- Sweat-mediated sodium excretion is a protective mechanism in hot climates for salt-sensitive individuals.
- Migration to cooler climates reduces sweat output, leading to increased sodium retention.
- This shift may elevate hypertension risk, independent of diet or socioeconomic status.

The hypothesis is framed within a climate-migration-health nexus, with implications for screening thresholds, dietary interventions, and culturally responsive public health strategies.

➤ Ethical Considerations

As a conceptual paper, no human participants were involved. However, the proposed framework is intended to inform ethically sound research and policy development, particularly in underserved and migrant communities.

III. LIMITATIONS

This methodology does not include primary data collection. The hypothesis requires empirical testing through:

- Longitudinal cohort studies comparing pre- and post-migration blood pressure trends
- Sweat sodium assays across climate zones
- Behavioural trials assessing dietary adaptation and salt reduction strategies

IV. DISCUSSION

This hypothesis invites a re-examination of how climate and physiology intersect with public health equity. If validated, it could explain why certain migrant populations experience elevated hypertension risk despite comparable or improved socioeconomic conditions post-migration. It also challenges the assumption that dietary sodium intake alone accounts for ethnic disparities in cardiovascular outcomes.

The implications for public health governance are significant. Screening protocols may need to incorporate climate-adjusted thresholds for salt-sensitive individuals. Behavioural interventions, such as culturally tailored salt reduction campaigns, could be prioritised for migrant communities transitioning to cooler climates. Moreover, climate-aware risk modelling could inform NHS resource allocation and policy design, ensuring that environmental physiology is not overlooked in cardiovascular prevention strategies.

This systems-level lens also opens avenues for interdisciplinary collaboration. Public health practitioners, behavioural scientists, climate modellers, and migration policy experts could co-design interventions that reflect the complex realities of global mobility and environmental adaptation.

V. GENERATIONAL IMPLICATIONS

This hypothesis carries generational significance. The physiological shift in sodium metabolism triggered by migration may not only affect first-generation migrants, but also their descendants, particularly if dietary patterns, salt sensitivity, and reduced sweat output persist across generations. Second- and third-generation individuals may inherit both genetic predispositions and cultural dietary norms, while living in climates that no longer support the thermoregulatory sodium loss their ancestors experienced. This creates a latent risk profile that is often overlooked in standard public health screening, which tends to focus on immediate socioeconomic factors rather than intergenerational physiological adaptation. Recognising this as a generational issue reframes hypertension as a legacy of climate displacement, requiring longitudinal surveillance and culturally responsive prevention strategies.

VI. CONCLUSION

Sweat-mediated sodium excretion is a physiologically significant, yet under-recognised, factor in hypertension risk, particularly among salt-sensitive individuals from hot climates. Migration to cooler regions may disrupt this thermoregulatory balance, leading to increased sodium retention and elevated blood pressure. Crucially, this shift may not be limited to first-generation migrants. Descendants of those who have relocated may inherit both genetic predispositions and cultural dietary norms while living in climates that no longer support the sodium-regulating mechanisms their ancestors relied upon. This creates a latent, intergenerational risk profile that is often overlooked in public health screening and policy design.

This conceptual paper calls for empirical validation of the hypothesis and urges public health systems to integrate climate, ethnicity, and physiology into cardiovascular risk frameworks. Doing so could advance a more equitable, responsive, and strategically intelligent approach to hypertension prevention, one that recognises not only the immediate effects of migration, but also its enduring physiological legacy across generations.

DECLARATIONS

➤ *Ethics Approval and Consent to Participate*

Not applicable. This study is a conceptual analysis and did not involve human participants, personal data, or biological material.

➤ *Consent for Publication*

Not applicable.

➤ *Availability of Data and Materials*

No datasets were generated or analysed during the current study. All referenced materials are publicly available and cited appropriately.

➤ *Competing Interests*

The author declares no competing interests.

➤ *Funding*

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➤ *Authors' Contributions*

Sean Somersall-Weekes conceived the hypothesis, conducted the literature synthesis, and drafted the manuscript. The author read and approved the final manuscript.

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