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Cross Sectional Study on the Impact of Weather Changes on Health Perceptions among Immigrants in Sunderland UK

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Abstract

Introduction: Climate change is intensifying in the United Kingdom (UK) with disproportional effects on the susceptible populations. Immigrants may face several exposure and adaptive restrictions due to structural inequalities, yet few empirical research examines climate-related health perception among this group. This study aimed to investigate the perception of weather change, perceived physical and mental health impacts, and socio-demographic predictors of perception among immigrants in Sunderland, UK.

Methods: A cross-sectional survey was conducted among immigrant between August to December 2025 and 401 participants recruited. Descriptive statistics, chi-square tests, reliability testing, and multivariable logistic regression were performed. The study was theoretically grounded in

environmental justice theory, the social determinants of health framework, and cultural risk perception theory.

Results: outcome of the study showed 52.1%, perceived significant weather changes. 56.9% reported physical health impacts and 61.1% reported mental health effects. Ethnicity ($p < 0.001$), religion ($p < 0.001$), and academic discipline ($p = 0.035$) were independently associated with perception. Logistic regression confirmed ethnic minority status as a significant predictor of weather-health perception after adjustment.

Conclusion: Weather-change perception among immigrants is socially structured and mediated by cultural identity and educational context. Climate-health adaptation strategies must incorporate equity-oriented, culturally responsive public health approaches.

Keywords: Environmental Justice Theory, Climate Change, United Kingdom

1. Introduction

Climate variability has emerged as a crucial global health threat (Watts *et al.*, 2023) ^[30]. In the UK, increasing heatwaves frequency, extremes cold and erratic precipitation have increased concern regarding climate associated morbidity and mortality (UKHSA, 2023) ^[28]. This changes in climate is recognised as a major driver of human mobility, with environmental stressors such as flooding, drought, and heat exposure reshaping settlement patterns and health vulnerabilities (Black *et al.*, 2011; Cattaneo *et al.*, 2019). Climate-induced migration is not solely an environmental phenomenon but a socio-economic and health issue, disproportionately affecting vulnerable populations and amplifying inequalities in host communities (McMichael *et al.*, 2020; Schwerdtle *et al.*, 2020). Emerging evidence suggests that climate mobility is closely linked with increased risks of infectious disease exposure, mental health stress, and barriers to healthcare access (Watts *et al.*, 2021; Romanello *et al.*, 2023 ^[13]).

However, climate health related effects are not equally distributed. Rather, they intersect with inequality, social vulnerability, and demographic identity.

1.1 Climate change, Health inequality and Migration

The framework of social determinants of health emphasises that health outcomes are shaped by socio-economic position, employment, housing, and environmental exposure (Marmot *et al.*, 2020) ^[11]. Most times immigrants occupy socio-economically deprived in host societies, regularly residing in areas with higher pollution and poorer housing quality (Riva *et al.*, 2021) ^[12].

Recently study by the University College London UK demonstrates that Recent UK that ethnic-minority immigrants experience overly higher exposure to air pollution compared with UK born residents (UCL, 2025) [27]. Environmental burdens therefore complicate migration related stressors including insecure employment, reduced healthcare access and discrimination (Abubakar *et al.*, 2018) [1].

1.2 Climate Vulnerability and Environmental Justice

Environmental justice theory highlights that marginalised groups possessing fewer adaptive resources whilst bearing disproportionate environmental risks (Schlosberg, 2013; Jennings *et al.*, 2020) [25, 8]. Climate change increases such inequities (Islam and Winkel, 2017) [7].

Deprived and ethnically diverse neighbourhoods in UK experiences higher exposure to air pollution, overheating housing, and flood risk (Taylor *et al.*, 2021) [26]. These exposures prone to shape not only health risk but also perception of weather and climate change.

1.3 Risk Perception and Cultural Mediation

The theory of risk perception claims that individuals interpret environmental hazards through cultural and social filters (Slovic, 2016). Cultural cognition shapes whether weather anomalies are interpreted as climate change, natural variability, or divine will (Kahan *et al.*, 2017) [9]. Religion, ethnicity, and education influence climate awareness and concern (Lee *et al.*, 2015; Ballew *et al.*, 2020) [10, 2].

However, limited research examines how these frameworks operate within immigrant populations in UK cities.

1.4 Study Context: Sunderland

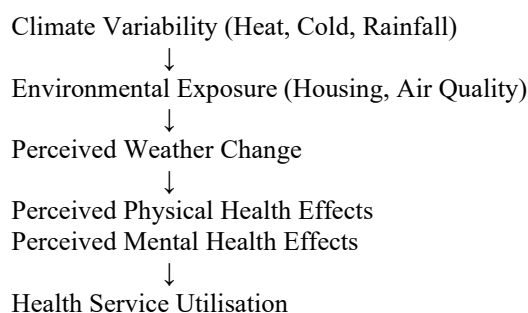
This study is conducted in Sunderland, located in Northeast England. Sunderland faces socio-economic deprivation and evolving demographic diversity. As climate change increases in the UK, understanding how immigrants experience and perceive weather-health effect is crucial for local adaptation planning.

2. Conceptual Framework

This study integrates:

1. Environmental Justice Theory
2. Social Determinants of Health Framework
3. Cultural Risk Perception Theory

Conceptual Framework Diagram (for graphical rendering)



3. Methods

Study Design

A cross-sectional, quantitative study design was used to investigate the effect of weather changes on health perceptions among immigrants in Sunderland between October 2025 to January 2026. A cross-sectional design was selected due to its suitability for capturing population-level perceptions at a specific point in time and its efficiency in examining multiple associations simultaneously.

Study Setting

The study was conducted at Sunderland, a major city in North-East England with a diverse student body representing more than 100 nationalities. The city of Sunderland provides a practical environment for exploring immigrant health perceptions due to its multicultural population and the increasing impact of climate variability in the region, including rising winter temperatures, irregular rainfall patterns, and seasonal heat fluctuations.

Study Population

The target population consisted of immigrant resident and students enrolled at the University of Sunderland during the 2024–2025 academic year. Immigrant status in this study was defined as any person born outside the UK, irrespective of citizenship, length of residence, or migration pathway (asylum, education, employment, or family reunification).

Inclusion Criteria

- Aged 18 years and above
- Born outside the United Kingdom
- Provided informed consent

Exclusion Criteria

- UK-born residents
- Incomplete questionnaires (>20% missing data)

Sample Size and Sampling Technique

A total of 401 participants completed the survey. Sample size adequacy was confirmed using Cochran's formula (at 95% confidence level and 5% margin of error), which recommended a minimum of 384 participants. To ensure representation across demographic groups, a stratified sampling approach was applied, stratifying by faculty and level of study. Within each stratum, convenience sampling was used to recruit eligible participants.

Data Collection Instrument

Data were collected using a structured, self-administered questionnaire adapted from previous studies on climate perception, migrant health, and environmental risk awareness (Leiserowitz *et al.*, 2019; WHO, 2025; Shanaah *et al.*, 2025). The questionnaire consisted of three sections: Socio-demographic characteristics (gender, age, ethnicity, religion, faculty, level of study, employment status, and residential status) Perception of weather change Measured through a binary outcome variable ("Yes" = perceives changes in weather; "No" = does not perceive changes). This item assessed respondents' awareness of shifts in temperature, rainfall, and changing seasonal patterns. And Health perception related to weather change Items assessing whether respondents felt that recent weather patterns affected their physical or mental health.

Validity and Reliability

Face and content validity were assessed by expert in public health and environmental epidemiology. A pretest was conducted with 20 immigrant, and minor adjustments were made for clarity. Cronbach’s alpha for the perception items was 0.81, indicating high internal consistency.

Data Collection Procedure

Data collection occurred across Sunderland, university campuses, and online through community group platforms. Participants received an online consent form before completing the survey. The survey period lasted 16 weeks, from October 2025 to January 2026.

Data Management and Statistical Analysis

IBM SPSS version 29 was used for data cleaning and analysis. Descriptive Analysis Frequencies and percentages summarised socio-demographic characteristics. To explore associations between demographic variables and perception of weather change: Chi-square tests (χ^2) were used for categorical variables. Fisher’s Exact test (marked as *f* in the table) was applied when expected frequencies were below five. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the University of Sunderland Research Ethics Committee. Participants were informed of the study purpose, voluntary participation, confidentiality, and the right to withdraw at any point without penalty. No identifying information was collected, and all data were stored on password-protected devices in line with GDPR regulations225.

4. Results
Demographic Characteristics of Participants

Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	225	56.1
	Male	169	49.1
	Non-Binary	5	1.2
	Prefer not say	4	1
Age Group	18–24	242	60.3
	25–29	51	12.7
	30–34	48	12.0
	35 and above	62	15.0
Ethnicity	White/Caucasian	165	41.1
	Black/African/Caribbean	106	26.4
	Asian	93	23.2
	Other	33	8.2
	Mixed/Multiple ethnic groups	4	1.0
Religion	Christianity	172	42.9
	Islam	106	26.4
	Hindu None/Prefer not to say	104	25.01
	Sikh	8	2.0
	Hindu	7	1.7
	Buddhism	4	1.0
Education level	Undergraduate	262	65.3
	Postgraduate (Masters/Diploma)	135	33.7
	PhD	4	1.0
Employment Status	Full-time	208	51.9
	Not employed	162	40.4

	Part-Time	28	7.0
	Others	8	2.0
Occupation	Health care professionals (Doctors, Nurses, Pharmacists, Care and support workers	231	57.6
	IT	72	18.0
	Business	55	13.7
	Education	25	6.2
	Artists	20	5.0
	Others	18	4.5
Residential status	Rented accommodation family	186	46.4
	Mortgage	120	29.9
	University Accommodation	77	19.2
	Others	18	4.5

A total of 401 immigrant respondents participated in the study. Table 1 shows that the sample was predominantly young, with 60.3% aged 18–24 years. The largest ethnic groups were White/Caucasian (41.1%) and Black/African/Caribbean/Black British (26.4%), followed by Asian (23.2%). Christianity (42.9%) and Islam (26.4%) were the most common religions. Most respondents were undergraduate students (65.3%) and professions include health professionals (57.6%). Slightly less than half (46.4%) lived in rented housing, and 51.9% were employed full time.

Table 2: Descriptive Statistics of Health Perception Variables Among Immigrants in Sunderland (2024-2025)

Health Perception Variable	Category	Frequency (n)	Percentage (n)
Perceived impact of weather on physical health	Yes	228	56.9
	No	173	43.1
Perceived impact of weather on mental health	Yes	245	61.1
	No	156	38.9
Experiences of weather-related symptoms	Headache/Fatigue	189	47.1
	Flu-like symptoms	103	25.7
	Breathing difficulties	56	13.9
	Skin irritation	29	7.2
Health service utilisation due to weather	No symptoms	24	6.0
	No	269	67.1
	Yes	132	32.9

Association Between Socio-Demographic Characteristics and Weather-Change Perception Among Immigrants in Sunderland (2024-2025)

Variable	X2	Df	p-value	Test Used
Gender	2.729	3	0.483	Fisher’s Exact
Age Group	2.515	3	0.473	Chi-square
Level of Study	2.922	2	0.320	Fisher’s Exact
Residential Status	3.900	3	0.373	Fisher’s Exact
Religion	119.096	4	<0.001***	Fisher’s Exact
Marital Status	6.192	5	0.289	Fisher’s Exact
Employment Status	1.567	3	0.671	Fisher’s Exact
Ethnicity	102.894	5	<0.001***	Fisher’s Exact
Faculty of Study	10.358	5	0.035*	Fisher’s Exact

* p < 0.05 *** p < 0.001

Chi-square analysis revealed statistically significant associations between weather-change perception and ethnicity ($\chi^2 = 102.894$, $p < 0.001$), religion ($\chi^2 = 119.096$, $p < 0.001$), and faculty of study ($\chi^2 = 10.358$, $p = 0.035$).

Fisher's Exact test was applied to account for small cell frequencies and confirmed the robustness of these associations. No significant relationships were observed for gender, age group, employment status, marital status, residential status, or level of study ($p > 0.05$). These findings suggest that socio-cultural identity and educational context significantly shape climate-related health perception among immigrants in Sunderland.

5. Discussion

The present study reveals clear deviation in the perception of weather change and its health impacts among immigrant in Sunderland. Significantly, socio-cultural factors namely ethnicity, religion, and profession emerged as significant predictors of whether individuals perceived weather change (McMichael *et al.*, 2020; Romanello *et al.*, 2023^[13]; UCL, 2025^[27]). This suggests that beyond raw exposure or demographic factors, cultural identity, social context, and educational or work environment shape how immigrants interpret and respond to climatic and weather shifts (UCL, 2025)^[27].

It was also observed that weather-change perception among immigrants is structured by socio-cultural identity and educational context. Consistent with environmental justice research (Jennings *et al.*, 2020; Islam and Winkel, 2017)^[8, 7], ethnic minority immigrants were more likely to perceive weather-health impacts. This may reflect differential environmental exposure (UCL, 2025)^[27] and lived vulnerability.

Mental health perception aligns with literature linking climate variability and psychological distress (Berry *et al.*, 2018; Clayton, 2020; Cianconi *et al.*, 2020)^[3, 5, 4]. Immigrant populations may experience compounded stress due to socio-economic precarity. Also, occupation-based differences support cultural cognition theory (Kahan *et al.*, 2017)^[9], suggesting educational or professional exposure mediates awareness.

6. Conclusion

Weather-health perception among immigrants is not homogeneous but mediated by identity and structural context. Equity-centred adaptation is essential for climate resilience in urban UK settings. As climate change accelerates global displacement, cities such as Sunderland may increasingly experience indirect migration pressures linked to environmental stress in other regions. Proactive planning and inclusive public health strategies are therefore essential to ensure resilience and health equity in an era of climate mobility (Cattaneo *et al.*, 2019; Watts *et al.*, 2021; WHO, 2022).

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