

IS AIR POLLUTION ASSOCIATED WITH POOR MENTAL WELL-BEING AND HOW THIS ASSOCIATION DIFFERS BY ETHNIC SUB-GROUPS IN THE UK?

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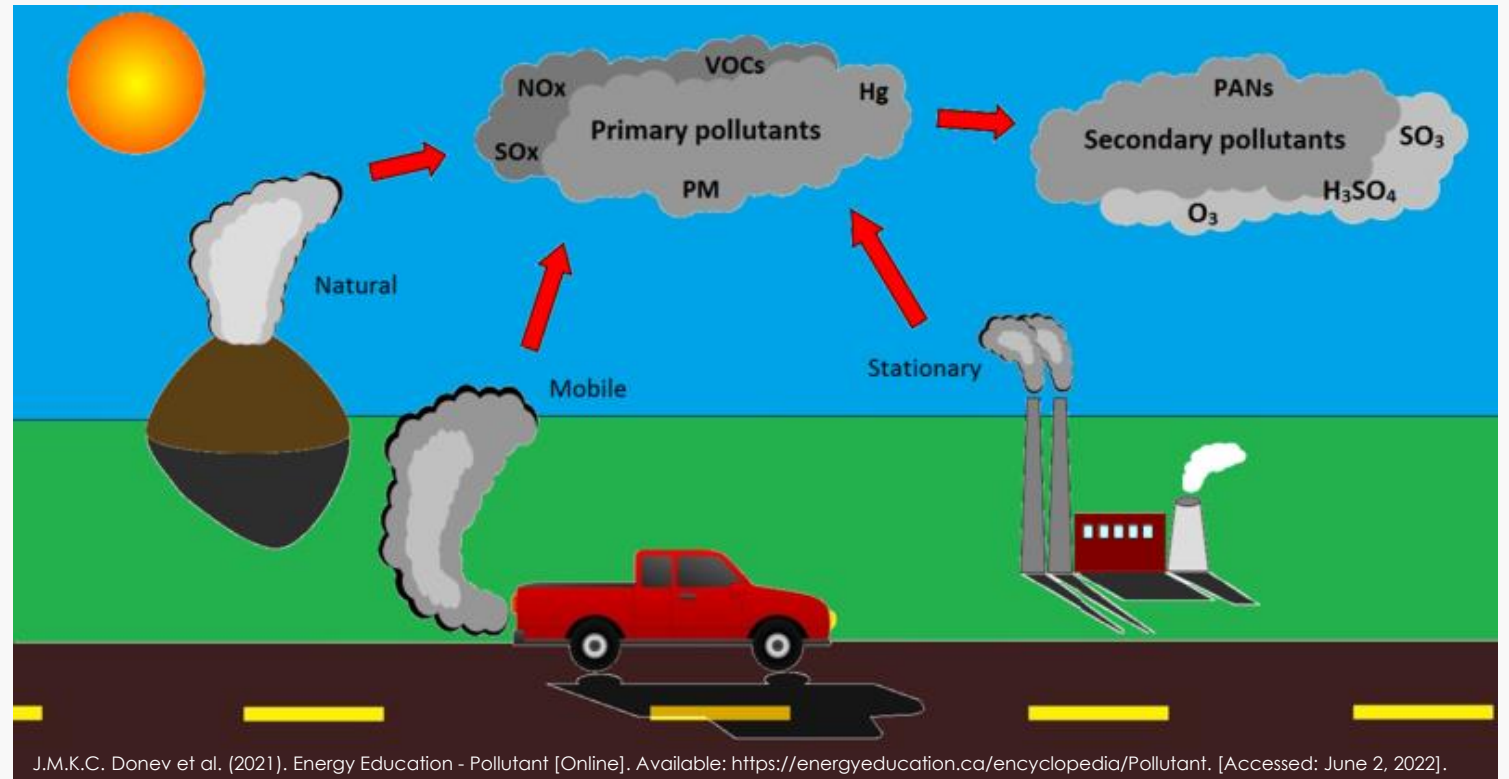
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Introduction

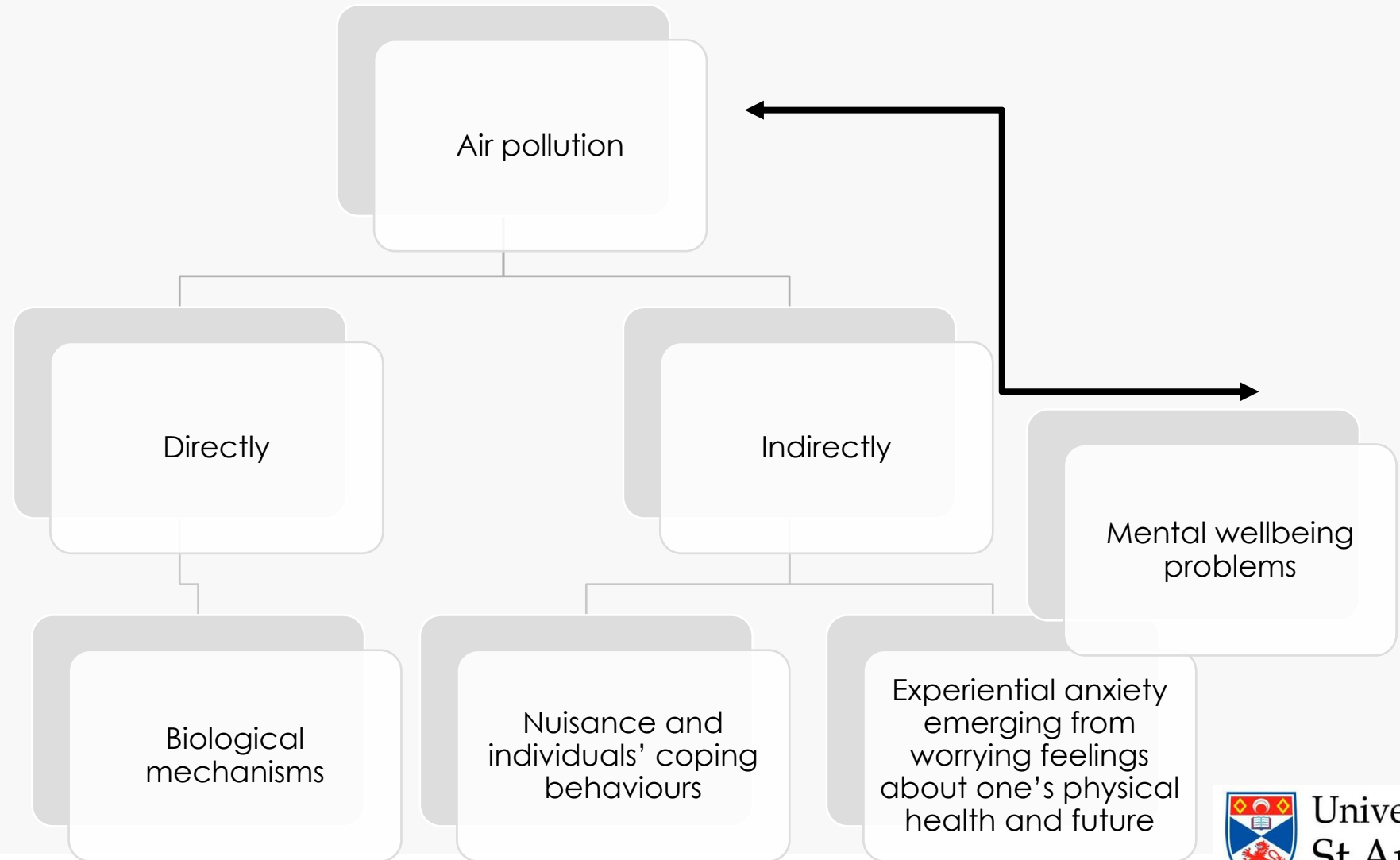
Air Pollution:
 NO_2 , SO_2 , PM_{10} ,
 $\text{PM}_{2.5}$

Poor health,
hospital
admissions,
mortality



Introduction

- Recent literature has been showing a relationship between environmental factors including exposure to ambient air pollution and mental wellbeing
- Though most of the evidence is fragmented and inconclusive



Effect Of Air Pollution On Human Health



Introduction

- Despite the establishment of linkages between air pollution and mental wellbeing in the literature, results are generally inconclusive and require further research.
- In this study, we aimed to investigate the effect of air pollution on mental well-being in the United Kingdom (UK) using a spatial-temporal (between-within) longitudinal design.
- We also aimed to assess if this effect differs by ethnic sub-groups in the UK

Methods

- We used individual-level data from the “UK Household Longitudinal study(UKHLS)” for 60,146 adult individuals (age:16+) with 349,748 repeated responses across 10 data collection waves (11 years: 2009-2019)
- This was linked to annual air pollution data (NO₂, SO₂, PM10, PM2.5) at the census Lower Super Output Areas (LSOAs) of individuals’ place of residence.
- Mental well-being was measured using the General Health Questionnaire (GHQ12) scale, composed of 12 questions each assessed on a 4-point Likert scale.
- The scale is summed up resulting in a general score between 0 and 36 (GHQ0-36), with a cut-off of 12 with scores ≥ 12 indicating poor mental well-being.
- The scale can also be dichotomised and then then summed up resulting in a total score between 0 and 12 (GHQ0-12), with two cut-offs of 2 (sample mean) and 4 with scores ≥ 2 and ≥ 4 indicating poor mental well-being.



Methods

- To assess the spatial-temporal effect of air pollution on mental well-being, we decomposed the overall effect of air pollution linked at the LSOAs level on mental well-being into between (spatial) and within (temporal) effects.
- Between effects were used to determine the spatial effect of air pollution by computing the mean of air pollution across the 11 years of follow-up (2009-2019) for each LSOA.
- Within effects were used to determine the temporal effect of air pollution by calculating the yearly air pollution deviation from the 11 years mean within each LSOA.
- Multilevel mixed-effect logit models were used for analysis.





Description of individuals' reported mental well-being



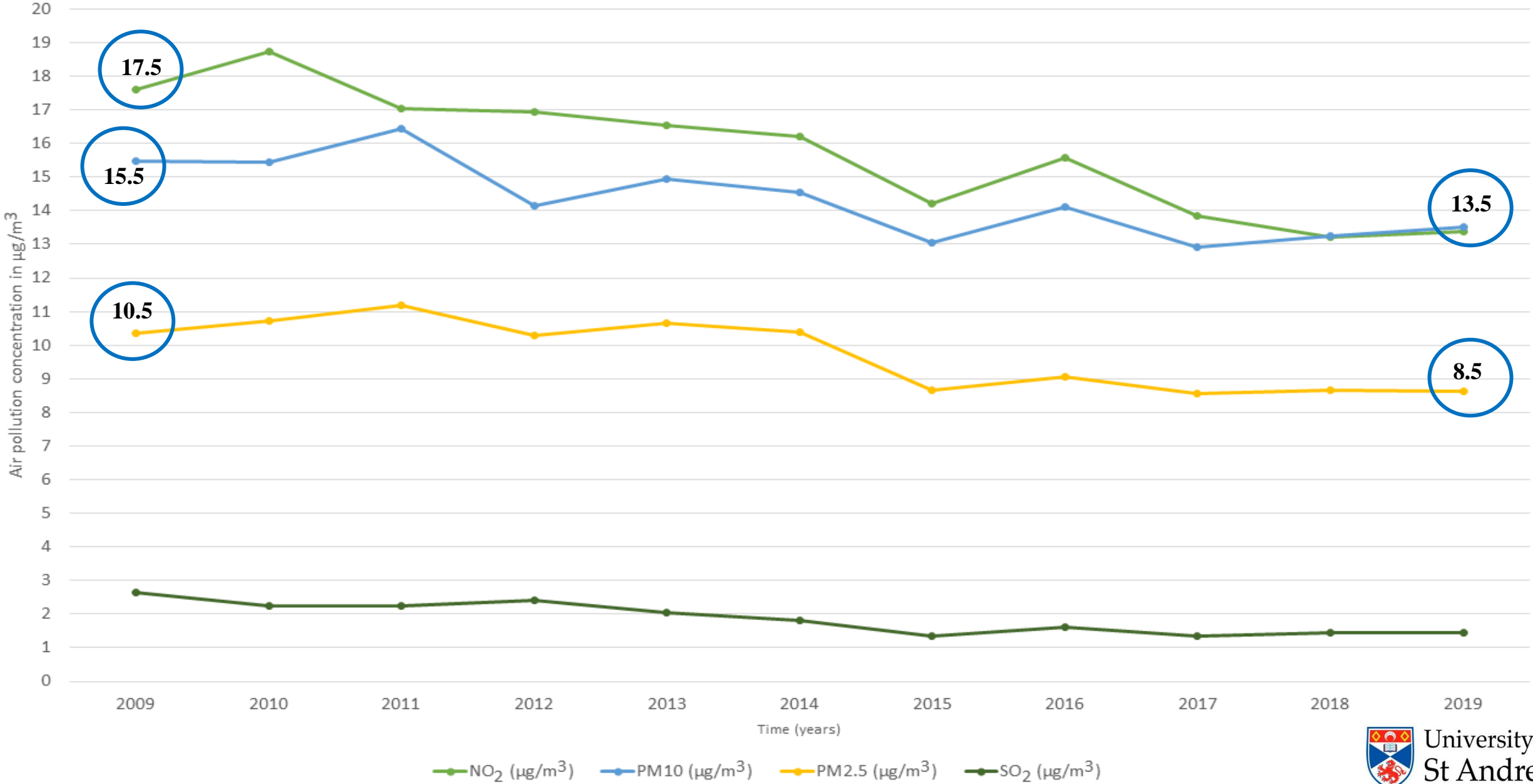
- The mean score for mental well-being GHQ12 (0-12) scale is 1.8 (SD=0.2) with 30% of responses having a GHQ12 score of 2 or more and 19% having a GHQ12 score of 4 or more.
- The mean score for GHQ12 (0-36) scale is 11.14 (SD=0.05) with 36% of responses having a score of 12 or more.

Description of individual's socio-demographic and lifestyle factors for the first and last waves of the UKHLS data (N=349,748 surveys from 60,146 individuals)

		Wave1 (2009-2011)	Wave10 (2018-2019)
		N=31,258	N=29,485
Gender	Male	43.2%	44.0%
	Female	56.8%	56.0%
Age	Young (<34)	26.2%	20.8%
	Middle age (34-58)	46.1%	43.5%
	Old (>58)	27.7%	35.7%
Ethnicity	British white	81.4%	79.1%
	Other white	4.1%	5.1%
	Indian	3.1%	3.6%
	Pakistani/Bangladeshi	3.5%	4.5%
	Black/African/Caribbean	4.0%	3.3%
	Mixed ethnicities	1.6%	1.7%
	Other ethnicities	2.3%	2.8%
Country of birth	Born in the UK	86.3%	68.4%
	Not born in the UK	13.7%	12.0%
	No answer	0.0%	19.6%
Marital status	Married	53.2%	55.2%
	Living as a couple	11.8%	9.6%
	Widowed	5.5%	5.9%
	Divorced/separated	9.1%	8.1%
	Single never married	20.4%	20.8%
	No answer	0.1%	0.4%

		Wave1 (2009-2011)	Wave10 (2018-2019)
		N=31,258	N=29,485
Educational qualification	University degree	31.9%	34.3%
	High school degree	32.9%	26.9%
	Lower educational levels	1.4%	1.0%
	Other qualifications	27.4%	33.3%
	Still a student	6.3%	4.6%
Occupation	Managers/Professionals/employers	12.4%	11.9%
	Non manual workers	27.5%	26.5%
	Manual workers	17.9%	16.3%
	Not applicable: Student/retired/Not working	42.0%	42.6%
	No answer	0.2%	2.7%
	Perceived financial situation	living comfortably/doing alright	59.9%
living difficultly		40.0%	28.2%
no answer		0.1%	0.2%
Cigarette smoking	non-smoker	73.8%	87.0%
	smoker	19.6%	12.8%
	no answer	6.6%	0.2%

The annual mean of NO₂, SO₂, PM10, and PM2.5 air pollutants at the LSOAs level in the UK from the year of 2009 to 2019 (N=42,619 LSOAs)



Correlation matrix of air pollutants at the LSOAs level (N=42,619 LSOAs)

	NO₂ (µg/m³)	SO₂ (µg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)
NO₂ (µg/m³)	1.00			
SO₂ (µg/m³)	0.37	1.00		
PM10 (µg/m³)	0.76	0.28	1.00	
PM2.5 (µg/m³)	0.79	0.32	0.97	1.00

The association of individuals' mental well-being with each of NO₂, SO₂, PM10, and PM2.5 air pollutants linked at the LSOAs level in separate models (N=349,748 surveys from 60,146

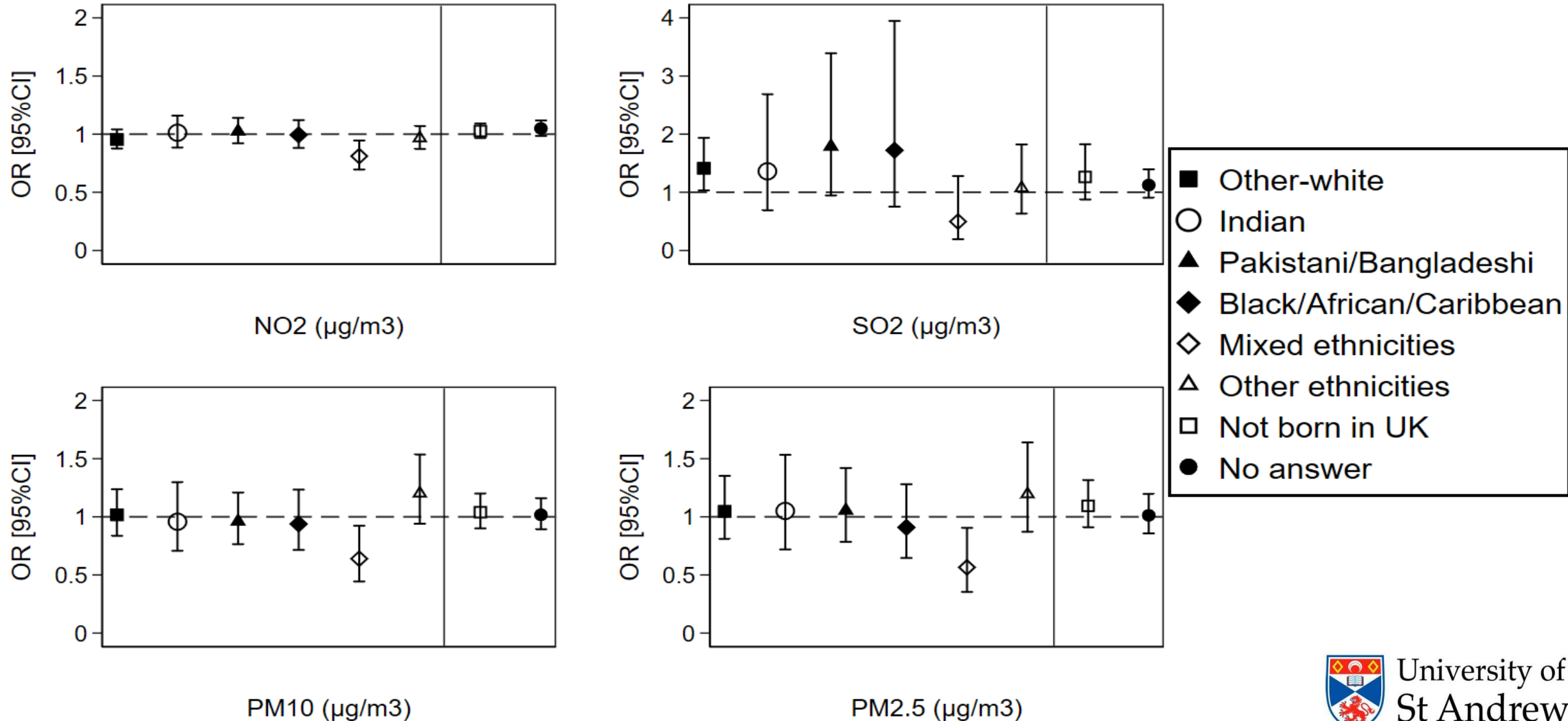
	Mental well-being (GHQ0-36^a ≥ 12)	Mental well-being (GHQ0-12^b ≥ 2)	Mental well-being (GHQ0-12^b ≥ 4)
	OR [95%CI]	OR [95%CI]	OR [95%CI]
Overall pollution effect			
NO₂ (µg/m³)	1.12 [1.09, 1.15]**	1.14 [1.11, 1.17]**	1.12 [1.09, 1.16]**
SO₂ (µg/m³)	1.30 [1.18, 1.44]**	1.29 [1.17, 1.42]**	1.31 [1.17, 1.47]**
PM10 (µg/m³)	1.22 [1.15, 1.30]**	1.28 [1.20, 1.36]**	1.23 [1.15, 1.31]**
PM2.5 (µg/m³)	1.35 [1.24, 1.47]**	1.44 [1.33, 1.56]**	1.38 [1.25, 1.51]**
Between (Spatial) pollution effect			
NO₂ (µg/m³)	1.11 [1.08, 1.15]**	1.13 [1.10, 1.17]**	1.12 [1.08, 1.15]**
SO₂ (µg/m³)	2.21 [1.77, 2.76]**	1.59 [1.29, 1.96]**	1.94 [1.53, 2.45]**
PM10 (µg/m³)	1.21 [1.13, 1.30]**	1.28 [1.19, 1.36]**	1.21 [1.13, 1.31]**
PM2.5 (µg/m³)	1.36 [1.23, 1.50]**	1.47 [1.34, 1.61]**	1.36 [1.23, 1.51]**
Within (Temporal) pollution effect			
NO₂ (µg/m³)	1.01 [0.91, 1.13]	1.04 [0.94, 1.16]	1.06 [0.94, 1.20]
SO₂ (µg/m³)	0.95 [0.80, 1.13]	1.04 [0.87, 1.23]	0.99 [0.81, 1.20]
PM10 (µg/m³)	1.08 [0.91, 1.29]	1.10 [0.92, 1.31]	1.23 [0.99, 1.51]
PM2.5 (µg/m³)	1.09 [0.88, 1.35]	1.14 [0.92, 1.41]	1.24 [0.97, 1.59]

**P-value <0.01; *P-value<0.05; ORs and 95% CIs are expressed in terms of 10 µg/m³ increase in the air pollutants;

Models are adjusted for age, gender, ethnicity, country of birth, marital status, education, occupation, perceived financial situation, smoking status, and year dummies (2009-2019).

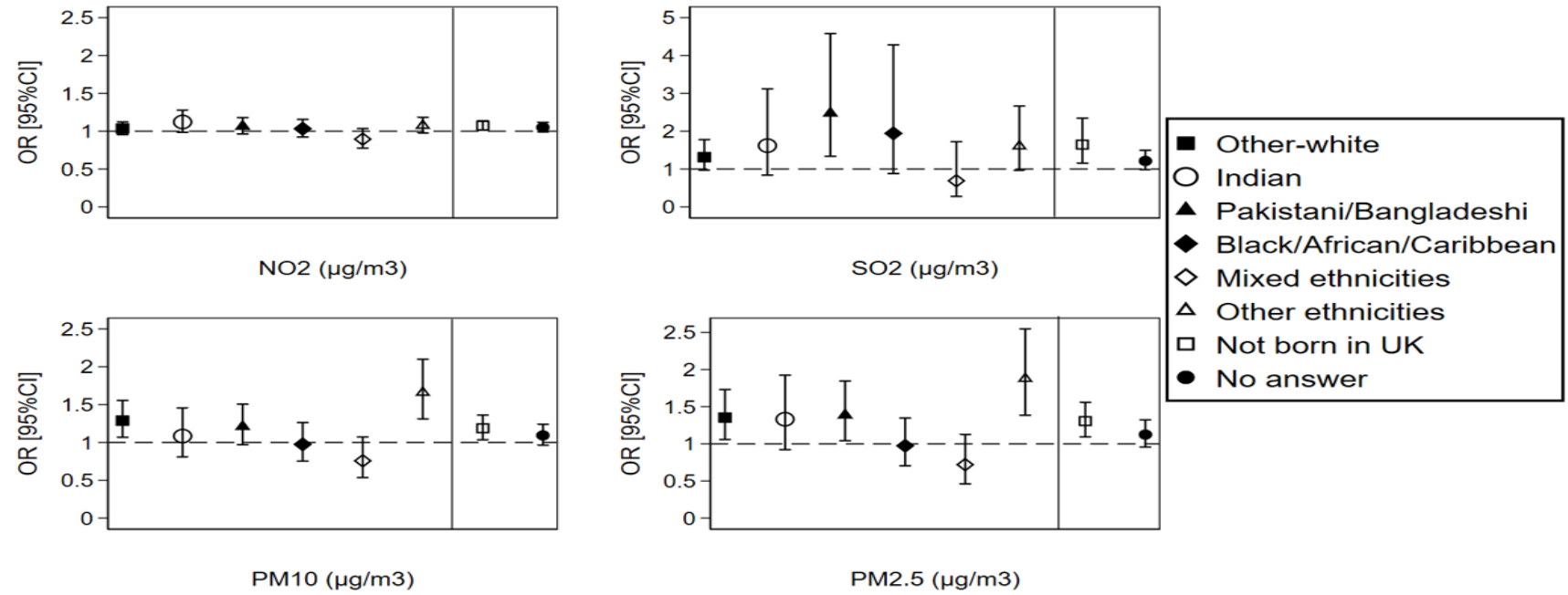
The overall effect of air pollution linked at the LSOAs level on individuals' mental well-being by ethnicity and country of birth (N=349,748 surveys from 60,146 individuals)

a) Mental well-being (GHQ0-36 \geq 12)

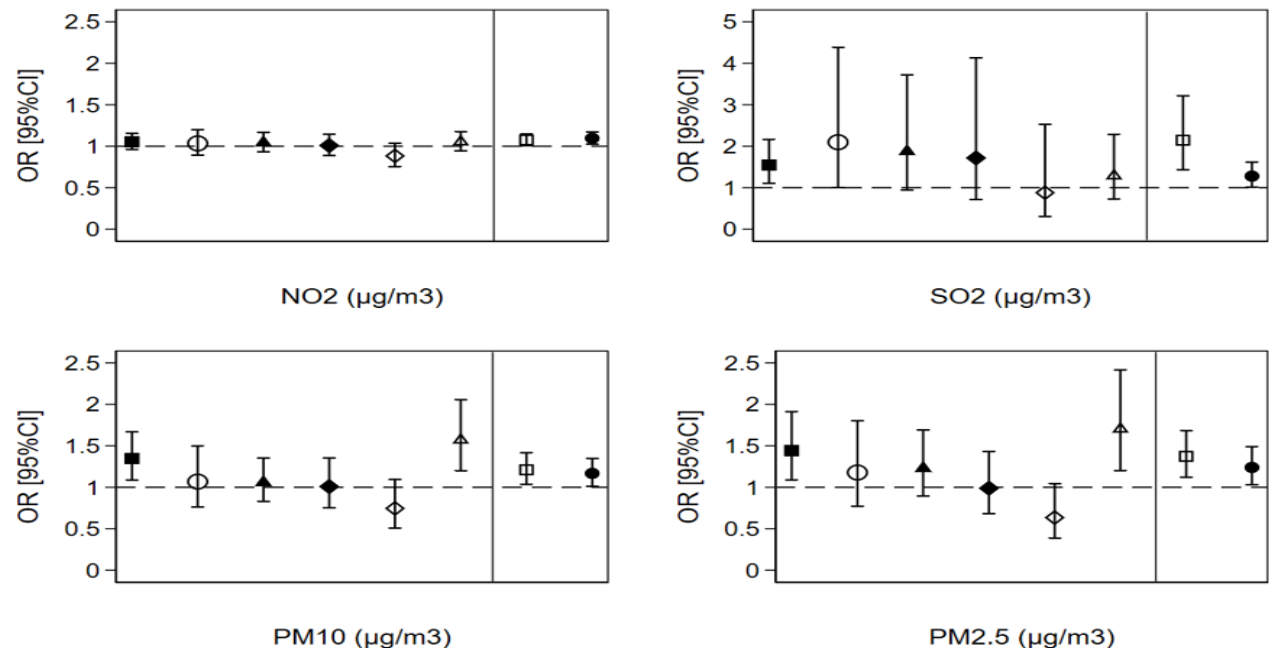


The overall effect of air pollution linked at the LSOAs level on individuals' mental well-being by ethnicity and country of birth (N=349,748 surveys from 60,146 individuals)

b) Mental well-being (GHQ0-12 ≥ 2)



c) Mental well-being (GHQ0-12 ≥ 4)





Conclusions

- Using longitudinal individual-level and contextual-linked pollution data, this study reveals an association between higher exposure to air pollution and mental well-being.
- This is mainly attributed to residing in more polluted areas rather than the air pollution variation across time within each geographical area.
- Thus, environmental policies to reduce air pollution emissions can eventually improve the mental well-being of people in the UK.
- However, the association between air pollution and mental well-being did not vary by ethnic groups and country of birth.
- Further research would help develop more the evidence on this important topic.

Air pollution and individuals' mental well-being in the adult population in United Kingdom: A spatial-temporal longitudinal study and the moderating effect of ethnicity

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Published: March 9, 2022 • <https://doi.org/10.1371/journal.pone.0264394>

Article	Authors	Metrics	Comments	Media Coverage	Peer Review
▼					

Abstract

1. Introduction
 2. Materials and methods
 3. Results
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- Figures

Abstract

Background

Recent studies suggest an association between ambient air pollution and mental well-being, though evidence is mostly fragmented and inconclusive. Research also suffers from methodological limitations related to study design and moderating effect of key demographics (e.g., ethnicity). This study examines the effect of air pollution on reported mental well-being in United Kingdom (UK) using spatial-temporal (*between-within*) longitudinal design and assesses the moderating effect of ethnicity.

Methods

Data for 60,146 adult individuals (age:16+) with 349,748 repeated responses across 10-data collection waves (2009–2019) from "Understanding-Society: The-UK-Household-Longitudinal-Study" were linked to annual concentrations of NO₂, SO₂, PM10, and PM2.5 pollutants using the individuals' place of residence, given at the local-authority and at the finer Lower-Super-Output-Areas (LSOAs) levels; allowing for analysis at two geographical scales across time. The





Thank you!

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