

Exploring the Link Between Noise Pollution and Depression in England for the First Time: An Analysis in Cheshire and Merseyside Integrated Care System

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Aim

To examine the link between environmental noise (road and rail network) and depression in Cheshire and Merseyside Integrated Care System (ICS) that covers a population of 2.7 million people living in nine local authorities.

Methods

We used the strategic noise map data published by the Department for Environment, Food & Rural Affairs and calculated the 24-hour annual average noise levels in small areas in Cheshire and Merseyside ICS [1]. Our primary outcome measure was depression prevalence, defined as the percentage of patients with a diagnosis of depression in their medical records [2].

To assess the impact of rail and road noise, we combined the two noise databases and calculated the total road and rail noise coverage for the 24-hour annual average noise, considering noise levels exceeding 55 dB, and then subtracted the intersecting area. We employed Geographical Weighted Regression and Generalised Structural Equation Spatial Modelling (GSESM) to estimate the relationship between transportation noise in 2019 and depression prevalence in 2020. Mediation models, including the indirect effects, were examined using ordinary least squared (OLS) regression analyses with the ArcGIS Pro 2.9.2 OLS tool.

Results

Knowsley had the highest coverage of areas exposed to road noise on a 24-hour basis, followed by Warrington. Halton and Warrington had the highest coverage of areas exposed to rail noise on a 24-basis. Combining road and rail noise, we found that Warrington and Knowsley had the highest percentage of noise coverage, with over half of their respective areas exposed to transportation noise exceeding 55 decibels on a 24-hour basis. (Table 1)

Figure 1 illustrates the correlation between areas with transportation noise levels of 55 decibels or higher and the prevalence of depression, with brown denoting areas that experienced both high transportation noise and high depression prevalence in 2019.

The results of the GSESM analyses suggested that while transportation noise had low direct significance in explaining depression levels in Cheshire and Merseyside ICS, it did significantly mediate other factors associated with depression prevalence. In areas where environmental noise levels exceed 55 dB LDEN, the impact of health deprivation and disability on depression was 0.62 times higher due to noise. (Table 2)

Sub ICB	55-59.9 dB	60-64.9dB	65-69.9 dB	70-74.9 dB	≥75 dB	Total percentage of road and rail noise coverage with noise levels >55 dB
Cheshire (mean road noise)	11.57	5.60	2.95	1.85	0.67	24.69
(mean rail noise)	1.20	0.65	0.38	0.19	0.07	
Halton (mean road noise)	17.13	8.24	4.37	2.68	1.56	36.69
(mean rail noise)	2.35	1.58	1.35	0.08	0.00	
Knowsley mean road noise)	32.84	10.26	6.45	3.93	2.43	56.99
(mean rail noise)	1.74	1.12	0.85	0.01	0.00	
Liverpool mean road noise)	11.17	4.75	3.26	3.25	1.01	24.96
(mean rail noise)	0.83	0.47	0.56	0.02	0.00	
South Sefton mean road noise)	12.64	5.56	3.92	3.67	1.03	27.85
(mean rail noise)	0.87	0.53	0.00	0.00	0.00	
Southport and Formby (mean road noise)	3.27	2.21	2.08	1.35	0.11	11.06
(mean rail noise)	1.15	0.99	0.00	0.00	0.00	
St Helens (mean road noise)	17.04	6.05	3.51	2.44	0.95	31.24
(mean rail noise)	1.06	1.01	0.44	0.05	0.00	
Warrington (mean road noise)	30.93	13.08	5.75	3.50	2.06	57.25
(mean rail noise)	1.65	1.03	0.80	0.15	0.00	
Wirral (mean road noise)	13.87	6.05	3.90	2.96	1.28	28.72
(mean rail noise)	0.69	0.30	0.00	0.00	0.00	

Table 1. Summary statistics for the mean road and rail noise coverage percentage (%) and dB levels in Cheshire and Merseyside ICS in 2019

Summary Findings

- To the best of our knowledge, this study is the first to investigate the impact of transportation noise pollution on depression prevalence in England.
- Our research revealed that, although transportation noise did not have an equal direct role in explaining depression levels in all areas, it did play a significant mediating role, amplifying the effect of other factors on depression, such as the impact of health deprivation and disability.
- Our study identified areas with a heavier noise burden, offering the opportunity to tailor public health interventions in these regions to enhance the quality of life for older people and support a healthier ageing process.

Correlation of areas with transportation noise coverage (≥55 Decibels) and depression prevalence in Cheshire and Merseyside ICS in 2019

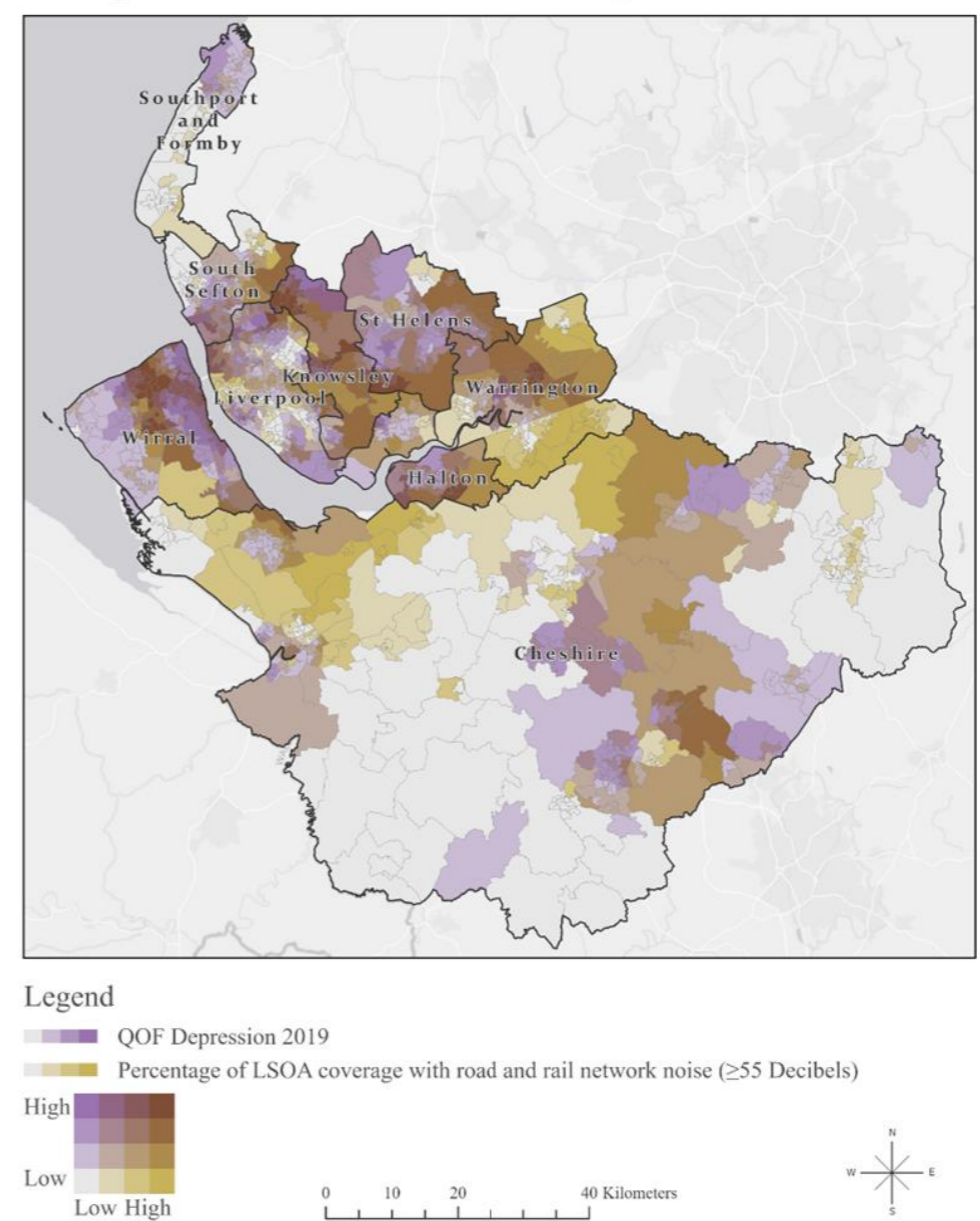


Figure 1. Map of Cheshire and Merseyside Integrated Care System showing the correlation of areas with transportation noise coverage (>55 Db) and depression prevalence in 2019.

Calculation of Indirect Effect (Judd & Kenny Difference of Coefficients Approach) [3]				
Variable	Step 1 Coefficient	Step 4 Coefficient	Indirect effect of transportation noise (step1-step4 coefficients)	Robust Pr
Education Skills and Training	0.024592	0.021382	0.00321	0.000000*
Health Deprivation and Disability	2.427641	1.809736	0.617905	0.000000*
Living Environment Deprivation	-0.008936	-0.011395	0.002459	0.000000*

Table 2. Results from the Generalised Structural Equation Spatial Modelling examining the indirect effect of noise in 2019 on depression prevalence in 2020 in Cheshire and Merseyside ICS

Conclusions

- While many studies discuss the effects of the environment on mental health and have occasionally noted the potential adverse effects of atmospheric pollution, a surprising omission has been any discussion of the effects of noise pollution on mental health. [4]
- This study [5] offers a valuable foundation for informed decision-making and targeted strategies to reduce noise-related mental health risks in affected local authorities, ultimately contributing to the well-being and healthy ageing of the population.

References

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