ASSOCIATION BETWEEN ULTRAFINE PARTICLE EXPOSURE AND TYPE TWO DIABETES MELLITUS

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INTRODUCTION

PARTICLE NUMBER CONCENTRATION (PNC) MEASUREMENTS[1]

- PNC: Measure of ultrafine particles (UFP; particles smaller than 100 nm)

- Obtained using data from mobile monitoring and fixed sites across the United States and a land-use regression (LUR) modeling framework

- Predict PNC at ~6 million residential census blocks in the contiguous United States

- Intraurban variation captured through highly spatially resolved mobile measurements in three US cities

- Interurban trends captured through longer-term fixed-site data in multiple urban locations across the United States

- Urban-rural gradients captured through longer-term data from rural locations

US CENTERS FOR DISEASE CONTROL AND PREVENTION TYPE 2 DIABETES MELLITUS (T2DM) INCIDENCE DATA[2]

- United States T2DM incidence data obtained through county-level measurements from the Centers for Disease Control and Prevention

- T2DM incidence data correlated with ultrafine particle (UFP) concentration measurements from the prior year

METHODS

- UFP estimates (available through county-level, yearly gridded PNC datafiles, calculated at a 1 km x 1 km resolution) *(Figure 1a)* and T2DM incidence (available through county-level, yearly, incidence number and percentages datafiles) *(Figure 1b)* were matched and correlated through a multiple linear regression analysis

- Controls included in analysis: age (18-44, 45-64, 65-74, 75+), gender (male, female), ethnicity and race (Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic Asian), and education (less than high school, high school, and more than high school)

RESULTS/DISCUSSION

MULTIPLE LINEAR REGRESSION MODEL

- Pearson correlation coefficient analysis (using $\frac{\Sigma(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\Sigma(x_i-\bar{x})^2\Sigma(y_i-\bar{y})^2}}$) between variables indicated presence of multi-collinearity *(Figure 2)*

- T2DM and UFP dataset features were scaled and translated using Python Scikit-Learn MinMax scaling method

- Variables with significant p-values and variance inflation factors were dropped

- Multiple linear regression model summary illustrated in *Table 1*
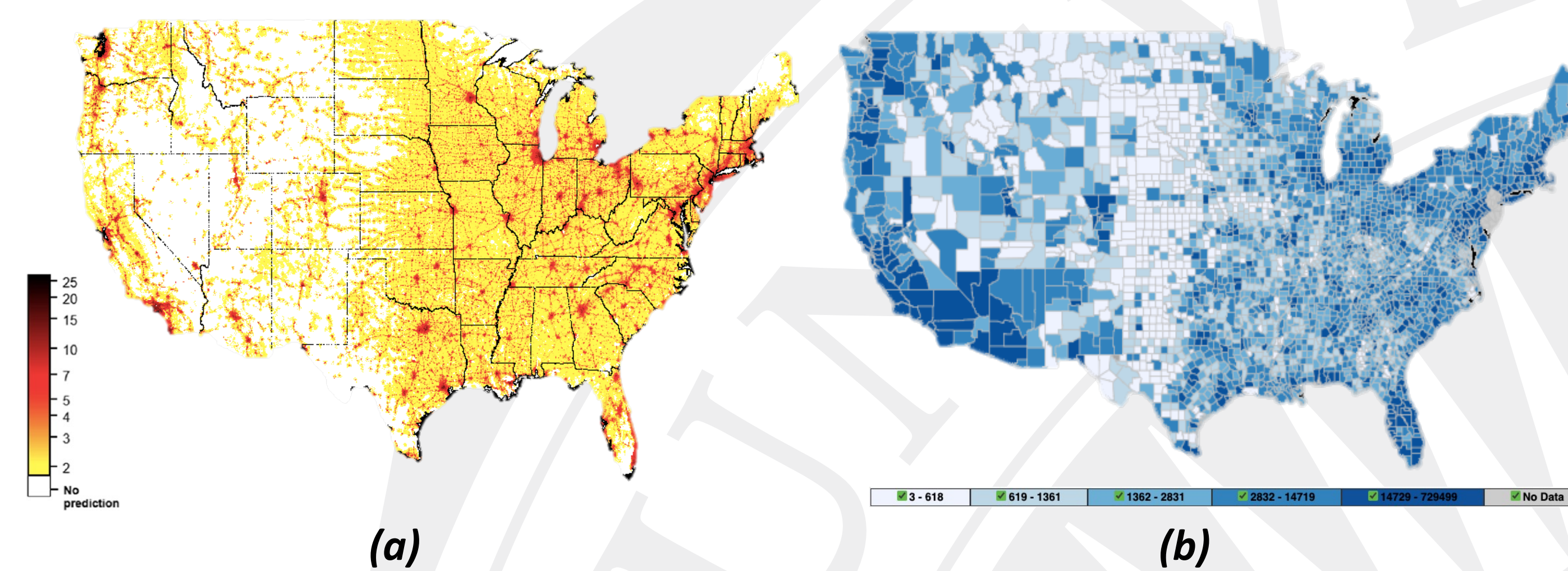

Figure 1. (a) LUR PNC (cm⁻³) United States coverage[1] (b) CDC United States T2DM Incidence[2]
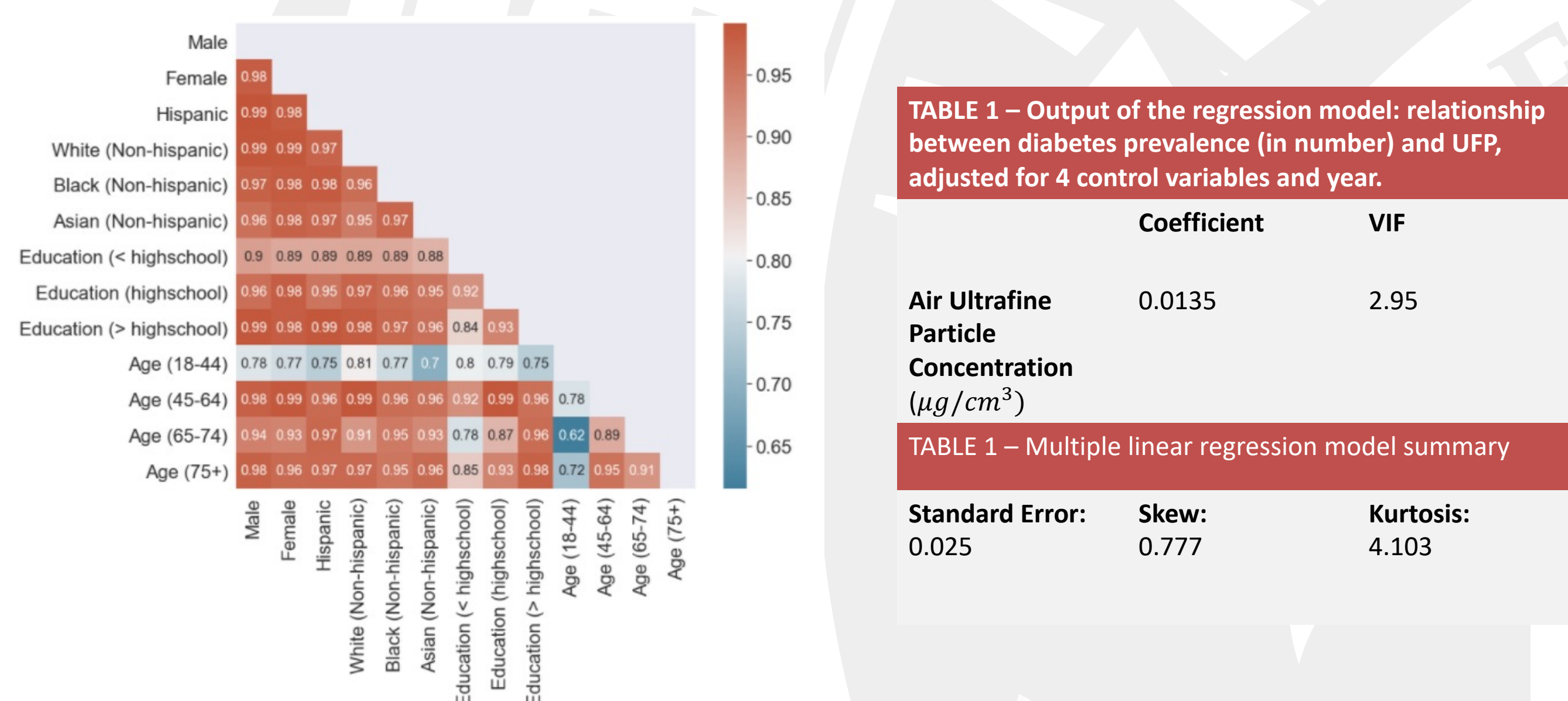

TABLE 1 – Output of the regression model: relationship between diabetes prevalence (in number) and UFP, adjusted for 4 control variables and year.		
	Coefficient	VIF
Air Ultrafine Particle Concentration ($\mu g/cm^3$)	0.0135	2.95
TABLE 1 – Multiple linear regression model summary		
Standard Error:	Skew:	Kurtosis:
0.025	0.777	4.103

Figure 2. Pearson correlation coefficient control variable analysis results
Table 1. Adjusted regression model results summary

CONCLUSIONS

- The UFP T2DM linear regression model results are consistent with previous studies, where positive linear relationships between PM$_{2.5}$ and T2DM were revealed[3]

- Although UFP estimates were spatially widespread, data has limited temporal availability, thus individual-level diabetes risk factors could not be assessed

- Future work includes implementation of additional control variables (e.g. physical activity, income)

- Future analysis will compare T2DM incidence with previous year to better understand UFP exposure related incidence

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