Air Pollution and Glucose Metabolism: An Analysis in Non-Diabetic Participants of the Heinz Nixdorf Recall Study

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Table S1. Spearman correlation coefficients between 28- and 91-day mean PM$_{2.5}$, PM$_{10}$, NO$_2$, and PN$_{AM}$ exposure levels from the EURAD model.

Table S2. Demographic characteristics of observations excluded from analysis due to missing exposure, outcome, or covariate data at baseline or follow-up examination.

Figure S1. Proposed directed acyclic graph (DAG) for the association between air pollution exposure and glucose metabolism outcomes. Minimal sufficient adjustment sets (MSAS) are listed in the top right corner, as determined using Daggity.net.

Figure S2. Associations between an IQR increase in PN$_{AM}$ exposure and blood glucose (top row) or HbA1c (bottom row) using a range of exposure windows and a multipollutant model. Linear mixed-effects models with random participant intercepts were run including the main model covariates (Model 3; covariates found in Table 3) with additional adjustment for a second air pollution measure: a) PM$_{2.5}$, b) PM$_{10}$, or c) NO$_2$. Error bars represent the 95% confidence interval for each point estimate. IQR values are provided in Table 2.
**Figure S3.** Associations between an IQR increase in 28-day air pollution exposure (PM$_{2.5}$, PM$_{10}$, NO$_2$, PN$_{AM}$) and blood glucose. Linear mixed-effects models with random participant intercepts were run including the main model covariates (“Total Model”; covariates found in Table 3). Additional models represent 1) estimates after additional adjustment for noise and distance to nearest major road ($n_{obs}$=7,048); 2) estimates after excluding based on a broader diabetes definition ($n_{obs}$=6,685); 3) estimates among participants who had fasted for 8 hours or more prior to blood collection ($n_{obs}$=4,969); 4) estimates in persons with pre-diabetes (fasting blood glucose between 100-125 mg/dL or an HbA1c level between 5.7-6.5%; $n_{obs}$=4,114) and among those with no such indications ($n_{obs}$=2,994); and 5) estimates by working status ($n_{obs}$=4,624 working <15 hrs/wk). Estimates for pre-diabetics/non-diabetics and working status were calculated with interaction terms with the respective air pollutant. Error bars represent the 95% confidence interval for each point estimate. IQR values are provided in Table 2.

**Figure S4.** Associations between an IQR increase in 91-day air pollution exposure (PM$_{2.5}$, PM$_{10}$, NO$_2$, PN$_{AM}$) and HbA1c upon additional model adjustment or in populations of interest. Linear mixed-effects models with random participant intercepts were run including the main model covariates (“Total Model”; covariates found in Table 3). Additional models represent 1) estimates after additional adjustment for noise and distance to nearest major road ($n_{obs}$=7,048); 2) estimates after excluding based on a broader diabetes definition ($n_{obs}$=6,685); 3) estimates among participants who had fasted for 8 hours or more prior to blood collection ($n_{obs}$=4,969); 4) estimates in persons with pre-diabetes (fasting blood glucose between 100-125 mg/dL or an HbA1c level between 5.7-6.5%; $n_{obs}$=4,114) and among those with no such indications ($n_{obs}$=2,994); and 5) estimates by working status ($n_{obs}$=4,624 working <15 hrs/wk). Estimates for pre-diabetics/non-diabetics and working status were calculated with interaction terms with the respective air pollutant. Error bars represent the 95% confidence interval for each point estimate. IQR values are provided in Table 2.

**Figure S5.** Estimates from the main model (covariates provided in Table 3) for the association between an IQR increase in 28-day mean exposure to air pollution and blood glucose level (mg/dL) within levels of potential effect modifiers and stratified by air pollutant (PM$_{2.5}$, PM$_{10}$, NO$_2$, and PN). Error bars represent the 95% confidence interval for each point estimate. Estimates were generated using linear mixed-effects models with a random participant intercept. Statistical significance for effect modification was evaluated using likelihood ratio tests comparing a model with interaction terms between the covariate in question and the air pollutant to model without an interaction. IQR values are provided in Table 2.

**Figure S6.** Estimates from the main model (covariates provided in Table 3) for the association between an IQR increase in 91-day mean exposure to air pollution and blood glucose level (mg/dL) within levels of potential effect modifiers and stratified by air pollutant (PM$_{2.5}$, PM$_{10}$, NO$_2$, and PN). Error bars represent the 95% confidence interval for each point estimate. Estimates were generated using linear mixed-effects models with a random participant intercept. Statistical significance for effect modification was evaluated using likelihood ratio tests comparing a model with interaction terms between the covariate in question and the air pollutant to model without an interaction. IQR values are provided in Table 2.
**Figure S7.** Estimates from the main model (covariates provided in Table 3) for the association between an IQR increase in 28-day mean exposure to air pollution and HbA1c (p.p.) within levels of potential effect modifiers and stratified by air pollutant (PM$_{2.5}$, PM$_{10}$, NO$_2$, and PN$_{AM}$). Estimates were generated using linear mixed-effects models with a random participant intercept. Statistical significance for effect modification was evaluated using likelihood ratio tests comparing a model with interaction terms between the covariate in question and the air pollutant to model without an interaction. IQR values are provided in Table 2.

**Figure S8.** Estimates from the main model (covariates provided in Table 3) for the association between an IQR increase in 91-day mean exposure to air pollution and HbA1c (p.p.) within levels of potential effect modifiers and stratified by air pollutant (PM$_{2.5}$, PM$_{10}$, NO$_2$, and PN$_{AM}$). Estimates were generated using linear mixed-effects models with a random participant intercept. Statistical significance for effect modification was evaluated using likelihood ratio tests comparing a model with interaction terms between the covariate in question and the air pollutant to model without an interaction. IQR values are provided in Table 2.