Identification and Evaluation of a Dynamic Ozone-FEV$_1$ Exposure-Response Model For Use in Conducting Risk Assessment in Support of the NAAQS for Ozone

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Ozone – FEV₁ Exposure-Response Model

Input: $C(t), \frac{V_E}{BSA}(t), \text{Age}, \text{BMI}$

Output: $\%\Delta\text{FEV}_1(t)$

1. Differential Equation
2. Logistic Function (between-subject variability)

Population characteristics of response (e.g. mean, median, %ile, proportion with response greater than X%, etc) can be calculated for any output value.
n-Fold Cross Validation - 15 EPA Studies
(mean observed vs. mean predicted FEV$_1$ % decrements)

C = 0.08 – 0.4 ppm
Activity = Rest – Heavy Exercise
Ages 18-35 yrs
Duration = 1-6.6 hr

Mean Observed Value (% FEV$_1$ decrement)
Mean Predicted Value (% FEV$_1$ decrement)

$R^2 = 0.91$
Slope = 0.94
Inter = -0.02
Application of Model to 7 Independent Studies
(mean observed vs. mean predicted FEV₁ % decrements)

C = 0.04 – 0.12 ppm      Activity = Strenuous Exercise
Ages 18-35 yrs Duration = 1-8 hr
Fit of Model to 23 Studies
(mean observed vs. mean predicted FEV$_1$ % decrements)

C = 0.04 – 0.40 ppm
Ages 18-35 yrs
Activity = Rest - Heavy Exercise
Duration = 1-8 hr

$R^2 = 0.85$
Slope = 0.97
Inter = -0.43
Model Predictions for 23 Studies
(observed vs. predicted proportion of participants with FEV$_1$ %decrements > 10%)

C = 0.04 – 0.40 ppm
Activity = Rest - Heavy Exercise
Ages 18-35 yrs
Duration = 1-8 hr

Figure 10.05

Identity Regression

$R^2 = 0.77$
Slope = 1.05
Inter = -0.02

\[\text{Ave Prob}[10+\text{ percent]} \mid \text{mljk}]

\[\text{Int.} = -0.02\]
\[\text{Slope} = 1.05\]
\[\text{Pseudo } R^2 = 0.77\]
\[\text{MSE} = 0.007\]
\[N \text{ obs.} = 388\]
Conclusions

• Dynamic model that predicts population FEV$_1$ response for healthy individuals, ages 18-35 yr, exposed over a wide range of variable exposure conditions

• This model could serve as the foundation for a new health risk model in the upcoming EPA risk assessment for ozone.

• I recommend discussion of this model in the ISA for a possible role in the EPA RA for ozone.