Between vs. Within for FeNO

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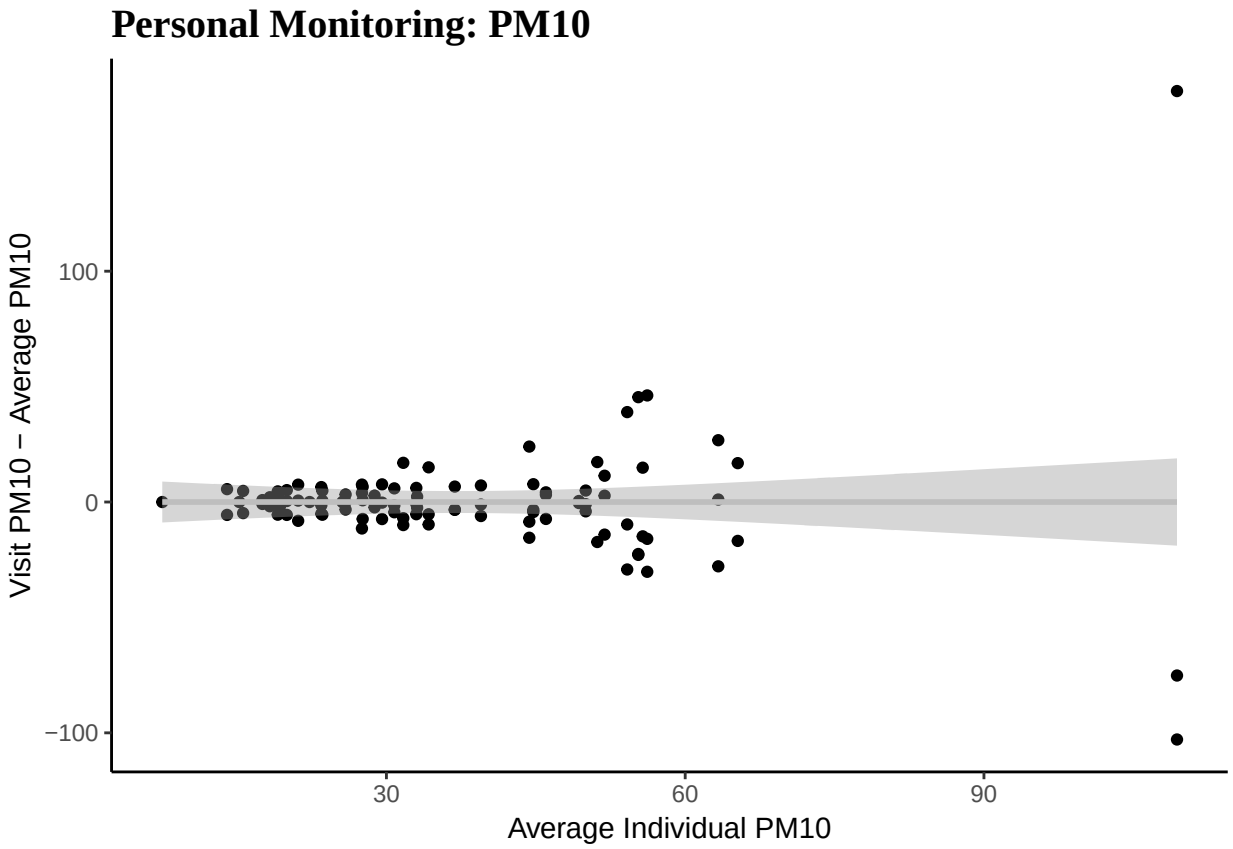
Exploration into Between and Within-Subject Effects

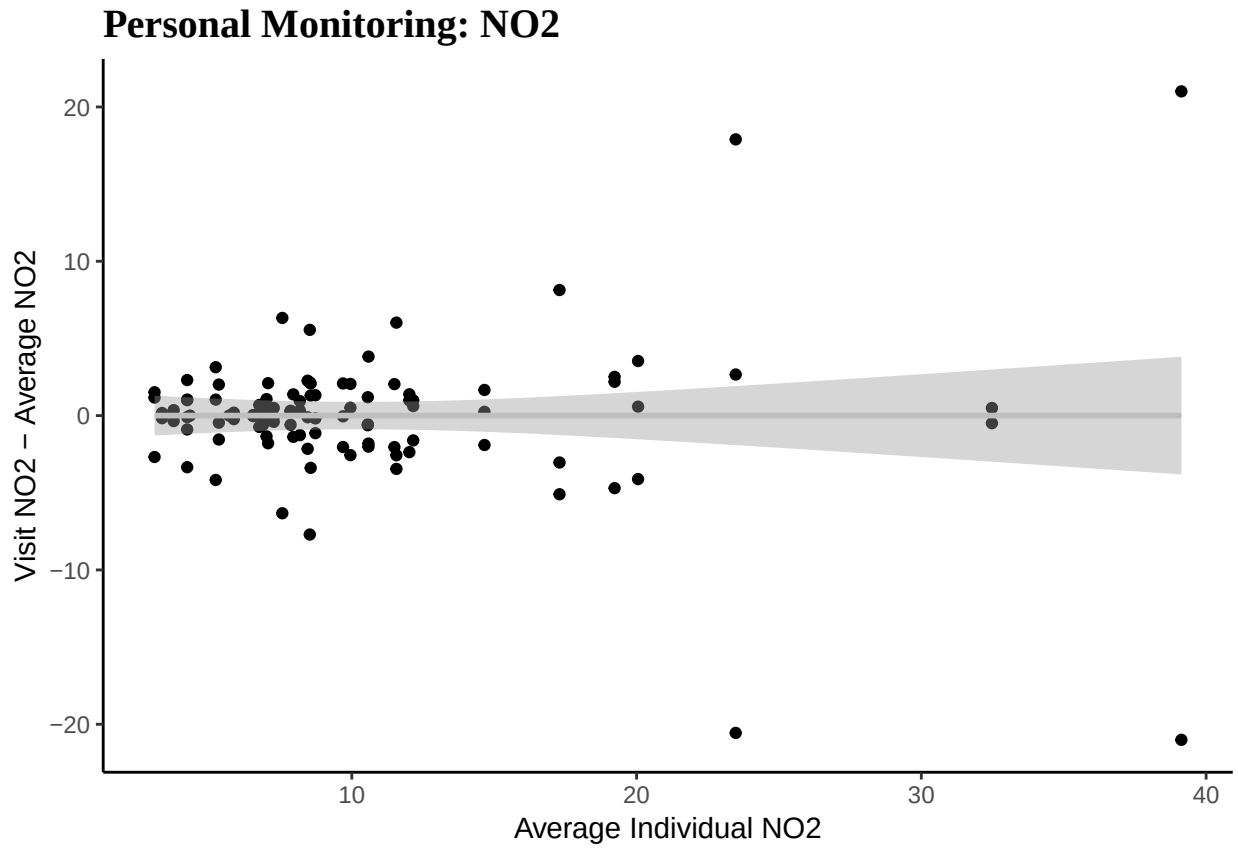
$$log(FeNO) = b_o + \beta_b \overline{x_i}_{exp} + \beta_w (X_{ij} - \overline{x_i})_{exp} + \epsilon_i$$

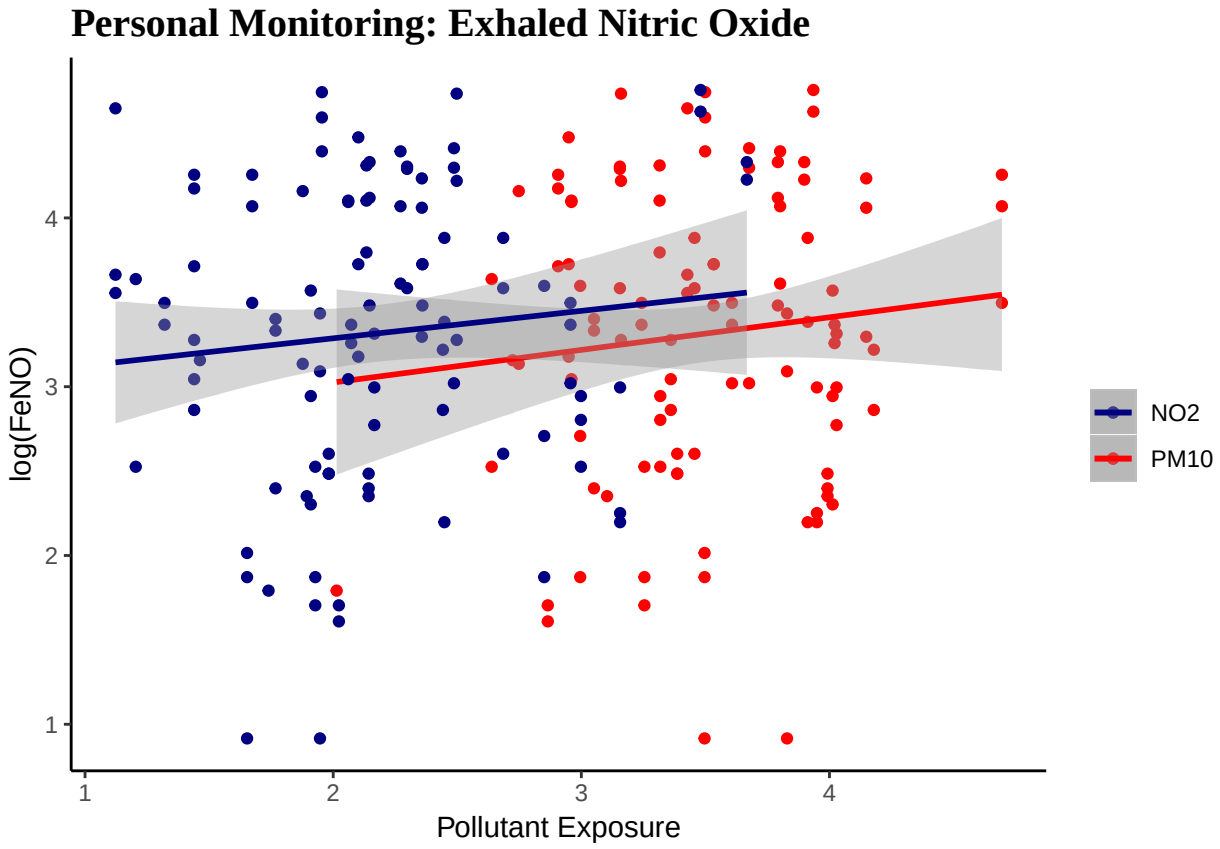
Where β_b is the average change in log(FeNO) for a given subject and β_w is the average additional contribution to log(FeNO) per study visit.

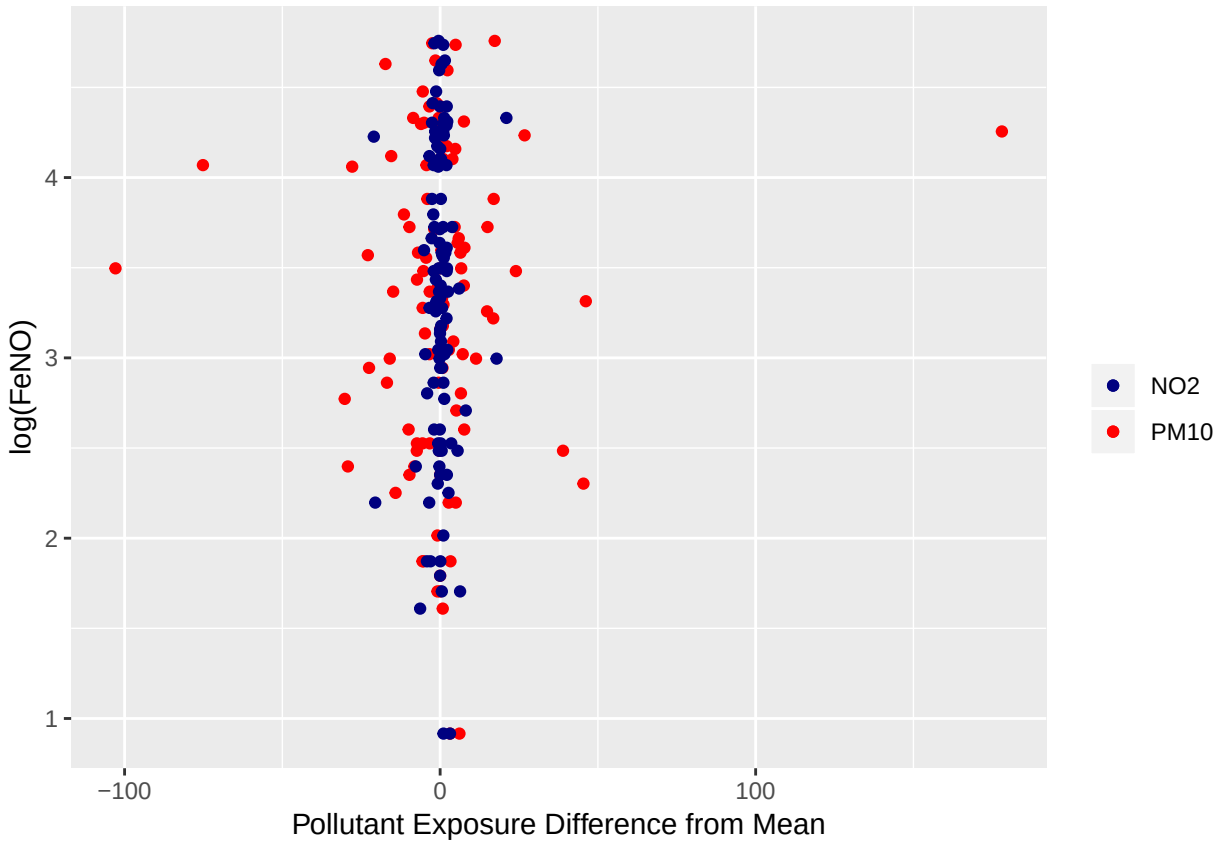
$\mathbf{X_{axis}} = \overline{x_i}$ = average exposure across all visits for subject i

$\mathbf{Y_{axis}} = x_{ij} - \overline{x_i}$ = exposure at visit j -average exposure across all visits for subject i.




Personal Monitoring: NO2
Visit NO2 − Average NO2
Average Individual NO2
20
10
0
−10
−20
10
20
30
40


Personal Monitoring: Exhaled Nitric Oxide
log(FeNO)
Pollutant Exposure
NO2
PM10
1
2
3
4




```
## NULL
```

```
model <- lmer(log_FeNO_avg ~ log(mean_pm10)  + diffpm10 + race_afam + age +as.factor(season) + (1|id), d

summary(model)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: log_FeNO_avg ~ log(mean_pm10) + diffpm10 + race_afam + age +
##     as.factor(season) + (1 | id)
##    Data: dat
##
## REML criterion at convergence: 229.5
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.04248 -0.51998  0.02722  0.54571  2.06530
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  id       (Intercept) 0.3077   0.5547
##  Residual             0.2514   0.5014
## Number of obs: 106, groups:  id, 40
##
## Fixed effects:
##                     Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)        -0.852813   1.118638 50.997059  -0.762 0.449353
## log(mean_pm10)      0.547214   0.218814 44.594680   2.501 0.016135 *
```

```
## diffpm10            0.002486   0.002065 62.324585   1.204 0.233221
## race_afamYes        0.825887   0.250584 37.458121   3.296 0.002153 **
## age                 0.212989   0.057188 50.092456   3.724 0.000497 ***
## as.factor(season)2  0.016818   0.129369 66.747734   0.130 0.896956
## as.factor(season)3 -0.405180   0.147149 70.097986  -2.754 0.007502 **
## as.factor(season)4 -0.413634   0.175440 69.856655  -2.358 0.021195 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) l(_10) dffp10 rc_fmY age    as.()2 as.()3
## lg(mn_pm10) -0.862
## diffpm10    -0.040  0.029
## race_afamYs -0.047 -0.101  0.018
## age         -0.775  0.368  0.053  0.134
## as.fctr(s)2  0.069 -0.072 -0.066 -0.035 -0.149
## as.fctr(s)3  0.096 -0.091 -0.008 -0.073 -0.161  0.489
## as.fctr(s)4  0.073 -0.088 -0.247 -0.070 -0.111  0.432  0.347
```

A brief summary of this can be interpreted as, the contribution to the health outcome of FeNO appears in this singular model to be driven by the average value of exposure for a subject - not the variation within the subject. We could say that a one percentage change in mean PM10 exposure results in an approximately 54.7% increase in FeNO. However, based on the limitations of the numbers of analyses done, this non-zero interpretation is questionable without more rigorous correction for multiple comparisons.

```
model2 <- lmer(log_FeNO_avg ~ log(mean_no2) + diffNO2 + race_afam + age + gender + as.factor(season) +

summary(model2)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## log_FeNO_avg ~ log(mean_no2) + diffNO2 + race_afam + age + gender +
##     as.factor(season) + (1 | id)
##    Data: dat
##
## REML criterion at convergence: 230.1
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.87292 -0.53865  0.01421  0.53514  2.17362
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  id       (Intercept) 0.3422   0.5850
##  Residual             0.2540   0.5039
## Number of obs: 106, groups:  id, 40
##
## Fixed effects:
##                     Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)         1.220382   0.762484 39.217050   1.601  0.11751
## log(mean_no2)       0.247570   0.193339 34.729889   1.280  0.20886
## diffNO2             0.012312   0.011266 61.006102   1.093  0.27876
## race_afamYes        0.871463   0.260322 34.969388   3.348  0.00196 **
## age                 0.161246   0.055175 43.826502   2.922  0.00547 **
```

```
## genderMale         -0.245746   0.244948 33.176784  -1.003  0.32300
## as.factor(season)2  0.004619   0.133821 65.417697   0.035  0.97257
## as.factor(season)3 -0.408328   0.151374 68.625763  -2.697  0.00878 **
## as.factor(season)4 -0.413578   0.178267 67.406320  -2.320  0.02338 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) lg(_2) dffNO2 rc_fmY age    gndrMl as.()2 as.()3
## log(men_n2) -0.605
## diffNO2      0.004  0.032
## race_afamYs -0.230  0.025  0.021
## age         -0.745  0.009  0.009  0.180
## genderMale  -0.344  0.249  0.008  0.067 -0.037
## as.fctr(s)2  0.043 -0.057 -0.244 -0.047 -0.131 -0.014
## as.fctr(s)3  0.071 -0.065 -0.210 -0.088 -0.139 -0.045  0.514
## as.fctr(s)4  0.048 -0.109 -0.271 -0.078 -0.077 -0.009  0.466  0.389
```