NHANES II

Blood-Lead Data Correlation With Air-Lead Concentration Data

The data analysis presented by "Ethyl Corporation's Comments Following EPA's Public Hearing on Proposed Rule for Lead in Gasoline" submitted October 8, 1982 used population density as a correlating variable for blood lead. Population density was suggested as representative of the local air-lead exposure. Air-lead concentration data are available for 24 of the locations for the quarter in which the blood-lead sampling occurred from air sampling reported by the National Air Sampling Network. The blood-lead contributions as described in the October 8, 1982 submission have been correlated with the independent variables of time (T), the logarithm of the population density (P), and the air lead concentration (A). Table 1 lists the variables. The results of the linear regression with this three-constant model are:

Independent Variable	t
T	5.08
P	0.63
A	1.27

S = 0.0948 for this correlation. t is the absolute value of the "Students t" and S is the residual squared error. Results of the linear regression with time and either population density or air lead concentration as independent variables gives the following:

Independent Variables		t		
X_1	X_2	X_1	X_2	S
T	P	5.27	1.41	0.0962
T	A	5.14	1.84	0.0935

The correlation with T and A shows a lower residual squared error than the correlation with T and P or with the three variables T, P, and A. Thus correlation with time and the air lead concentration provides the "best fit" of the blood-lead contributions. The resulting correlation equation is:

$$\text{Blood lead contribution} = 2.925 - 0.0002197T + 0.0777A \quad (1)$$

Correlation of the blood lead contribution with the single variable A gives a correlation coefficient (r) of 0.21 adjusted for the degrees of freedom and S = 0.1372, t(a) = 1.45. Thus air lead concentration without time as a variable does not provide a statistically significant representation of the data.

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The blood lead contribution for each location is essentially the natural logarithm of the mean blood lead for the location. Equation 1 with T in the range of that for the data sampling shows blood-lead response to air-lead in the range of 1.0 to 1.5 µg/100 ml per µg/m^3 which is consistent with reported values for this ratio. Equation 1 also shows that incremental air lead from zero to 1 µg/m^3 represents 7.5% of the blood lead contribution.

Correlation of the NHANES II data with the corresponding air lead concentrations show that the assumption of population density to represent local air lead exposure is a good assumption. As gasoline lead is transmitted by air movement and is respired into the lungs with absorption into the blood, air-lead concentration would be expected to be the variable that represents gasoline lead contribution to blood lead. This is observed to be about 7.5% for the air-lead increment of zero to one µg/m^3.

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Attachment

1-18-83

TABLE 1

Data Summary

Location ID No.	Blood-Lead Contribution*	Sample Time+	Air-Lead Concentration $\mu g/m^3$	Population Density no./mi^2
3	2.89	111	0.82	257
5	2.92	151	0.32	2091
6	2.93	882	0.43	352
9	2.90	237	1.18	497
11	2.76	268	0.69	1691
12	2.67	1321	0.46	1293
13	3.08	284	1.18	5734
20	2.84	1062	0.99	1338
21	3.08	522	1.84	3805
24	2.63	1326	0.58	95
25	2.91	665	1.05	543
28	2.74	1127	1.21	1131
30	2.54	1361	0.14	263
31	2.78	1261	0.50	1997
33	2.58	1421	1.45	11643
36	2.88	105	1.05	70
37	2.82	707	1.60	1593
38	3.06	143	0.54	247
43	2.80	934	0.49	509
52	2.86	535	0.99	5217
55	2.82	605	0.46	223
57	2.86	1064	1.63	1269
58	2.77	663	0.40	328
63	2.75	1262	0.96	2189

* Averaged mean blood-lead contribution for each location.
\+ Weighted average sample time (days) from January 1, 1976.