

## The Association of RIOPA Questionnaire Items with Personal PM2.5 in Adults: Implications for NCS Phase II Questionnaires

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### Introduction

One goal of the formative NCS Tulane (Orleans Parish) research project is to demonstrate how statistical modeling can be applied to combine NCS data with other existing air quality data to develop enhanced personal exposure estimates for NCS participants. One objective is to model the ability of environmental and activity related questionnaire elements to predict personal PM2.5 concentrations in order to help inform possible NCS questionnaire enhancements. Another objective is to examine extant EPA monitoring, indoor and outdoor PM2.5 data, and to assess their performance on the personal PM2.5 model.

### Methods

The authors examined the association of relevant questions from the Relationships of Indoor, Outdoor, and Personal Air (RIOPA) study with personal PM2.5 exposure. The Kruskal Wallis test was used to examine differences in personal PM2.5 between groups of questionnaire items. RIOPA indoor and outdoor PM2.5 measurements were examined. Questionnaire items and indoor and outdoor concentrations were tested in univariate variance components models. Extant EPA data for Houston was extracted due to its proximity to Orleans Parish. Analyses were conducted using STATA (2009 StataCorp).

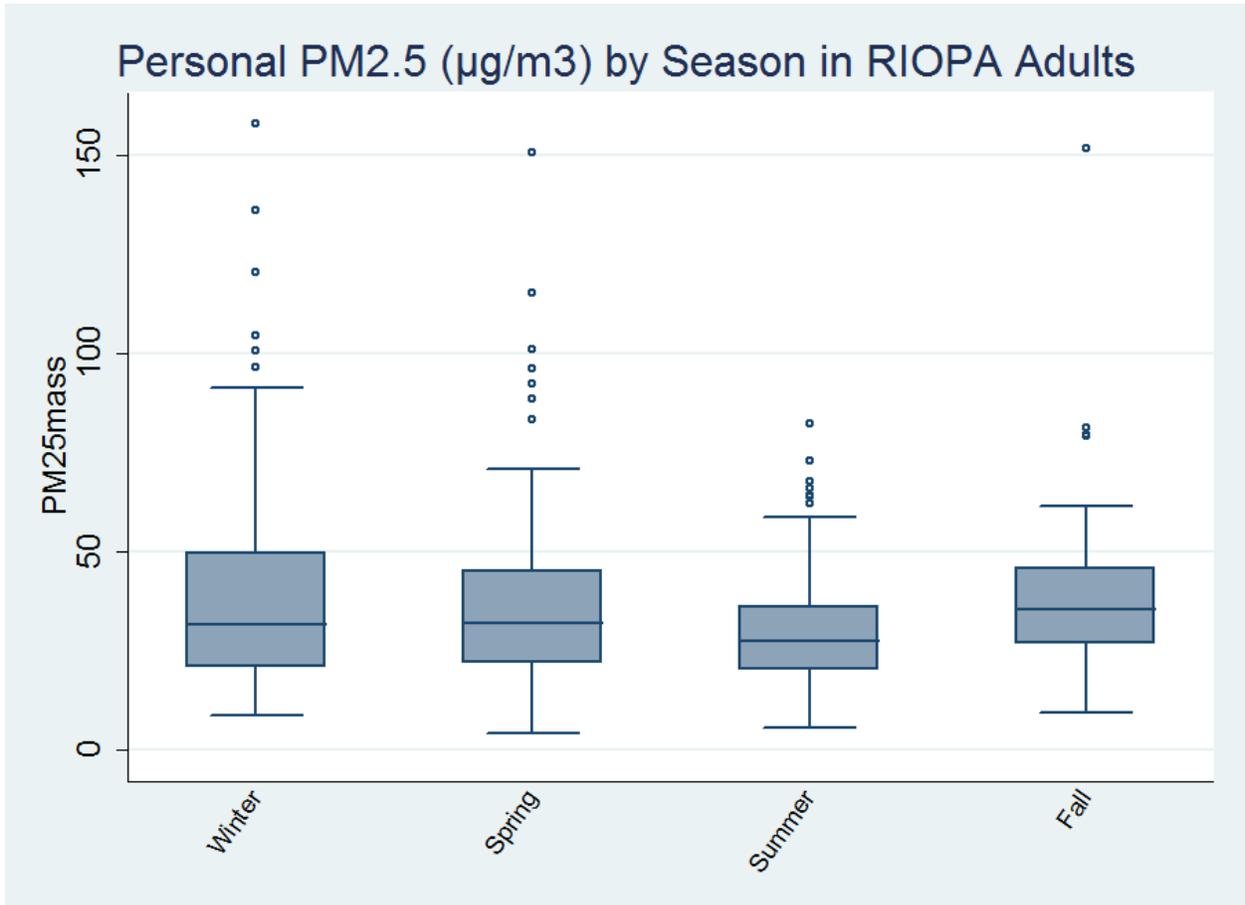
### Results

The graph presents the distribution of personal PM2.5 by season. Preliminary results of the questionnaire analysis are presented in Tables 1 and 2 (Bolded questions are in common with current NCS items). Indoor PM2.5 is a strong predictor of the variability in personal PM2.5 concentrations (not shown). Modeling with EPA data is ongoing.

### Conclusions

Several questionnaire items were significant, suggesting potential improvements in the performance of the personal PM2.5 model.

Graph and Tables



**Table 1 Distribution of personal PM2.5 in adults across levels of significant RIOPA questionnaire items**

RIOPA Questionnaire Variable	No.*	% of Adults	Median Personal PM2.5 (min, max) ( $\mu\text{g}/\text{m}^3$ )	P Value <sup>†</sup>
<b>Baseline Questionnaire</b>				
13. Was most of this work or school (activities that happened in the past week) time spent outside the home?				
No	23	22.55	35.6 (10, 96.2)	
Yes	79	77.45	27.2 (5.7, 79.5)	0.011
Years at home (derived) <sup>‡</sup>				
	237		NA	0.020
<b>24. About when was this building first built?</b>				
1995 TO PRESENT OR 1985 TO 1994	30	12.61	31.55 (5.4, 104.3)	
1984 TO 1975 OR 1960 TO 1975	78	32.77	26.75 (5.7, 88.3)	
1945 TO 1959	52	21.85	25 (7.8, 158)	
1900 TO 1944	32	13.45	28.05 (3.9, 151.5)	
BEFORE 1900	2	0.84	49.2 (30.8, 67.6)	
DON'T KNOW	44	18.49	35.85 (8.5, 135.9)	0.029
26. In the past year, has there been a major renovation to this house or apartment, such as adding a room, putting up or taking down a wall, replacing windows, or refinishing floors?				
No	177	74.68	27.3 (3.9, 158)	
Yes	60	25.32	32.5 (7.6, 151.5)	0.005
32. Is there a garage attached to this house or apartment				
No	164	66.4	30.8 (10, 151.5)	
Yes	83	33.6	26.2 (3.9, 158)	0.011
34. Is there a doorway leading directly from the garage into the living quarters				
No	198	80.16	30.8 (3.9, 158)	
Yes	49	19.84	24.3 (5.7, 96.5)	0.038
35. Are automobiles, van, trucks, or other motor vehicles usually parked in the attached garage?				
No	189	76.52	30.6 (8.5, 158)	
Yes	58	23.48	26.95 (3.9, 87.6)	0.063
37. Do most of the windows in this house or apartment open?				
No	66	26.72	33.6 (7.8, 104.3)	
Yes	181	73.28	27.3 (3.9, 158)	<0.001
38. Is air conditioning used to cool this house or apartment?				
No	95	34.46	31.4 (12.7, 104.3)	
Yes	152	61.54	28.05 (3.9, 158)	0.246
39A. Use of central unit/units				
No	155	62.75	31.4 (10, 151.5)	
Yes	92	37.25	26.45 (3.9, 158)	0.004
45. Does this house or apartment have central heating system with ducts that blow air into most rooms?				

RIOPA Questionnaire Variable	No.*	% of Adults	Median Personal PM2.5 (min, max) ( $\mu\text{g}/\text{m}^3$ )	P Value <sup>†</sup>
No	122	49.39	31.4 (10, 151.5)	
Yes	125	50.61	27.4 (3.9, 158)	0.022
53. Is a fireplace used in this house or apartment?				
No	172	69.64	31.7 (5.7, 158)	
Yes	75	30.36	25.9 (3.9, 81)	0.001
56A. Use of mothballs in the house				
No	214	86.64	30.75 (5.7, 158)	
Yes	33	13.36	22.3 (3.9, 100.8)	0.010
56D. Use of scented candles in the house				
No	116	46.96	32.25 (5.7, 135.9)	
Yes	131	53.04	26.5 (3.9, 158)	0.019
Activity Questionnaire				
18. Did you spend time indoor, besides your home, with someone who was smoking				
No	266	95.68	30.5 (3.9, 158)	
Yes	12	4.32	42.6 (16.1, 96.5)	0.034
59. Sweeping indoors?				
No	135	48.56	30.1 (3.9, 158)	
Yes	143	91.08	31.8 (7.6, 151.5)	0.020
63. Woodworking?				
No	272	97.84	30.6 (3.9, 158)	
Yes	6	2.16	72.3 (19.2, 115.3)	0.01
68. During the last 48 hours (the study period) did you or anyone else start a car or other motor vehicle in:				
Attached garage	48	33.33	26.2 (3.9, 70.7)	
Detached garage or a carport attached to the home.	96	66.67	33.35 (7.6, 158)	<0.001

\*Subjects with personal PM2.5 measurements. <sup>†</sup>Kruskal Wallis test except for years at home where the p value for the Spearman correlation is presented. <sup>‡</sup>Years at home was derived from questions 24 and 25. The Spearman correlation coefficient is -0.152.

**Table 2 Univariate variance components model results using the significant RIOPA questionnaire items as predictors**

RIOPA Questionnaire Variable	No.	Beta Coefficient [95% CI]	Model <sup>†</sup> Likelihood Ratio	P Value
13	104	-0.258 [-0.483, -0.033]	-73.47	0.025
Years at home (derived)	237	-0.006 [-0.013, -0.001]	-199.85	0.033
<b>24</b>	238	0.057 [0.012, 0.1033]	-199.68	0.014
<b>26</b>	237	0.228 [0.059, 0.396]	-198.68	0.008
32	247	-0.216 [-0.378, -0.053]	-204.44	0.009
34	247	-0.162 [-0.347, 0.024]	-206.33	0.088
35	247	-0.190 [-0.369, -0.012]	-205.64	0.037
<b>37</b>	247	-0.327 [-0.489, -0.164]	-200.21	<0.001
38	247	-0.1636 [-0.317, -0.0107]	-205.58	0.036
<b>39A</b>	247	-0.224 [-0.380, -0.068]	-203.88	0.005
45	247	-0.196 [-0.34, -0.047]	-204.49	0.01
53	247	-0.239 [-0.399, -0.079]	-203.57	0.003
56A	247	-0.274 [-0.484, -0.064]	-204.56	0.011
56D	247	-0.179 [-0.321, -0.037]	-204.77	0.014
18	278	0.293 [-0.035, 0.622]	-237.96	0.080
59	278	0.148 [0.009, 0.286]	-237.32	0.037
63	278	0.668 [0.208, 1.129]	-235.51	0.004
68	144	0.395 [0.193, 0.598]	-117.39	<0.001

<sup>†</sup> Univariate variance components model examining log personal PM2.5 as the outcome across the question groups (Yes vs. No) with visit as a covariate.