

## **APPENDIX P-4.**

### **Interaction Tables for the Pulmonary Assessment Occupation and Body Fat Removed from Final Model**

This appendix contains exposure analyses results of interactions between covariates and dioxin after occupation and body fat have been removed from those final dioxin models (Models 2 through 6) that contained occupation or body fat. These tables are supplements to tables in Appendix P-3, which are main effects results with occupation and body fat removed from the model. Results are presented for each separate stratum of the covariate and include sample sizes, percent abnormal, relative risks, confidence intervals, and p-values for discrete dependent variables. Sample sizes, adjusted means, differences of adjusted means and confidence intervals or adjusted slopes and standard errors, and p-values are given for continuous dependent variables. Means are transformed back to the original scale, if necessary. Chapter 7, Statistical Methods, provides further details on the analytical approaches used in the interaction analyses. The analysis model, covariate involved in the interaction, and references to the analysis tables in Chapter 20 and Appendix P-3 are given in the heading of each subtable. A summary of the interactions described in this appendix follows.

<b>Appendix P-4 Table</b>	<b>Chapter 20 Table</b>	<b>Appendix P-3 Table</b>	<b>Dependent Variable</b>	<b>Model</b>	<b>Covariate</b>
P-4-1	20-3	P-3-1	Asthma	4 6	Age Age
P-4-2	20-4	P-3-2	Bronchitis	4 5 6	Industrial Chemicals Exposure Industrial Chemicals Exposure Industrial Chemicals Exposure
P-4-3	20-7	P-3-5	X Ray Interpretation	4 5 6	Current Cigarette Smoking Current Cigarette Smoking Current Cigarette Smoking
P-4-4	20-9	P-3-7	FEV <sub>1</sub>	2	Current Cigarette Smoking
P-4-5	20-11	P-3-9	Loss of Vital Capacity	4 5	Race, Current Cigarette Smoking Current Cigarette Smoking
P-4-6	20-12	P-3-10	Obstructive Abnormality	3	Lifetime Cigarette Smoking History

**Table P-4-1.**  
**Interaction Table for Asthma**  
**Occupation and Body Fat Removed from Final Model**

<b>a) MODEL 4: RANCH HANDS — CURRENT DIOXIN — ADJUSTED</b> (Current Dioxin-by-Age: Tables 20-3 and P-3-1)				
Stratum	Current Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Current Dioxin + 1)
	Current Dioxin	n	Percent Yes	
<b>Born ≥ 1942</b>	Low	97	1.0	1.29 (0.96,1.73)      0.092
	Medium	97	8.2	
	High	170	5.9	
<b>Born &lt; 1942</b>	Low	195	4.6	0.69 (0.45,1.04)      0.077
	Medium	199	3.0	
	High	126	1.6	

<b>b) MODEL 6: RANCH HANDS — CURRENT DIOXIN — ADJUSTED</b> (Current Dioxin-by-Age: Tables 20-3 and P-3-1)				
Stratum	Current Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Current Dioxin + 1)
	Current Dioxin	n	Percent Yes	
<b>Born ≥ 1942</b>	Low	101	3.0	1.27 (0.96,1.67)      0.097
	Medium	96	7.3	
	High	167	5.4	
<b>Born &lt; 1942</b>	Low	195	5.6	0.74 (0.56,1.05)      0.101
	Medium	197	1.0	
	High	127	3.1	

<sup>a</sup> Relative risk for a twofold increase in current dioxin.

Note: Model 4: Low =  $\leq 8.1$  ppt; Medium =  $> 8.1\text{--}20.5$  ppt; High =  $> 20.5$  ppt.

Model 6: Low =  $\leq 46$  ppq; Medium =  $> 46\text{--}128$  ppq; High =  $> 128$  ppq.

**Table P-4-2.**  
**Interaction Table for Bronchitis**  
**Occupation and Body Fat Removed from Final Model**

<b>a) MODEL 4: RANCH HANDS — CURRENT DIOXIN — ADJUSTED</b> (Current Dioxin-by-Industrial Chemicals Exposure: Tables 20-4 and P-3-2)					
Current Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Current Dioxin + 1)		
Stratum	Current Dioxin	n	Percent Yes	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
No	Low	155	13.6	1.11 (0.91,1.35)	0.316
	Medium	125	14.4		
	High	93	21.5		
	Low	131	29.8	0.80 (0.69,0.93)	0.004
	Medium	164	22.0		
	High	200	17.0		

  

<b>b) MODEL 5: RANCH HANDS — CURRENT DIOXIN — ADJUSTED</b> (Current Dioxin-by-Industrial Chemicals Exposure: Tables 20-4 and P-3-2)					
Current Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Current Dioxin + 1)		
Stratum	Current Dioxin	n	Percent Yes	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
No	Low	151	14.6	1.12 (0.94,1.33)	0.202
	Medium	128	12.5		
	High	94	22.3		
	Low	141	30.5	0.84 (0.74,0.95)	0.007
	Medium	157	22.3		
	High	197	15.7		

  

<b>c) MODEL 6: RANCH HANDS — CURRENT DIOXIN — ADJUSTED</b> (Current Dioxin-by-Industrial Chemicals Exposure: Tables 20-4 and P-3-2)					
Current Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Current Dioxin + 1)		
Stratum	Current Dioxin	n	Percent Yes	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
No	Low	152	14.5	1.07 (0.90,1.29)	0.437
	Medium	128	12.5		
	High	94	22.3		
	Low	140	30.0	0.80 (0.70,0.92)	0.001
	Medium	157	22.3		
	High	197	15.7		

<sup>a</sup> Relative risk for a twofold increase in current dioxin.

Note: Model 4: Low =  $\leq 8.1$  ppt; Medium =  $> 8.1\text{--}20.5$  ppt; High =  $> 20.5$  ppt.

Models 5 and 6: Low =  $\leq 46$  ppq; Medium =  $> 46\text{--}128$  ppq; High =  $> 128$  ppq.

**Table P-4-3.**  
**Interaction Table for X Ray Interpretation**  
**Occupation and Body Fat Removed from Final Model**

a) MODEL 4: RANCH HANDS — CURRENT DIOXIN — ADJUSTED (Current Dioxin-by-Current Cigarette Smoking: Tables 20-7 and P-3-5)				Analysis Results for $\log_2$ (Current Dioxin + 1)	
Stratum	Current Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Current Dioxin + 1)	
	Current Dioxin	n	Percent Yes	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
<b>0-Never Smoked</b>	Low	84	10.7	1.01 (0.77,1.32)	0.946
	Medium	84	14.3		
	High	79	11.4		
<b>0-Former Smoker</b>	Low	138	13.0	1.08 (0.88,1.32)	0.466
	Medium	144	16.0		
	High	126	17.5		
<b>&gt;0-20 Cigarettes/Day</b>	Low	46	4.4	1.26 (0.86,1.83)	0.237
	Medium	44	9.1		
	High	57	12.3		
<b>&gt;20 Cigarettes/ Day</b>	Low	26	34.6	0.50 (0.32,0.79)	0.003
	Medium	28	10.7		
	High	36	2.8		

  

b) MODEL 5: RANCH HANDS — CURRENT DIOXIN — ADJUSTED (Current Dioxin-by-Current Cigarette Smoking: Tables 20-7 and P-3-5)				Analysis Results for $\log_2$ (Current Dioxin + 1)	
Stratum	Current Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Current Dioxin + 1)	
	Current Dioxin	n	Percent Yes	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
<b>0-Never Smoked</b>	Low	88	12.5	1.02 (0.80,1.30)	0.863
	Medium	83	12.0		
	High	76	11.8		
<b>0-Former Smoker</b>	Low	136	14.0	1.10 (0.92,1.31)	0.293
	Medium	145	15.9		
	High	127	16.5		
<b>&gt;0-20 Cigarettes/Day</b>	Low	49	4.1	1.25 (0.90,1.76)	0.187
	Medium	43	11.6		
	High	55	10.9		
<b>&gt;20 Cigarettes/ Day</b>	Low	26	38.5	0.71 (0.54,0.94)	0.016
	Medium	26	0.0		
	High	38	7.9		

**Table P-4-3. (Continued)**  
**Interaction Table for X Ray Interpretation**  
**Occupation and Body Fat Removed from Final Model**

c) MODEL 6: RANCH HANDS — CURRENT DIOXIN — ADJUSTED (Current Dioxin-by-Current Cigarette Smoking: Tables 20-7 and P-3-5)				Analysis Results for Log <sub>2</sub> (Current Dioxin + 1)	
Stratum	Current Dioxin Category	Summary Statistics		Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
		Current Dioxin	n	Percent Yes	
<b>0-Never Smoked</b>	Low	88	12.5	0.99 (0.77,1.26)	0.905
	Medium	83	12.0		
	High	76	11.8		
<b>0-Former Smoker</b>	Low	137	13.9	1.04 (0.87,1.25)	0.670
	Medium	145	15.9		
	High	127	16.5		
<b>&gt;0-20 Cigarettes/Day</b>	Low	48	4.2	1.19 (0.84,1.68)	0.322
	Medium	43	11.6		
	High	55	10.9		
<b>&gt; 20 Cigarettes/ Day</b>	Low	26	38.5	0.67 (0.50,0.88)	0.005
	Medium	26	0.0		
	High	38	7.9		

<sup>a</sup> Relative risk for a twofold increase in current dioxin.

Note: Model 4: Low =  $\leq 8.1$  ppt; Medium =  $> 8.1\text{-}20.5$  ppt; High =  $> 20.5$  ppt.

Models 5 and 6: Low =  $\leq 46$  ppq; Medium =  $> 46\text{-}128$  ppq; High =  $> 128$  ppq.

**Table P-4-4.**  
**Interaction Table for FEV<sub>1</sub> (Percent of Predicted)**  
**Occupation and Body Fat Removed from Final Model**

a) MODEL 2: RANCH HANDS — INITIAL DIOXIN — ADJUSTED Initial Dioxin-by-Current Cigarette Smoking: Tables 20-9 and P-3-7)				Analysis Results for Log <sub>2</sub> (Initial Dioxin)	
Stratum	Initial Dioxin	n	Adjusted Mean	Adjusted Slope (Std. Error)	p-Value
<b>0-Never Smoked</b>	Low	47	98.4	-2.985 (0.959)	0.002
	Medium	39	96.2		
	High	53	91.1		
<b>0-Former Smoker</b>	Low	91	92.7	-1.244 (0.012)	0.120
	Medium	80	91.0		
	High	68	88.8		
<b>&gt;0-20 Cigarettes/ Day</b>	Low	24	79.8	1.836 (1.311)	0.162
	Medium	30	88.7		
	High	34	89.8		
<b>&gt;20 Cigarettes/ Day</b>	Low	12	86.7	3.225 (1.902)	0.091
	Medium	24	85.5		
	High	18	93.0		

Note: Low = 39-98 ppt; Medium = >98-232 ppt; High = >232 ppt.

**Table P-4-5.**  
**Interaction Table for Loss of Vital Capacity**  
**Occupation and Body Fat Removed from Final Model**

a) MODEL 4: RANCH HANDS — CURRENT DIOXIN — ADJUSTED (Current Dioxin-by-Race: Tables 20-11 and P-3-9)								
Stratum	Dioxin Category	n	Analysis Results for $\log_2$ (Current Dioxin + 1)			Mild vs. None		Moderate or Severe vs. None
			Percent	Mild	Mod. or Sev.	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Adj. Relative Risk (95% C.I.) <sup>a</sup>
Non-Black	Low	282	95.0	4.3	0.7	1.29 (1.05,1.60)	0.017	0.94 (0.51,1.74)
	Medium	277	93.5	5.4	1.1			
	High	282	94.0	5.7	0.3			
Black	Low	12	83.3	16.7	0.0	0.57 (0.25,1.31)	0.184	1.97 (0.64,6.03)
	Medium	22	81.8	13.6	4.6			
	High	17	76.5	5.9	17.6			

b) MODEL 4: RANCH HANDS — CURRENT DIOXIN — ADJUSTED (Current Dioxin-by-Current Cigarette Smoking: Tables 20-11 and P-3-9)								
Stratum	Dioxin Category	n	Analysis Results for $\log_2$ (Current Dioxin + 1)			Mild vs. None		Moderate or Severe vs. None
			Percent	Mild	Mod. or Sev.	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Adj. Relative Risk (95% C.I.) <sup>a</sup>
0-Never Smoked	Low	84	100.0	0.0	0.0	2.36 (1.47,3.79)	<0.001	1.53 (0.65,3.56)
	Medium	83	96.4	1.2	2.4			
	High	80	88.7	8.8	2.5			
0-Former Smoker	Low	138	94.9	3.6	1.5	1.28 (0.93,1.77)	0.133	0.49 (0.17,1.43)
	Medium	144	93.8	6.2	0.0			
	High	126	93.6	5.6	0.8			
>0-20 Cigarettes/ Day	Low	46	91.3	8.7	0.0	0.79 (0.52,1.22)	0.292	1.64 (0.59,4.54)
	Medium	44	81.8	15.9	2.3			
	High	57	96.5	1.8	1.8			
>20 Cigarettes/ Day	Low	26	80.8	19.2	0.0	0.94 (0.60,1.48)	0.796	1.74 (0.49,6.14)
	Medium	28	92.9	3.6	3.6			
	High	36	94.4	5.6	0.0			

**Table P-4-5. (Continued)**  
**Interaction Table for Loss of Vital Capacity**  
**Occupation and Body Fat Removed from Final Model**

c) MODEL 5: RANCH HANDS — CURRENT DIOXIN — ADJUSTED (Current Dioxin-by-Current Cigarette Smoking: Tables 20-11 and P-3-9)						
Current Dioxin Category Summary Statistics				Analysis Results for $\log_2$ (Current Dioxin + 1)		
Stratum	Dioxin Category	Percent				
		n	None	Mild	Mod. or Sev.	
0-Never Smoked	Low	88	100.0	0.0	0.0	2.28 (1.46,3.58) <0.001
	Medium	82	96.3	1.2	2.4	1.37 (0.62,3.02) 0.433
	High	77	88.3	9.1	2.6	
0-Former Smoker	Low	136	94.9	3.7	1.5	1.25 (0.94,1.67) 0.129
	Medium	145	93.8	6.2	0.0	0.65 (0.31,1.37) 0.260
	High	127	93.7	5.5	0.8	
>0-20 Cigarettes/ Day	Low	49	91.8	8.2	0.0	0.89 (0.64,1.23) 0.490
	Medium	43	81.4	16.3	2.3	1.61 (0.65,4.01) 0.402
	High	55	96.4	1.8	1.8	
>20 Cigarettes/ Day	Low	26	80.8	19.2	0.0	0.99 (0.71,1.38) 0.952
	Medium	26	92.3	3.9	3.9	1.62 (0.50,5.25) 0.422
	High	38	94.7	5.3	0.0	

<sup>a</sup> Relative risk for a twofold increase in current dioxin.

Note: Model 4: Low =  $\leq 8.1$  ppt; Medium =  $> 8.1-20.5$  ppt; High =  $> 20.5$  ppt.

Model 5: Low =  $\leq 46$  ppq; Medium =  $> 46-128$  ppq; High =  $> 128$  ppq.

**Table P-4-6.**  
**Interaction Table for Obstructive Abnormality**  
**Occupation and Body Fat Removed from Final Model**

a) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY — ADJUSTED (Dioxin Category-by-Lifetime Cigarette Smoking History: Tables 20-12 and P-3-10)										
Stratum	Dioxin Category	n	Percent			Mild vs. None		Moderate or Severe vs. None		p-Value
			None	Mild	Mod. or Sev.	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
<b>0 Pack-years</b>	Comparison	282	77.0	21.3	1.8					
	Background RH	108	72.2	24.1	3.7	1.02 (0.59,1.77)	0.952	1.86 (0.47,7.38)	0.378	
	Low RH	72	79.2	18.1	2.8	0.62 (0.31,1.24)	0.176	0.94 (0.17,5.26)	0.940	
	High RH	67	85.1	14.9	0.0	0.91 (0.42,1.96)	0.815	--	--	
	Low plus High RH	139	82.0	16.6	1.4	0.73 (0.41,1.27)	0.259	0.69 (0.13,3.73)	0.662	
<b>&gt;0-10 Pack-years</b>	Comparison	323	58.2	36.8	5.0					
	Background RH	109	60.6	33.9	5.5	0.83 (0.51,1.36)	0.462	1.03 (0.37,2.88)	0.949	
	Low RH	69	56.5	34.8	8.7	1.04 (0.58,1.86)	0.905	2.10 (0.75,5.89)	0.157	
	High RH	93	69.9	25.8	4.3	0.80 (0.46,1.40)	0.435	1.24 (0.38,4.09)	0.724	
	Low plus High RH	162	64.2	29.6	6.2	0.90 (0.58,1.39)	0.636	1.64 (0.69,3.93)	0.265	
<b>&gt;10 Pack-years</b>	Comparison	455	45.3	43.1	11.7					
	Background RH	155	29.7	55.5	14.8	1.64 (1.07,2.53)	0.024	1.55 (0.82,2.91)	0.177	
	Low RH	119	39.5	47.9	12.6	1.19 (0.75,1.87)	0.459	1.14 (0.56,2.31)	0.717	
	High RH	100	42.0	48.0	10.0	1.30 (0.79,2.12)	0.298	0.99 (0.44,2.22)	0.971	
	Low plus High RH	219	40.6	48.0	11.4	1.24 (0.86,1.78)	0.250	1.07 (0.60,1.93)	0.810	

<sup>a</sup> Relative risk and confidence interval relative to Comparisons.

--: Relative risk, confidence interval, and p-value not presented due to zero number of abnormalities.

Note: RH = Ranch Hand.

Comparison: Current Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): Current Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): Current Dioxin  $\leq$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  143 ppt.

High (Ranch Hand): Current Dioxin  $\leq$  10 ppt, Initial Dioxin  $>$  143 ppt.