

**Table 13-42. Analysis of Prealbumin (Discrete) (Continued)**

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Number (%) Low	Est. Relative Risk (95% C.I.) <sup>a,b</sup>	p-Value
Comparison	1,194	10 (0.8)		
Background RH	376	6 (1.6)	1.94 (0.69,5.41)	0.207
Low RH	236	1 (0.4)	0.50 (0.06,3.95)	0.513
High RH	240	5 (2.1)	2.50 (0.84,7.42)	0.099
Low plus High RH	476	6 (1.3)	1.13 (0.33,3.90)	0.849

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,193		
Background RH	374	1.74 (0.61,5.01)	0.302
Low RH	235	0.49 (0.06,3.93)	0.506
High RH	238	4.34 (1.25,15.05)	0.021
Low plus High RH	473	1.48 (0.41,5.32)	0.552

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

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Low	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Low	283	4 (1.4)	1.02 (0.69,1.49)	0.931
Medium	285	3 (1.1)		
High	284	5 (1.8)		

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

**Table 13-42. Analysis of Prealbumin (Discrete) (Continued)**

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

Analysis Results for Log <sub>2</sub> (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
847	1.00 (0.63, 1.60)	0.993	

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

No significant relation between prealbumin and initial dioxin was found in the unadjusted Model 2 analysis (Table 13-42(c): p=0.203). A marginally significant relation was found in the adjusted analysis (Table 13-42(d): Adj. RR=1.76, p=0.081), indicating an increased prevalence of low prealbumin levels as initial dioxin increased. In the Model 3 unadjusted-analysis of prealbumin, a marginally significant difference was revealed between Ranch Hands in the high dioxin category and the Comparison group (Table 13-42(e): Est. RR=2.50, p=0.099). The same contrast was significant in the adjusted analysis (Table 13-42(f): Adj. RR=4.34, p=0.021). Of the Ranch Hands in the high dioxin category, 2.1 percent had low prealbumin levels versus 0.8 percent of the Comparisons. The Model 4 unadjusted and adjusted analyses were nonsignificant (Table 13-42(g,h): p>0.93 for each analysis).

*13.2.2.3.34 Albumin (Continuous)*

All unadjusted and adjusted Model 1 and 2 analyses were nonsignificant (Table 13-43(a-d): p>0.18 for each analysis).

**Table 13-43. Analysis of Albumin (mg/dl) (Continuous)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Mean	Difference of Means (95% C.I.)	p-Value
All	Ranch Hand	859	4,195.6	-5.6 (-34.9, 23.8)	0.709
	Comparison	1,231	4,201.2		
Officer	Ranch Hand	340	4,172.9	-31.8 (-78.3, 14.8)	0.181
	Comparison	490	4,204.6		
Enlisted Flyer	Ranch Hand	150	4,190.0	30.1 (-42.4, 102.5)	0.416
	Comparison	185	4,159.9		
Enlisted	Ranch Hand	369	4,218.8	7.0 (-37.3, 51.2)	0.758
Groundcrew	Comparison	556	4,211.9		

**Table 13-43. Analysis of Albumin (mg/dl) (Continuous) (Continued)**

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean	Difference of Adj. Means (95% C.I.)	p-Value
All	Ranch Hand	854	4,180.8	-3.0 (-32.1,26.0)	0.837
	Comparison	1,229	4,183.8		
Officer	Ranch Hand	340	4,163.1	-28.9 (-74.9,17.1)	0.218
	Comparison	489	4,192.1		
Enlisted Flyer	Ranch Hand	148	4,201.9	37.0 (-35.0,109.0)	0.314
	Comparison	184	4,164.9		
Enlisted	Ranch Hand	366	4,190.5	5.8 (-38.1,49.6)	0.797
Groundcrew	Comparison	556	4,184.7		

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics				Analysis Results for Log <sub>2</sub> (Initial Dioxin)		
Initial Dioxin	n	Mean	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Slope (Std. Error)	p-Value
Low	158	4,170.0	4,164.4	0.023	13.830 (10.970)	0.208
Medium	159	4,163.0	4,162.4			
High	159	4,221.3	4,227.5			

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (Initial Dioxin)		
Initial Dioxin	n	Adj. Mean	R <sup>2</sup>	Adj. Slope (Std. Error)	p-Value
Low	158	4,148.8	0.054	-1.264 (12.791)	0.921
Medium	158	4,133.0			
High	157	4,169.0			

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Mean	Adj. Mean <sup>a</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.)	p-Value
Comparison	1,194	4,199.1	4,199.7		
Background RH	376	4,212.2	4,200.6	0.9 (-37.7,39.6)	0.962
Low RH	236	4,151.7	4,155.3	-44.5 (-90.8,1.8)	0.060
High RH	240	4,217.3	4,228.9	29.2 (-16.9,75.3)	0.215
Low plus High RH	476	4,184.8	4,192.4	-7.3 (-42.6,28.0)	0.685

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 13-43. Analysis of Albumin (mg/dl) (Continuous) (Continued)**

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adj. Mean	Difference of Adj. Mean vs. Comparisons (95% C.I.)	p-Value
Comparison	1,193	4,183.0		
Background RH	374	4,187.9	5.0 (-34.0,43.9)	0.803
Low RH	235	4,154.2	-28.7 (-74.7,17.3)	0.221
High RH	238	4,200.2	17.2 (-30.0,64.4)	0.476
Low plus High RH	473	4,177.3	-5.6 (-41.0,29.8)	0.755

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin +1)		
1987 Dioxin	n	Mean	R <sup>2</sup>	Adjusted Slope (Std. Error)	p-Value
Low	283	4,227.5	<0.001	-2.471 (7.678)	0.748
Medium	285	4,153.4			
High	284	4,210.1			

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Adj. Mean	R <sup>2</sup>	Adjusted Slope (Std. Error)	p-Value
Low	283	4,223.1	0.040	-11.121 (8.711)	0.202
Medium	283	4,157.9			
High	281	4,181.3			

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

The unadjusted Model 3 analysis showed a marginally significant difference between Ranch Hands in the low dioxin category and Comparisons (Table 13-43(e): difference of means = -44.5 mg/dl, p=0.060). No significant differences were noted in the adjusted Model 3 analysis of albumin (Table 13-43(f): p>0.22 for each contrast). In the Model 4 unadjusted and adjusted analyses of albumin, no significant associations with 1987 dioxin were found (Table 13-43(g,h): p>0.20 for each analysis).

**13.2.2.3.35 Albumin (Discrete)**

Because of a sparse number of low albumin values among the participants, some analyses were not possible. Table 13-44 contains the results of these analyses. Unadjusted chi-square tests of association in Model 3 revealed a significantly smaller percentage of Ranch Hands in the low and high dioxin categories combined with a low albumin level than Comparisons (Table 13-44(e): p=0.099). All other analyses in Models 1 through 4 were nonsignificant (Table 13-44(a–h): p $\geq$ 0.17 for all other analyses).

**Table 13-44. Analysis of Albumin (Discrete)****(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%)		Est. Relative Risk (95% C.I.)	p-Value
			Low	High		
<i>All</i>	<i>Ranch Hand</i>	859	3 (0.3)	856 (99.7)	0.43 (0.12,1.56)	0.170
	<i>Comparison</i>	1,231	10 (0.8)	1,221 (99.2)		
Officer	Ranch Hand	340	3 (0.9)	337 (99.1)	1.08 (0.24,4.86)	0.919
	Comparison	490	4 (0.8)	486 (99.2)		
Enlisted Flyer	Ranch Hand	150	0 (0.0)	150 (100.0)	--	0.999 <sup>a</sup>
	Comparison	185	1 (0.5)	184 (99.5)		
Enlisted Groundcrew	Ranch Hand	369	0 (0.0)	369 (100.0)	--	0.171 <sup>a</sup>
	Comparison	556	5 (0.9)	551 (99.1)		

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a low albumin level.

--: Results not presented because of the sparse number of participants with a low albumin level.

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	0.45 (0.12,1.65)	0.200
Officer	1.08 (0.24,4.91)	0.918
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a low albumin level.

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category	Summary Statistics		Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>a</sup>		
	Initial Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Low	158	158 (100.0)	--	--	--
Medium	159	159 (100.0)			
High	159	159 (100.0)			

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

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

--: Results not presented because of the sparse number of Ranch Hands with a low albumin level.

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category	Analysis Results for Log <sub>2</sub> (Initial Dioxin)		
	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
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<sup>a</sup> Relative risk for a twofold increase in initial dioxin.

--: Results not presented because of the sparse number of Ranch Hands with a low albumin level.

**Table 13-44. Analysis of Albumin (Discrete) (Continued)**

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Number (%)	Est. Relative Risk (95% C.I.) <sup>ab</sup>	p-Value
		Low		
Comparison	1,194	10 (0.8)		
Background RH	376	2 (0.5)	0.68 (0.15,3.14)	0.618
Low RH	236	0 (0.0)	--	0.325 <sup>c</sup>
High RH	240	0 (0.0)	--	0.318 <sup>c</sup>
Low plus High RH	476	0 (0.0)	--	0.099 <sup>c</sup>

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with a low albumin level.

--: Results not presented because of the sparse number of Ranch Hands with a low albumin level.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,193		
Background RH	374	0.67 (0.14,3.20)	0.611
Low RH	235	--	--
High RH	238	--	--
Low plus High RH	473	--	--

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

--: Results not presented because of the sparse number of Ranch Hands with a low albumin level.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics		Analysis Results for Log <sub>2</sub> (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	283	1 (0.4)	0.68 (0.24,1.96)
Medium	285	1 (0.4)	
High	284	0 (0.0)	

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

Table 13-44. Analysis of Albumin (Discrete) (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED

Analysis Results for Log <sub>2</sub> (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
847	0.52 (0.09,3.01)	0.442

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, and industrial chemical exposure because of the sparse number of participants with a low albumin level.

13.2.2.3.36  $\alpha$ -1-Acid Glycoprotein (Continuous)

The Model 1 unadjusted and adjusted analyses of  $\alpha$ -1-acid glycoprotein revealed no overall difference between Ranch Hands and Comparisons (Table 13-45(a,b): p>0.46 for each analysis). After stratifying by occupation, a significant difference between Ranch Hands and Comparisons was discovered among the enlisted groundcrew for both the unadjusted and adjusted analyses (Table 13-45(a,b): difference of means=2.61 mg/dl, p=0.044, for the unadjusted analysis; difference of adjusted means=2.76 mg/dl, p=0.030, for the adjusted analysis). The adjusted mean  $\alpha$ -1-acid glycoprotein level among the Ranch Hand enlisted groundcrew was 86.86 mg/dl versus 84.10 mg/dl among the Comparison enlisted groundcrew.

The unadjusted Model 2 analysis was not significant (Table 13-45(c): p=0.992). After covariate adjustment, a marginally significant inverse relation between  $\alpha$ -1-acid glycoprotein and initial dioxin was detected (Table 13-45(d): adjusted slope=-0.016, p=0.086). The adjusted mean  $\alpha$ -1-acid glycoprotein levels in the low, medium, and high initial dioxin categories were 82.09 mg/dl, 83.12 mg/dl, and 79.32 mg/dl, respectively.

Table 13-45. Analysis of  $\alpha$ -1-Acid Glycoprotein (mg/dl) (Continuous)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED

Occupational Category	Group	n	Mean <sup>a</sup>	Difference of Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	859	84.65	0.50 --	0.550
	Comparison	1,231	84.15		
Officer	Ranch Hand	340	80.89	-1.33 --	0.298
	Comparison	490	82.22		
Enlisted Flyer	Ranch Hand	150	85.49	-0.38 --	0.855
	Comparison	185	85.88		
Enlisted Groundcrew	Ranch Hand	369	87.92	2.61 --	0.044
	Comparison	556	85.31		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**Table 13-45. Analysis of  $\alpha$ -1-Acid Glycoprotein (mg/dl) (Continuous) (Continued)**

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean <sup>a</sup>	Difference of Adj. Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	854	83.11	0.60 --	0.464
	Comparison	1,229	82.51		
Officer	Ranch Hand	340	78.64	-1.43 --	0.248
	Comparison	489	80.08		
Enlisted Flyer	Ranch Hand	148	83.83	0.15 --	0.942
	Comparison	184	83.68		
Enlisted Groundcrew	Ranch Hand	366	86.86	2.76 --	0.030
	Comparison	556	84.10		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>b</sup>		
Initial Dioxin	n	Mean <sup>a</sup>	Adj. Mean <sup>b</sup>	Slope	p-Value
Low	158	84.39	84.41	<0.001	0.000 (0.008)
Medium	159	87.88	87.88		
High	159	85.33	85.32		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Slope and standard error based on natural logarithm of  $\alpha$ -1-acid glycoprotein versus log<sub>2</sub> (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (Initial Dioxin)		
Initial Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adj. Slope	p-Value
Low	158	82.09	0.046	-0.016 (0.009)	0.086
Medium	158	83.12			
High	157	79.32			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of  $\alpha$ -1-acid glycoprotein versus log<sub>2</sub> (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

Table 13-45. Analysis of  $\alpha$ -1-Acid Glycoprotein (mg/dl) (Continuous) (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED

Dioxin Category	n	Mean <sup>a</sup>	Adj. Mean <sup>b</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>c</sup>	p-Value <sup>d</sup>
Comparison	1,194	84.28	84.29		
Background RH	376	83.12	83.02	-1.27 --	0.256
Low RH	236	84.79	84.82	0.53 --	0.692
High RH	240	86.92	87.02	2.73 --	0.045
Low plus High RH	476	85.86	85.92	1.63 --	0.114

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>d</sup> P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED

Dioxin Category	n	Adj. Mean <sup>a</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
Comparison	1,193	82.72		
Background RH	374	82.67	-0.05 --	0.961
Low RH	235	83.42	0.70 --	0.600
High RH	238	83.78	1.06 --	0.436
Low plus High RH	473	83.60	0.88 --	0.389

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	83.77	0.001	0.005 (0.005)	0.336
Medium	285	83.02			
High	284	87.18			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of  $\alpha$ -1-acid glycoprotein versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

Table 13-45. Analysis of  $\alpha$ -1-Acid Glycoprotein (mg/dl) (Continuous) (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	82.64	0.056	-0.012 (0.006)	0.049
Medium	283	80.92			
High	281	81.52			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of  $\alpha$ -1-acid glycoprotein versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

In the Model 3 unadjusted analysis of  $\alpha$ -1-acid glycoprotein, a significant difference between Ranch Hands in the high dioxin category and Comparisons was found (Table 13-45(e): difference of means=2.73 mg/dl, p=0.045). The adjusted analysis showed no significant contrasts between each of the dioxin categories and Comparisons (Table 13-45(f): p>0.38 for each contrast).

No significant association between  $\alpha$ -1-acid glycoprotein and 1987 dioxin was revealed in the unadjusted Model 4 analysis (Table 13-45(g): p=0.336). After covariate adjustment, a significant inverse relation was found (Table 13-45(h): adjusted slope=−0.012, p=0.049). The mean  $\alpha$ -1-acid glycoprotein levels in the low, medium, and high 1987 dioxin categories were 82.64 mg/dl, 80.92 mg/dl, and 81.52 mg/dl, respectively.

### 13.2.2.3.37 $\alpha$ -1-Acid Glycoprotein (Discrete)

The unadjusted analysis of  $\alpha$ -1-acid glycoprotein in Model 1 did not show a significant group difference between Ranch Hands and Comparisons overall or after stratifying by occupation (Table 13-46(a): p>0.10 for each contrast). The adjusted analysis revealed a marginally significant difference between Ranch Hands and Comparisons among the enlisted groundcrew stratum (Table 13-46(b): Adj. RR=1.86, p=0.066). The percentage of Ranch Hand enlisted groundcrew with high  $\alpha$ -1-acid glycoprotein levels was 5.4 versus 3.2 of Comparison enlisted groundcrew.

Table 13-46. Analysis of  $\alpha$ -1-Acid Glycoprotein (Discrete)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED

Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	859	37 (4.3)	1.34 (0.85,2.11)	0.209
	Comparison	1,231	40 (3.2)		
Officer	Ranch Hand	340	8 (2.4)	0.76 (0.32,1.82)	0.542
	Comparison	490	15 (3.1)		
Enlisted Flyer	Ranch Hand	150	9 (6.0)	1.62 (0.59,4.47)	0.348
	Comparison	185	7 (3.8)		
Enlisted Groundcrew	Ranch Hand	369	20 (5.4)	1.71 (0.89,3.28)	0.105
	Comparison	556	18 (3.2)		

**Table 13-46. Analysis of  $\alpha$ -1-Acid Glycoprotein (Discrete) (Continued)**

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	1.39 (0.88,2.21)	0.163
Officer	0.73 (0.31,1.76)	0.487
Enlisted Flyer	1.78 (0.64,4.95)	0.270
Enlisted Groundcrew	1.86 (0.96,3.60)	0.066

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin	Initial Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (Initial Dioxin) <sup>a</sup>	
	n	Number (%) High	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Low	158	6 (3.8)	1.00 (0.72,1.38)	0.991
Medium	159	10 (6.3)		
High	159	7 (4.4)		

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

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

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Dioxin Category	Analysis Results for $\log_2$ (Initial Dioxin)		
	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
	473	0.92 (0.63,1.35)	0.684

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

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.) <sup>ab</sup>	p-Value
Comparison	1,194	39 (3.3)		
Background RH	376	13 (3.5)	1.00 (0.52,1.90)	0.992
Low RH	236	11 (4.7)	1.47 (0.74,2.91)	0.272
High RH	240	12 (5.0)	1.65 (0.85,3.21)	0.141
Low plus High RH	476	23 (4.8)	1.56 (0.92,2.64)	0.101

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 13-46. Analysis of  $\alpha$ -1-Acid Glycoprotein (Discrete) (Continued)**

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,193		
Background RH	374	1.12 (0.58,2.16)	0.745
Low RH	235	1.47 (0.73,2.94)	0.279
High RH	238	1.54 (0.77,3.08)	0.222
Low plus High RH	473	1.50 (0.88,2.58)	0.138

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

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Low	283	11 (3.9)	1.00 (0.80,1.25)	0.986
Medium	285	9 (3.2)		
High	284	16 (5.6)		

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

Analysis Results for $\log_2$ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>		p-Value
847	0.87 (0.68,1.11)		0.261

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

All unadjusted and adjusted analyses in Models 2 through 4 showed no significant relation between dioxin and dichotomized  $\alpha$ -1-acid glycoprotein (Table 13-46(c–h):  $p>0.10$  for each analysis).

**13.2.2.3.38  $\alpha$ -1-Antitrypsin (Continuous)**

Both the unadjusted and adjusted Model 1 analyses of  $\alpha$ -1-antitrypsin revealed significant overall group differences (Table 13-47(a,b): difference of means=3.5 mg/dl,  $p=0.002$ ; difference of adjusted means=3.6 mg/dl,  $p=0.001$ , respectively). The adjusted mean  $\alpha$ -1-antitrypsin level was 146.7 mg/dl for all Ranch Hands and 143.1 mg/dl for all Comparisons. After stratifying by occupation, the unadjusted and adjusted analyses each showed a significant difference between Ranch Hands and Comparisons among the enlisted groundcrew (Table 13-47(a,b): difference of means=5.5 mg/dl,  $p=0.001$ , unadjusted; difference of adjusted means=5.9 mg/dl,  $p<0.001$ , adjusted). In addition, stratifying by occupation in the adjusted analysis revealed a marginally significant difference between Ranch Hands and Comparisons within the

enlisted flyer stratum (Table 13-47(b)): difference of adjusted means=4.7 mg/dl, p=0.086). The adjusted mean  $\alpha$ -1-antitrypsin levels for Ranch Hands and Comparisons in the enlisted flyer stratum were 150.5 mg/dl and 145.9 mg/dl, respectively. Within the enlisted groundcrew stratum, the adjusted mean  $\alpha$ -1-antitrypsin levels were 151.5 mg/dl and 145.6 mg/dl for Ranch Hands and Comparisons, respectively.

**Table 13-47. Analysis of  $\alpha$ -1-Antitrypsin (mg/dl) (Continuous)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Mean <sup>a</sup>	Difference of Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	859	150.0	3.5 --	0.002
	Comparison	1,231	146.5		
Officer	Ranch Hand	340	143.9	0.9 --	0.609
	Comparison	490	143.0		
Enlisted Flyer	Ranch Hand	150	155.3	4.2 --	0.136
	Comparison	185	151.1		
Enlisted Groundcrew	Ranch Hand	369	153.5	5.5 --	0.001
	Comparison	556	148.0		

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.

<sup>c</sup> P-value is based on difference of means on square root scale.

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean <sup>a</sup>	Difference of Adj. Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	854	146.7	3.6 --	0.001
	Comparison	1,229	143.1		
Officer	Ranch Hand	340	138.6	0.7 --	0.693
	Comparison	489	137.9		
Enlisted Flyer	Ranch Hand	148	150.5	4.7 --	0.086
	Comparison	184	145.9		
Enlisted Groundcrew	Ranch Hand	366	151.5	5.9 --	<0.001
	Comparison	556	145.6		

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.

<sup>c</sup> P-value is based on difference of means on square root scale.

**Table 13-47. Analysis of  $\alpha$ -1-Antitrypsin (mg/dl) (Continuous) (Continued)**

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics				Analysis Results for $\log_2$ (Initial Dioxin) <sup>b</sup>		
Initial Dioxin	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	R <sup>2</sup>	Slope (Std. Error) <sup>c</sup>	p-Value
Low	158	148.4	148.2	0.013	0.066 (0.036)	0.071
Medium	159	153.8	153.7			
High	159	151.8	152.1			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Slope and standard error based on square root of  $\alpha$ -1-antitrypsin versus  $\log_2$  (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin)		
Initial Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adj. Slope (Std. Error) <sup>b</sup>	p-Value
Low	158	145.0	0.101	0.023 (0.041)	0.582
Medium	158	148.8			
High	157	145.6			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of  $\alpha$ -1-antitrypsin versus  $\log_2$  (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>c</sup>	p-Value <sup>d</sup>
Comparison	1,194	146.8	146.8		
Background RH	376	148.0	147.9	1.1 --	0.470
Low RH	236	148.8	148.9	2.1 --	0.244
High RH	240	153.8	154.0	7.2 --	<0.001
Low plus High RH	476	151.3	151.4	4.6 --	0.001

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.

<sup>d</sup> P-value is based on difference of means on square root scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 13-47. Analysis of  $\alpha$ -1-Antitrypsin (mg/dl) (Continuous) (Continued)**

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adj. Mean <sup>a</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
Comparison	1,193	143.8		
Background RH	374	147.2	3.4 --	0.024
Low RH	235	145.5	1.7 --	0.339
High RH	238	148.4	4.6 --	0.011
Low plus High RH	473	147.0	3.2 --	0.020

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.

<sup>c</sup> P-value is based on difference of means on square root scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin +1)		
1987 Dioxin	n	Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	148.3	0.003	0.040 (0.025)	0.109
Medium	285	148.2			
High	284	153.1			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of  $\alpha$ -1-antitrypsin versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq$  7.9 ppt; Medium =  $>$  7.9–19.6 ppt; High =  $>$  19.6 ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin +1)		
1987 Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	147.2	0.102	-0.047 (0.027)	0.089
Medium	283	145.2			
High	281	145.0			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of  $\alpha$ -1-antitrypsin versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq$  7.9 ppt; Medium =  $>$  7.9–19.6 ppt; High =  $>$  19.6 ppt.

The unadjusted Model 2 analysis revealed a marginally significant positive association between  $\alpha$ -1-antitrypsin and initial dioxin (Table 13-47(c): slope=0.066, p=0.071). After adjusting for covariates, the relation became nonsignificant (Table 13-47(d): p=0.582).

The unadjusted Model 3 analysis revealed a marginally significant difference in mean  $\alpha$ -1-antitrypsin levels between Ranch Hands in the high dioxin category and Comparisons, as well as between Ranch Hands in the low and high dioxin categories combined and Comparisons (Table 13-47(e): difference of means=7.2 mg/dl,  $p<0.001$ ; difference of means=4.6 mg/dl,  $p=0.001$ , respectively).

Three significant contrasts were found in the adjusted Model 3 analysis of  $\alpha$ -1-antitrypsin: Ranch Hands in the background dioxin category versus Comparisons (Table 13-47(f): difference of adjusted means=3.4 mg/dl,  $p=0.024$ ), Ranch Hands in the high dioxin category versus Comparisons (difference of adjusted means=4.6 mg/dl,  $p=0.011$ ), and Ranch Hands in the low and high dioxin categories combined versus Comparisons (difference of adjusted means=3.2 mg/dl,  $p=0.020$ ). The adjusted mean  $\alpha$ -1-antitrypsin levels for Ranch Hands in the background dioxin category, Ranch Hands in the high dioxin category, Ranch Hands in the low and high dioxin categories combined, and Comparisons were 147.2 mg/dl, 148.4 mg/dl, 147.0 mg/dl, and 143.8 mg/dl, respectively.

The unadjusted Model 4 analysis results were nonsignificant (Table 13-47(g):  $p=0.109$ ). After adjusting for covariates, a marginally significant inverse relation between  $\alpha$ -1-antitrypsin and 1987 dioxin was seen (Table 13-47(g): adjusted slope=-0.047,  $p=0.089$ ). The adjusted mean  $\alpha$ -1-antitrypsin levels in the low, medium, and high 1987 dioxin categories were 147.2 mg/dl, 145.2 mg/dl, and 145.0 mg/dl, respectively.

#### *13.2.2.3.39 $\alpha$ -1-Antitrypsin (Discrete)*

All unadjusted and adjusted results for Models 1 through 4 did not reveal a significant association between the percentage of individuals with low  $\alpha$ -1-antitrypsin levels and dioxin or between the percentage of individuals with high  $\alpha$ -1-antitrypsin levels and dioxin (Table 13-48(a-h):  $p>0.11$  for all analyses).

**Table 13-48. Analysis of  $\alpha$ -1-Antitrypsin (Discrete)****(a) MODEL 1: RANCH HANDS VS. COMPARISONS — UNADJUSTED**

Occupational Category	Group	n	Number (%)			Abnormal Low vs. Normal		Abnormal High vs. Normal	
			Abnormal Low	Normal	Abnormal High	Est. Relative Risk (95% C.I.)	p-Value	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	859	11 (1.3)	840 (97.8)	8 (0.9)	0.88 (0.41,1.87)	0.737	2.30 (0.75,7.06)	0.145
	<i>Comparison</i>	1,231	18 (1.5)	1,208 (98.1)	5 (0.4)				
Officer	Ranch Hand	340	8 (2.4)	330 (97.1)	2 (0.6)	1.06 (0.42,2.65)	0.908	--	0.327 <sup>a</sup>
	Comparison	490	11 (2.2)	479 (97.8)	0 (0.0)				
Enlisted Flyer	Ranch Hand	150	1 (0.7)	148 (98.7)	1 (0.7)	1.23 (0.08,19.83)	0.884	0.61 (0.07,5.25)	0.657
	Comparison	185	1 (0.5)	182 (98.4)	2 (1.1)				
Enlisted Groundcrew	Ranch Hand	369	2 (0.5)	362 (98.1)	5 (1.4)	0.50 (0.10,2.51)	0.403	2.52 (0.61,10.42)	0.202
	Comparison	556	6 (1.1)	547 (98.4)	3 (0.5)				

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of participants with abnormal high  $\alpha$ -1-antitrypsin levels.

--: Results not presented because of the sparse number of participants with abnormal high  $\alpha$ -1-antitrypsin levels.

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS — ADJUSTED**

Occupational Category	Abnormal Low vs. Normal			Abnormal High vs. Normal		
	Adj. Relative Risk (95% C.I.)	p-Value	Adj. Relative Risk (95% C.I.)	p-Value		
<i>All</i>	0.81 (0.37,1.78)	0.606	2.51 (0.80,7.90)	0.116		
Officer	1.10 (0.44,2.78)	0.834	--	--		
Enlisted Flyer	--	--	0.73 (0.08,6.49)	0.778		
Enlisted Groundcrew	0.47 (0.10,2.34)	0.358	2.69 (0.63,11.58)	0.183		

--: Results not presented because of the sparse number of participants with abnormal  $\alpha$ -1-antitrypsin levels.

Note: Results are not adjusted for race because of the sparse number of participants with abnormal  $\alpha$ -1-antitrypsin levels.

**Table 13-48. Analysis of  $\alpha$ -1-Antitrypsin (Discrete) (Continued)**

**(c) MODEL 2: RANCH HANDS — INITIAL DIOXIN — UNADJUSTED**

Initial Dioxin Category	n	Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin) <sup>a</sup>			
		Abnormal Low	Normal	Abnormal High	Abnormal Low vs. Normal	Abnormal High vs. Normal		
		Number (%)		Est. Relative Risk (95% C.I.) <sup>b</sup>	p-Value	Est. Relative Risk (95% C.I.) <sup>b</sup>	p-Value	
Low	158	1 (0.6)	156 (98.7)	1 (0.6)	0.83 (0.37,1.90)	0.667	1.05 (0.39,2.80)	0.925
Medium	159	2 (1.3)	156 (98.1)	1 (0.6)				
High	159	1 (0.6)	157 (98.7)	1 (0.6)				

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

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

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS — INITIAL DIOXIN — ADJUSTED**

n	Analysis Results for $\log_2$ (Initial Dioxin)			
	Abnormal Low vs. Normal		Abnormal High vs. Normal	
	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
473	0.75 (0.30,1.84)	0.526	0.80 (0.21,3.00)	0.735

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

Note: Results are not adjusted for race, occupation, current wine consumption, and degreasing chemical exposure because of the sparse number of participants with abnormal  $\alpha$ -1-antitrypsin levels.

**Table 13-48. Analysis of  $\alpha$ -1-Antitrypsin (Discrete) (Continued)**

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY — UNADJUSTED**

Dioxin Category	n	Number (%)		Abnormal Low vs. Normal		Abnormal High vs. Normal		
		Abnormal Low	Normal	Abnormal High	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Est. Relative Risk (95% C.I.) <sup>a,b</sup>	p-Value
Comparison	1,194	17 (1.4)	1,172 (98.2)	5 (0.4)				
Background RH	376	7 (1.9)	364 (96.8)	5 (1.3)	1.14 (0.47,2.79)	0.772	2.48 (0.70,8.77)	0.158
Low RH	236	2 (0.8)	233 (98.7)	1 (0.4)	0.61 (0.14,2.67)	0.513	1.03 (0.11,9.33)	0.976
High RH	240	2 (0.8)	236 (98.3)	2 (0.8)	0.68 (0.16,2.98)	0.610	3.49 (0.64,19.06)	0.149
Low plus High RH	476	4 (0.8)	469 (98.5)	3 (0.6)	0.65 (0.22,1.93)	0.434	1.91 (0.42,8.72)	0.404

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY — ADJUSTED**

Dioxin Category	n	Abnormal Low vs. Normal		Abnormal High vs. Normal	
		Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,193				
Background RH	374	0.78 (0.30,2.01)	0.602	2.76 (0.74,10.35)	0.131
Low RH	235	0.76 (0.17,3.35)	0.712	1.16 (0.13,10.62)	0.895
High RH	238	1.41 (0.28,7.06)	0.677	2.64 (0.43,16.23)	0.295
Low plus High RH	473	1.03 (0.32,3.31)	0.955	1.75 (0.36,8.53)	0.486

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

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

Results are not adjusted for race because of the sparse number of participants with abnormal  $\alpha$ -1-antitrypsin levels.

**Table 13-48. Analysis of  $\alpha$ -1-Antitrypsin (Discrete) (Continued)****(g) MODEL 4: RANCH HANDS — 1987 DIOXIN — UNADJUSTED**

1987 Dioxin Category	n	1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2(1987 \text{ Dioxin} + 1)$			
		Abnormal Low	Normal	Abnormal High	Abnormal Low vs. Normal	Abnormal High vs. Normal		
		Number (%)		Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
Low	283	5 (1.8)	274 (96.8)	4 (1.4)	0.76 (0.49,1.19)	0.229	0.80 (0.48,1.33)	0.393
Medium	285	3 (1.1)	280 (98.2)	2 (0.7)				
High	284	3 (1.1)	279 (98.2)	2 (0.7)				

<sup>a</sup>Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq 7.9$  ppt; Medium =  $> 7.9$ -19.6 ppt; High =  $> 19.6$  ppt.

**(h) MODEL 4: RANCH HANDS — 1987 DIOXIN — ADJUSTED**

n	Analysis Results for $\log_2(1987 \text{ Dioxin} + 1)$			
	Abnormal Low vs. Normal		Abnormal High vs. Normal	
	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
847	0.84 (0.52,1.37)	0.486	0.75 (0.44,1.29)	0.302

<sup>a</sup>Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race and occupation because of the sparse number of participants with abnormal  $\alpha$ -1-antitrypsin levels.

### 13.2.2.3.40 $\alpha$ -2-Macroglobulin (Continuous)

All unadjusted and adjusted analyses of Models 1 through 4 showed no significant associations between dioxin and  $\alpha$ -2-macroglobulin in its continuous form (Table 13-49(a-h):  $p>0.23$  for each analysis).

**Table 13-49. Analysis of  $\alpha$ -2-Macroglobulin (mg/dl) (Continuous)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Mean <sup>a</sup>	Difference of Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	859	170.6	-0.7 --	0.726
	Comparison	1,231	171.3		
Officer	Ranch Hand	340	170.6	-0.4 --	0.901
	Comparison	490	171.0		
Enlisted Flyer	Ranch Hand	150	177.0	-0.4 --	0.935
	Comparison	185	177.4		
Enlisted	Ranch Hand	369	168.1	-1.5 --	0.608
Groundcrew	Comparison	556	169.6		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean <sup>a</sup>	Difference of Adj. Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	854	161.9	-0.9 --	0.610
	Comparison	1,229	162.8		
Officer	Ranch Hand	340	154.5	-1.2 --	0.643
	Comparison	489	155.7		
Enlisted Flyer	Ranch Hand	148	163.8	-1.9 --	0.664
	Comparison	184	165.7		
Enlisted	Ranch Hand	366	167.4	-0.2 --	0.951
Groundcrew	Comparison	556	167.6		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**Table 13-49. Analysis of  $\alpha$ -2-Macroglobulin (mg/dl) (Continuous) (Continued)**

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin) <sup>b</sup>		
Initial Dioxin	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	R <sup>2</sup>	Slope (Std. Error) <sup>c</sup>
Low	158	168.1	168.1	<0.001	-0.004 (0.009)
Medium	159	175.3	175.3		
High	159	167.4	167.4		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Slope and standard error based on natural logarithm of  $\alpha$ -2-macroglobulin versus  $\log_2$  (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin)		
Initial Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adj. Slope (Std. Error) <sup>b</sup>	p-Value
Low	158	154.2	0.135	0.009 (0.010)	0.368
Medium	158	163.5			
High	157	161.3			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of  $\alpha$ -2-macroglobulin versus  $\log_2$  (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>c</sup>	p-Value <sup>d</sup>
Comparison	1,194	171.2	171.2		
Background RH	376	170.2	170.2	-1.0 --	0.706
Low RH	236	170.2	170.2	-1.0 --	0.747
High RH	240	170.2	170.2	-1.0 --	0.741
Low plus High RH	476	170.2	170.2	-1.0 --	0.669

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>d</sup> P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 13-49. Analysis of  $\alpha$ -2-Macroglobulin (mg/dl) (Continuous) (Continued)**

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adj. Mean <sup>a</sup>	Difference of Adj. Mean vs. Comparisons (95% C.L.) <sup>b</sup>	p-Value <sup>c</sup>
Comparison	1,193	163.2		
Background RH	374	162.2	-1.0 --	0.683
Low RH	235	159.9	-3.3 --	0.232
High RH	238	163.3	0.1 --	0.959
Low plus High RH	473	161.6	-1.6 --	0.461

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (1987 Dioxin +1)		
1987 Dioxin	n	Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	169.9	<0.001	-0.004 (0.006)	0.522
Medium	285	170.6			
High	284	170.2			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of  $\alpha$ -2-macroglobulin versus log<sub>2</sub> (1987 dioxin + 1).

Note: Low =  $\leq$  7.9 ppt; Medium =  $>$  7.9–19.6 ppt; High =  $>$  19.6 ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (1987 Dioxin +1)		
1987 Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	162.9	0.131	-0.005 (0.006)	0.390
Medium	283	161.1			
High	281	162.8			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of  $\alpha$ -2-macroglobulin versus log<sub>2</sub> (1987 dioxin + 1).

Note: Low =  $\leq$  7.9 ppt; Medium =  $>$  7.9–19.6 ppt; High =  $>$  19.6 ppt.

### 13.2.2.3.41 $\alpha$ -2-Macroglobulin (Discrete)

The unadjusted and adjusted Model 1 analyses of  $\alpha$ -2-macroglobulin were nonsignificant (Table 13-50(a,b):  $p>0.15$  for each analysis). The unadjusted Model 2 analysis was not significant (Table 13-50(c):  $p=0.254$ ), but the adjusted analysis was marginally significant (Table 13-50(d): Adj. RR=1.48,  $p=0.072$ ).

The unadjusted Model 3 analysis revealed a marginally significant difference in high  $\alpha$ -2-macroglobulin levels between Ranch Hands in the background dioxin category and Comparisons (Table 13-50(e): Est. RR=0.46,  $p=0.080$ ). The percentage of Ranch Hands in the background category with high  $\alpha$ -2-macroglobulin levels was 1.6 versus 3.8 for Comparisons. The same contrast was marginally significant in the adjusted Model 3 analysis (Table 13-50(f): Adj. RR=0.45,  $p=0.079$ ).

**Table 13-50. Analysis of  $\alpha$ -2-Macroglobulin (Discrete)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%) High	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	859	24 (2.8)	0.72 (0.44,1.19)	0.199
	Comparison	1,231	47 (3.8)		
Officer	Ranch Hand	340	8 (2.4)	0.63 (0.27,1.47)	0.287
	Comparison	490	18 (3.7)		
Enlisted Flyer	Ranch Hand	150	5 (3.3)	0.55 (0.19,1.61)	0.271
	Comparison	185	11 (5.9)		
Enlisted Groundcrew	Ranch Hand	369	11 (3.0)	0.92 (0.43,1.97)	0.827
	Comparison	556	18 (3.2)		

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	0.70 (0.42,1.16)	0.157
Officer	0.59 (0.25,1.40)	0.234
Enlisted Flyer	0.46 (0.15,1.39)	0.169
Enlisted Groundcrew	1.01 (0.46,2.19)	0.988

Note: Results are not adjusted for race because of the sparse number of participants with high  $\alpha$ -2-macroglobulin levels.

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (Initial Dioxin) <sup>a</sup>	
Initial Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.) <sup>b</sup>
Low	158	2 (1.3)	1.22 (0.87,1.71)
Medium	159	10 (6.3)	
High	159	5 (3.1)	

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

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

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**Table 13-50. Analysis of  $\alpha$ -2-Macroglobulin (Discrete) (Continued)**

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Analysis Results for $\log_2$ (Initial Dioxin)			
Dioxin Category	n	Adjusted Relative Risk	p-Value
		(95% C.I.) <sup>a</sup>	
	473	1.48 (0.96,2.27)	0.072

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

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with high  $\alpha$ -2-macroglobulin levels.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		High	(95% C.I.) <sup>ab</sup>	
Comparison	1,194	45 (3.8)		
Background RH	376	6 (1.6)	0.46 (0.19,1.10)	0.080
Low RH	236	7 (3.0)	0.75 (0.33,1.69)	0.492
High RH	240	10 (4.2)	1.00 (0.49,2.03)	0.999
Low plus High RH	476	17 (3.6)	0.87 (0.49,1.55)	0.632

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adjusted Relative Risk	p-Value
		(95% C.I.) <sup>a</sup>	
Comparison	1,193		
Background RH	374	0.45 (0.19,1.10)	0.079
Low RH	235	0.61 (0.27,1.40)	0.246
High RH	238	1.09 (0.51,2.31)	0.823
Low plus High RH	473	0.82 (0.45,1.49)	0.511

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

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

Results are not adjusted for race because of the sparse number of participants with high  $\alpha$ -2-macroglobulin levels.

**Table 13-50. Analysis of  $\alpha$ -2-Macroglobulin (Discrete) (Continued)**

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics		Analysis Results for $\text{Log}_2$ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	283	3 (1.1)	1.37 (1.06,1.77)
Medium	285	8 (2.8)	
High	284	12 (4.2)	

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq 7.9$  ppt; Medium =  $> 7.9$ – $19.6$  ppt; High =  $> 19.6$  ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

Analysis Results for $\text{Log}_2$ (1987 Dioxin + 1)		p-Value
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	
847	1.50 (1.08,2.08)	0.014

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race because of the sparse number of participants with high  $\alpha$ -2-macroglobulin levels.

Both the unadjusted and adjusted Model 4 analyses revealed significant associations between  $\alpha$ -2-macroglobulin and 1987 dioxin (Table 13-50(g,h)): Est. RR=1.37, p=0.020; Adj. RR=1.50, p=0.014, respectively). The percentages of participants with high  $\alpha$ -2-macroglobulin values in the low, medium, and high 1987 dioxin categories were 1.1, 2.8, and 4.2, respectively.

**13.2.2.3.42 Apolipoprotein B (mg/dl) (Continuous)**

The Model 1 analysis of apolipoprotein B did not show a significant overall difference between Ranch Hands and Comparisons in either the unadjusted or adjusted analyses (Table 13-51(a,b): p>0.27 for each analysis). After stratifying by occupation, a significant difference between Ranch Hands and Comparisons was discovered among the officers in both the unadjusted and adjusted analyses (Table 13-51(a,b): difference of means=–3.3 mg/dl, p=0.053, for the unadjusted analysis; difference of adjusted means=–3.3 mg/dl, p=0.048, for the adjusted analysis). The adjusted mean apolipoprotein B level among the Ranch Hand officers was 105.9 mg/dl versus 109.2 mg/dl among the Comparison officers.

**Table 13-51. Analysis of Apolipoprotein B (mg/dl) (Continuous)****(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Mean <sup>a</sup>	Difference of Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
<i>All</i>	<i>Ranch Hand</i>	859	110.5	-1.1 --	0.320
	<i>Comparison</i>	1,231	111.5		
Officer	Ranch Hand	340	106.4	-3.3 --	0.053
	Comparison	490	109.6		
Enlisted Flyer	Ranch Hand	150	113.2	-2.0 --	0.463
	Comparison	185	115.2		
Enlisted Groundcrew	Ranch Hand	369	113.1	1.2 --	0.479
	Comparison	556	112.0		

<sup>a</sup> Transformed from square root scale.<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.<sup>c</sup> P-value is based on difference of means on square root scale.**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean <sup>a</sup>	Difference of Adj. Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
<i>All</i>	<i>Ranch Hand</i>	854	110.6	-1.2 --	0.275
	<i>Comparison</i>	1,229	111.8		
Officer	Ranch Hand	340	105.9	-3.3 --	0.048
	Comparison	489	109.2		
Enlisted Flyer	Ranch Hand	148	112.9	-2.2 --	0.413
	Comparison	184	115.1		
Enlisted Groundcrew	Ranch Hand	366	112.6	1.2 --	0.457
	Comparison	556	111.4		

<sup>a</sup> Transformed from square root scale.<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.<sup>c</sup> P-value is based on difference of means on square root scale.**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics				Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>b</sup>		
Initial Dioxin	n	Mean <sup>a</sup>	Adj. Mean <sup>b</sup>	R <sup>2</sup>	Slope (Std. Error) <sup>c</sup>	p-Value
Low	158	107.1	107.0	0.014	0.107 (0.041)	0.009
Medium	159	113.9	113.9			
High	159	114.5	114.6			

<sup>a</sup> Transformed from square root scale.<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.<sup>c</sup> Slope and standard error based on square root of apolipoprotein B versus log<sub>2</sub> (initial dioxin).

Note: Low = 27–63 ppt; Medium = &gt;63–152 ppt; High = &gt;152 ppt.

**Table 13-51. Analysis of Apolipoprotein B (mg/dl) (Continuous) (Continued)**

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin)		
Initial Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adj. Slope (Std. Error) <sup>b</sup>	p-Value
Low	158	108.5	0.033	0.061 (0.048)	0.209
Medium	158	113.8			
High	157	113.2			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of apolipoprotein B versus  $\log_2$  (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>c</sup>	p-Value <sup>d</sup>
Comparison	1,194	111.5	111.5		
Background RH	376	108.8	108.8	-2.7 --	0.057
Low RH	236	108.9	108.9	-2.6 --	0.131
High RH	240	114.7	114.6	3.1 --	0.073
Low plus High RH	476	111.8	111.8	0.3 --	0.843

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.

<sup>d</sup> P-value is based on difference of means on square root scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adj. Mean <sup>a</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
Comparison	1,193	112.0		
Background RH	374	110.0	-2.0 --	0.170
Low RH	235	109.5	-2.5 --	0.154
High RH	238	113.6	1.6 --	0.358
Low plus High RH	473	111.6	-0.4 --	0.761

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.

<sup>c</sup> P-value is based on difference of means on square root scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 13-51. Analysis of Apolipoprotein B (mg/dl) (Continuous) (Continued)**

<b>(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED</b>					
1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	109.2	0.011	0.083 (0.027)	0.002
Medium	285	108.0			
High	284	114.2			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of apolipoprotein B versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq 7.9$  ppt; Medium =  $> 7.9$ –19.6 ppt; High =  $> 19.6$  ppt.

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	111.0	0.023	0.046 (0.031)	0.142
Medium	283	109.0			
High	281	112.9			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of apolipoprotein B versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq 7.9$  ppt; Medium =  $> 7.9$ –19.6 ppt; High =  $> 19.6$  ppt.

The unadjusted Model 2 analysis revealed a significant relation between initial dioxin and apolipoprotein B (Table 13-51(c): slope=0.107, p=0.009). The adjusted analysis results were not significant (Table 13-51(d): p=0.209).

The unadjusted Model 3 analysis revealed two marginally significant contrasts: Ranch Hands in the background dioxin category versus Comparisons and Ranch Hands in the high dioxin category versus Comparisons (Table 13-51(e): difference of means=–2.7 mg/dl, p=0.057; difference of means=3.1 mg/dl, p=0.073, respectively). After adjusting for covariates, no contrasts were significant (Table 13-51(f): p>0.15 for each contrast).

The Model 4 unadjusted analysis of apolipoprotein B revealed a significant association with 1987 dioxin (Table 13-51(g): slope=0.083, p=0.002). The adjusted analysis was nonsignificant (Table 13-51(h): p=0.142).

The reference range between 1992 and 1997 decreased according to the manufacturer's recommendation. Consequently, the mean levels shown in Table 13-51 are less than the 1992 mean levels.

#### 13.2.2.3.43 Apolipoprotein B (Discrete)

Both the unadjusted and adjusted Model 1 analyses of apolipoprotein B in its dichotomous form revealed marginally significant overall group differences (Table 13-52(a,b): Est. RR=0.86, p=0.087; Adj. RR=0.85, p=0.073, respectively). After stratifying by occupation, unadjusted and adjusted analyses revealed group differences within the enlisted flyer stratum (Table 13-52(a,b): Est. RR=0.55, p=0.007; Adj. RR=0.53, p=0.005, respectively). The percentage of participants in the Ranch Hand group with high

apolipoprotein B values was 49.2 versus 53.0 for Comparisons. Within the enlisted flyer stratum, 48.0 percent of the Ranch Hands had high apolipoprotein B values versus 62.7 percent of the Comparisons. The unadjusted Model 2 analysis revealed a marginally significant association between apolipoprotein B and initial dioxin (Table 13-52(c): Est. RR=1.14, p=0.059). The adjusted analysis showed no significant results (Table 13-52(d): p=0.456).

**Table 13-52. Analysis of Apolipoprotein B (Discrete)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
			High		
<i>All</i>	<i>Ranch Hand</i>	859	423 (49.2)	0.86 (0.72,1.02)	0.087
	<i>Comparison</i>	1,231	653 (53.0)		
Officer	Ranch Hand	340	149 (43.8)	0.80 (0.61,1.06)	0.114
	Comparison	490	242 (49.4)		
Enlisted Flyer	Ranch Hand	150	72 (48.0)	0.55 (0.35,0.85)	0.007
	Comparison	185	116 (62.7)		
Enlisted Groundcrew	Ranch Hand	369	202 (54.7)	1.07 (0.82,1.39)	0.615
	Comparison	556	295 (53.1)		

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	0.85 (0.71,1.02)	0.073
Officer	0.80 (0.61,1.06)	0.115
Enlisted Flyer	0.53 (0.34,0.82)	0.005
Enlisted Groundcrew	1.07 (0.82,1.40)	0.603

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin) <sup>a</sup>		
Initial Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value	
		High			
Low	158	73 (46.2)	1.14 (0.99,1.31)	0.059	
Medium	159	84 (52.8)			
High	159	88 (55.3)			

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

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

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Analysis Results for $\log_2$ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
473	1.06 (0.90,1.25)	0.456

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

**Table 13-52. Analysis of Apolipoprotein B (Discrete) (Continued)**

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.) <sup>ab</sup>	p-Value
Comparison	1,194	636 (53.3)		
Background RH	376	174 (46.3)	0.75 (0.60,0.95)	0.017
Low RH	236	113 (47.9)	0.81 (0.61,1.07)	0.132
High RH	240	132 (55.0)	1.08 (0.81,1.42)	0.606
Low plus High RH	476	245 (51.5)	0.93 (0.75,1.16)	0.524

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,193		
Background RH	374	0.79 (0.62,1.00)	0.050
Low RH	235	0.82 (0.62,1.09)	0.164
High RH	238	0.97 (0.73,1.30)	0.849
Low plus High RH	473	0.89 (0.72,1.11)	0.305

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

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Low	283	135 (47.7)	1.12 (1.02,1.23)	0.017
Medium	285	130 (45.6)		
High	284	154 (54.2)		

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

**Table 13-52. Analysis of Apolipoprotein B (Discrete) (Continued)**

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

Analysis Results for Log <sub>2</sub> (1987 Dioxin + 1)		
	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
847	1.07 (0.96,1.18)	0.242

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Model 3 revealed significant relations between Ranch Hands in the background dioxin category and Comparisons for both the unadjusted and adjusted analyses (Table 13-52(e,f): Est. RR=0.75, p=0.017; Adj. RR=0.79, p=0.050, respectively). The percentage of high apolipoprotein B values among the Ranch Hands in the background dioxin category was 46.3 versus 53.3 for Comparisons.

The unadjusted Model 4 analysis of apolipoprotein B showed a significant association with 1987 dioxin (Table 13-52(g): Est. RR=1.12, p=0.017). After adjusting for covariates, the relation became nonsignificant (Table 13-52(h): p=0.242).

The reference range between 1992 and 1997 decreased according to the manufacturer's recommendation. The change may explain partially the decrease in the percentage of participants with high apolipoprotein B levels between 1992 and 1997.

**13.2.2.3.44 C3 Complement (mg/dl) (Continuous)**

The unadjusted and adjusted Model 1 analyses of C3 complement in its continuous form revealed no significant group differences (Table 13-53(a,b): p>0.50 for each analysis).

**Table 13-53. Analysis of C3 Complement (mg/dl) (Continuous)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Mean <sup>a</sup>	Difference of Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	859	118.9	0.4 ..	0.640
	Comparison	1,231	118.5		
Officer	Ranch Hand	340	114.9	0.3 ..	0.814
	Comparison	490	114.6		
Enlisted Flyer	Ranch Hand	150	120.3	-0.4 ..	0.862
	Comparison	185	120.7		
Enlisted Groundcrew	Ranch Hand	369	122.1	0.8 ..	0.537
	Comparison	556	121.3		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**Table 13-53. Analysis of C3 Complement (mg/dl) (Continuous) (Continued)**

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean <sup>a</sup>	Difference of Adj. Means (95% C.L.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	854	120.2	0.2 --	0.837
	Comparison	1,229	120.0		
Officer	Ranch Hand	340	116.5	0.4 --	0.765
	Comparison	489	116.1		
Enlisted Flyer	Ranch Hand	148	120.8	-1.4 --	0.505
	Comparison	184	122.2		
Enlisted Groundcrew	Ranch Hand	366	122.8	0.6 --	0.668
	Comparison	556	122.3		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>b</sup>			
Initial Dioxin	n	Mean <sup>a</sup>	Adj. Mean <sup>b</sup>	R <sup>2</sup>	Slope (Std. Error) <sup>c</sup>	p-Value
Low	158	118.3	118.8	0.071	0.012 (0.005)	0.023
Medium	159	123.6	123.7			
High	159	124.0	123.4			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Slope and standard error based on natural logarithm of C3 complement versus log<sub>2</sub> (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (Initial Dioxin)			
Initial Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adj. Slope (Std. Error) <sup>b</sup>	p-Value	
Low	158	119.1	0.083	0.009 (0.006)	0.145	
Medium	158	123.9				
High	157	122.7				

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of C3 complement versus log<sub>2</sub> (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**Table 13-53. Analysis of C3 Complement (mg/dl) (Continuous) (Continued)**

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>c</sup>	p-Value <sup>d</sup>
Comparison	1,194	118.5	118.5		
Background RH	376	115.2	116.7	-1.8 --	0.107
Low RH	236	120.0	119.5	1.0 --	0.399
High RH	240	123.9	122.3	3.8 --	0.003
Low plus High RH	476	122.0	120.9	2.4 --	0.013

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>d</sup> P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adj. Mean <sup>a</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
Comparison	1,193	120.1		
Background RH	374	119.5	-0.6 --	0.594
Low RH	235	121.0	0.9 --	0.518
High RH	238	121.8	1.7 --	0.217
Low plus High RH	473	121.4	1.3 --	0.213

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (1987 Dioxin +1)		
1987 Dioxin	n	Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	115.1	0.040	0.021 (0.004)	<0.001
Medium	285	117.8			
High	284	124.1			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of C3 complement versus log<sub>2</sub> (1987 dioxin + 1).

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

**Table 13-53. Analysis of C3 Complement (mg/dl) (Continuous) (Continued)**

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	117.6	0.067	0.017 (0.004)	<0.001
Medium	283	119.6			
High	281	124.6			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of C3 complement versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq 7.9$  ppt; Medium =  $> 7.9$ –19.6 ppt; High =  $> 19.6$  ppt.

A significant relation was found between initial dioxin and C3 complement in the unadjusted Model 2 analysis (Table 13-53(c): slope=0.012, p=0.023). The adjusted analysis was nonsignificant (Table 13-53(d): p=0.145).

The unadjusted Model 3 analysis revealed a significant difference in mean C3 complement levels between Ranch Hands in the high dioxin category and Comparisons, as well as between Ranch Hands in the low and high dioxin categories combined and Comparisons (Table 13-53(e): difference of means=3.8 mg/dl, p=0.003; difference of means=2.4 mg/dl, p=0.013, respectively). The adjusted analysis showed no significant differences between any of the Ranch Hand categories and Comparisons (Table 13-53(f): p>0.21 for each contrast).

Both the unadjusted and adjusted Model 4 analyses revealed significant associations between C3 complement and 1987 dioxin (Table 13-53(g,h): slope=0.021, p<0.001; adjusted slope=0.017, p<0.001, respectively). The adjusted mean C3 complement levels in the low, medium, and high 1987 dioxin categories were 117.6 mg/dl, 119.6 mg/dl, 124.6 mg/dl, respectively.

#### 13.2.2.3.45 C3 Complement (Discrete)

The unadjusted and adjusted Model 1 analyses showed no significant difference in the percentage of low C3 complement values between Ranch Hands and Comparisons (Table 13-54(a,b): p>0.19 for each analysis).

**Table 13-54. Analysis of C3 Complement (Discrete)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
			Low		
All	Ranch Hand	859	15 (1.7)	0.76 (0.41,1.44)	0.398
	Comparison	1,231	28 (2.3)		
Officer	Ranch Hand	340	6 (1.8)	0.61 (0.23,1.61)	0.317
	Comparison	490	14 (2.9)		
Enlisted Flyer	Ranch Hand	150	1 (0.7)	0.24 (0.03,2.09)	0.197
	Comparison	185	5 (2.7)		
Enlisted Groundcrew	Ranch Hand	369	8 (2.2)	1.35 (0.51,3.52)	0.544
	Comparison	556	9 (1.6)		

**Table 13-54. Analysis of C3 Complement (Discrete) (Continued)**

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	0.79 (0.42,1.50)	0.474
Officer	0.62 (0.23,1.63)	0.333
Enlisted Flyer	0.27 (0.03,2.33)	0.233
Enlisted Groundcrew	1.41 (0.54,3.71)	0.487

Note: Results are not adjusted for race because of the sparse number of participants with low C3 complement levels.

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (Initial Dioxin) <sup>a</sup>	
Initial Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) <sup>b</sup>
Low	158	1 (0.6)	1.06 (0.45,2.49)
Medium	159	1 (0.6)	
High	159	1 (0.6)	

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

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

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Analysis Results for $\log_2$ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
473	1.01 (0.39,2.62)	0.977

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

Note: Results are not adjusted for race and occupation because of the sparse number of Ranch Hands with low C3 complement levels.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Number (%)	Est. Relative Risk (95% C.I.) <sup>ab</sup>	p-Value
Comparison	1,194	26 (2.2)		
Background RH	376	12 (3.2)	1.28 (0.63,2.57)	0.495
Low RH	236	1 (0.4)	0.20 (0.03,1.46)	0.111
High RH	240	2 (0.8)	0.44 (0.10,1.86)	0.261
Low plus High RH	476	3 (0.6)	0.29 (0.08,1.04)	0.057

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 13-54. Analysis of C3 Complement (Discrete) (Continued)**

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,193		
Background RH	374	1.25 (0.61,2.57)	0.536
Low RH	235	0.21 (0.03,1.57)	0.128
High RH	238	0.49 (0.11,2.17)	0.351
Low plus High RH	473	0.32 (0.09,1.16)	0.083

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

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

Results are not adjusted for race because of the sparse number of participants with low C3 complement levels.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics		Analysis Results for Log <sub>2</sub> (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Low	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	283	10 (3.5)	0.61 (0.41,0.91)
Medium	285	3 (1.1)	
High	284	2 (0.7)	

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq$  7.9 ppt; Medium =  $>$  7.9–19.6 ppt; High =  $>$  19.6 ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

Analysis Results for Log <sub>2</sub> (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
847	0.57 (0.39,0.84)	0.004

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with low C3 complement levels.

The Model 2 unadjusted and adjusted analyses results were nonsignificant (Table 13-54(c,d): p>0.89 for each analysis). Both the unadjusted and adjusted Model 3 analyses revealed marginally significant differences between Ranch Hands in the low and high dioxin categories combined and Comparisons (Table 13-54(e,f): Est. RR=0.29, p=0.057; Adj. RR=0.32, p=0.083, respectively). The percentage of low C3 complement values for Ranch Hands in the low and high dioxin categories combined was 0.6 versus 2.2 in the Comparison category.

The Model 4 unadjusted and adjusted analyses each revealed a significant association between C3 complement and 1987 dioxin (Table 13-54(g,h): Est. RR=0.61, p=0.011; Adj. RR=0.57, p=0.004,

respectively). The percentages of low C3 complement values in the low, medium, and high 1987 dioxin categories were 3.5, 1.1, and 0.7, respectively.

#### 13.2.2.3.46 C4 Complement (Continuous)

The Model 1 unadjusted analysis of C4 complement showed no overall group differences (Table 13-55(a,b):  $p>0.33$  for each analysis). Stratifying by occupation revealed a significant difference between Ranch Hand and Comparison officers, as well as enlisted flyers (Table 13-55(a): difference of means=−0.81 mg/dl,  $p=0.024$ , for the officer stratum; difference of means=1.02 mg/dl,  $p=0.076$ , for the enlisted flyer stratum). After adjusting for covariates, a significant difference between Ranch Hands and Comparisons was noted only among the officer stratum (Table 13-55(b)): difference of adjusted means=−0.90 mg/dl,  $p=0.017$ ). The adjusted mean C4 complement value for Ranch Hand officers was 26.02 mg/dl versus 26.91 mg/dl for Comparison officers.

**Table 13-55. Analysis of C4 Complement (mg/dl) (Continuous)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Mean <sup>a</sup>	Difference of Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	859	25.71	−0.20 --	0.395
	Comparison	1,231	25.91		
Officer	Ranch Hand	340	24.73	−0.81 --	0.024
	Comparison	490	25.54		
Enlisted Flyer	Ranch Hand	150	26.52	1.02 --	0.076
	Comparison	185	25.50		
Enlisted Groundcrew	Ranch Hand	369	26.31	−0.06 --	0.862
	Comparison	556	26.38		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean <sup>a</sup>	Difference of Adj. Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	854	26.98	−0.23 --	0.333
	Comparison	1,229	27.21		
Officer	Ranch Hand	340	26.02	−0.90 --	0.017
	Comparison	489	26.91		
Enlisted Flyer	Ranch Hand	148	27.74	0.98 --	0.104
	Comparison	184	26.77		
Enlisted Groundcrew	Ranch Hand	366	27.61	−0.06 --	0.876
	Comparison	556	27.67		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**Table 13-55. Analysis of C4 Complement (mg/dl) (Continuous) (Continued)**

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics				Analysis Results for $\log_2$ (Initial Dioxin) <sup>b</sup>		
Initial Dioxin	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	R <sup>2</sup>	Slope (Std. Error) <sup>c</sup>	p-Value
Low	158	25.70	25.72	0.002	-0.003 (0.007)	0.701
Medium	159	26.43	26.43			
High	159	26.07	26.05			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Slope and standard error based on natural logarithm of C4 complement versus  $\log_2$  (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin)		
Initial Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adj. Slope (Std. Error) <sup>b</sup>	p-Value
Low	158	26.58	0.019	-0.004 (0.008)	0.638
Medium	158	27.31			
High	157	27.01			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of C4 complement versus  $\log_2$  (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>c</sup>	p-Value <sup>d</sup>
Comparison	1,194	25.91	25.90		
Background RH	376	25.26	25.41	-0.49 --	0.109
Low RH	236	26.07	26.03	0.13 --	0.733
High RH	240	26.06	25.91	0.01 --	0.986
Low plus High RH	476	26.06	25.97	0.07 --	0.816

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>d</sup> P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**Table 13-55. Analysis of C4 Complement (mg/dl) (Continuous) (Continued)**

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adj. Mean <sup>a</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
Comparison	1,193	27.24		
Background RH	374	26.93	-0.31 --	0.336
Low RH	235	27.27	0.03 --	0.942
High RH	238	26.97	-0.27 --	0.494
Low plus High RH	473	27.12	-0.12 --	0.680

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin +1)		
1987 Dioxin	n	Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	25.10	0.004	0.009 (0.005)	0.070
Medium	285	25.85			
High	284	26.19			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of C4 complement versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin +1)		
1987 Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	26.73	0.044	0.001 (0.005)	0.849
Medium	283	27.16			
High	281	27.02			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of C4 complement versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

The unadjusted and adjusted analyses for Models 2 and 3 showed no significant relation between dioxin and C4 complement (Table 13-55(c–f):  $p>0.10$  for each analysis). A marginally significant association between 1987 dioxin and C4 complement was revealed in the unadjusted Model 4 analysis (Table 13-55(g): slope=0.009,  $p=0.070$ ). After covariate adjustment, the adjusted analysis results became nonsignificant (Table 13-55(h):  $p=0.849$ ).

### 13.2.2.3.47 C4 Complement (Discrete)

Because of a sparse number of low C4 complement values among the participants, some analyses were not possible. Table 13-56 contains the results of these analyses.

**Table 13-56. Analysis of C4 Complement (Discrete)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%)	Est. Relative Risk	p-Value
			Low	(95% C.I.)	
<i>All</i>	<i>Ranch Hand</i>	859	2 (0.2)	<i>1.43 (0.20,10.20)</i>	<i>0.719</i>
	<i>Comparison</i>	1,231	2 (0.2)		
Officer	Ranch Hand	340	2 (0.6)	2.89 (0.26,32.04)	0.386
	Comparison	490	1 (0.2)		
Enlisted Flyer	Ranch Hand	150	0 (0.0)	--	0.999 <sup>a</sup>
	Comparison	185	1 (0.5)		
Enlisted Groundcrew	Ranch Hand	369	0 (0.0)	--	--
	Comparison	556	0 (0.0)		

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a low C4 complement level.

--: Results not presented because of the sparse number of participants with a low C4 complement level.

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.46 (0.20,10.59)</i>	<i>0.707</i>
Officer	2.85 (0.26,31.68)	0.394
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a low C4 complement level.

Note: Results for analysis across all occupational categories are not adjusted for race, occupation, and degreasing chemical exposure because of the sparse number of participants with a low C4 complement level; results for individual occupational categories are not adjusted for race and degreasing chemical exposure because of the sparse number of participants with a low C4 complement level.

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>a</sup>	
Initial Dioxin	n	Number (%) Low	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Low	158	0 (0.0)	--	--
Medium	159	0 (0.0)		
High	159	0 (0.0)		

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

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

--: Results not presented because of the sparse number of Ranch Hands with a low C4 complement level.

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**Table 13-56. Analysis of C4 Complement (Discrete) (Continued)**

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Dioxin Category	n	Analysis Results for Log <sub>2</sub> (Initial Dioxin)		p-Value
		Adjusted Relative Risk (95% C.I.) <sup>a</sup>	Number (%) Low	
Comparison	1,194	2 (0.2)		--

--: Results not presented because of the sparse number of Ranch Hands with a low C4 complement level.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Number (%) Low	Est. Relative Risk (95% C.I.) <sup>ab</sup>	p-Value
Comparison	1,194	2 (0.2)		
Background RH	376	2 (0.5)	3.46 (0.47,25.38)	0.222
Low RH	236	0 (0.0)	--	0.999 <sup>c</sup>
High RH	240	0 (0.0)	--	0.999 <sup>c</sup>
Low plus High RH	476	0 (0.0)	--	0.913 <sup>c</sup>

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a low C4 complement level.

--: Results not presented because of the sparse number of Ranch Hands with a low C4 complement level.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,193		
Background RH	374	2.99 (0.40,22.39)	0.286
Low RH	235	--	--
High RH	238	--	--
Low plus High RH	473	--	--

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

--: Results not presented because of the sparse number of Ranch Hands with a low C4 complement level.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for race, occupation, and degreasing chemical exposure because of the sparse number of participants with a low C4 complement level.

**Table 13-56. Analysis of C4 Complement (Discrete) (Continued)**

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Low	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	283	2 (0.7)	0.32 (0.12,0.90)
Medium	285	0 (0.0)	
High	284	0 (0.0)	

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq 7.9$  ppt; Medium =  $> 7.9$ – $19.6$  ppt; High =  $> 19.6$  ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

Analysis Results for $\log_2$ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
847	0.26 (0.08,0.86)	0.024	

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, industrial chemical exposure, and degreasing chemical exposure because of the sparse number of Ranch Hands with a low C4 complement level.

Unadjusted and adjusted results for Models 1 through 3 revealed no significant associations between C4 complement in its dichotomous form and dioxin (Table 13-56(a–f):  $p>0.22$  for each contrast). The unadjusted and adjusted Model 4 analyses revealed a significant relation between C4 complement and 1987 dioxin (Table 13-56(g,h): Est. RR=0.32,  $p=0.033$ ; Adj. RR=0.26,  $p=0.024$ , respectively).

**13.2.2.3.48 Haptoglobin (Continuous)**

The unadjusted and adjusted Model 1 analyses of haptoglobin each revealed a significant overall group difference (Table 13-57(a,b): difference of means=8.7 mg/dl,  $p=0.002$ , for the unadjusted analysis; difference of means=8.0 mg/dl,  $p=0.003$ , for the adjusted analysis). The adjusted mean haptoglobin values for the Ranch Hands were 128.5 mg/dl versus 120.5 mg/dl for the Comparisons. After stratifying by occupation, both the unadjusted and adjusted analyses showed a significant difference in mean haptoglobin levels between Ranch Hands and Comparisons in the enlisted groundcrew stratum (Table 13-57(a,b): difference of means=10.2 mg/dl,  $p=0.016$ , for the unadjusted analysis; difference of adjusted means=9.9 mg/dl,  $p=0.016$ , for the adjusted analysis). The adjusted mean haptoglobin level among Ranch Hand enlisted groundcrew was 137.4 mg/dl versus 127.4 mg/dl among Comparison enlisted groundcrew.

**Table 13-57. Analysis of Haptoglobin (mg/dl) (Continuous)****(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Mean <sup>a</sup>	Difference of Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	859	135.2	8.7 --	0.002
	Comparison	1,231	126.5		
Officer	Ranch Hand	340	122.4	6.1 --	0.140
	Comparison	490	116.3		
Enlisted Flyer	Ranch Hand	150	147.8	10.4 --	0.141
	Comparison	185	137.4		
Enlisted Groundcrew	Ranch Hand	369	142.5	10.2 --	0.016
	Comparison	556	132.3		

<sup>a</sup> Transformed from square root scale.<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.<sup>c</sup> P-value is based on difference of means on square root scale.**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean <sup>a</sup>	Difference of Adj. Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	854	128.5	8.0 --	0.003
	Comparison	1,229	120.5		
Officer	Ranch Hand	340	112.2	5.4 --	0.172
	Comparison	489	106.8		
Enlisted Flyer	Ranch Hand	148	137.3	9.5 --	0.160
	Comparison	184	127.8		
Enlisted Groundcrew	Ranch Hand	366	137.4	9.9 --	0.016
	Comparison	556	127.4		

<sup>a</sup> Transformed from square root scale.<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.<sup>c</sup> P-value is based on difference of means on square root scale.**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin	n	Initial Dioxin Category Summary Statistics		Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>b</sup>		
		Mean <sup>a</sup>	Adj. Mean <sup>a,b</sup>	R <sup>2</sup>	Slope (Std. Error) <sup>c</sup>	p-Value
Low	158	130.2	130.3	0.002	0.084 (0.097)	0.387
Medium	159	144.4	144.5			
High	159	140.0	139.9			

<sup>a</sup> Transformed from square root scale.<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.<sup>c</sup> Slope and standard error based on square root of haptoglobin versus log<sub>2</sub> (initial dioxin).

Note: Low = 27–63 ppt; Medium = &gt;63–152 ppt; High = &gt;152 ppt.

**Table 13-57. Analysis of Haptoglobin (mg/dl) (Continuous) (Continued)**

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin)		
Initial Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adj. Slope (Std. Error) <sup>b</sup>	p-Value
Low	158	118.8	0.066	-0.087 (0.111)	0.433
Medium	158	124.6			
High	157	116.4			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of haptoglobin versus  $\log_2$  (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>c</sup>	p-Value <sup>d</sup>
Comparison	1,194	126.7	126.7		
Background RH	376	131.3	131.4	4.7 --	0.210
Low RH	236	134.6	134.5	7.8 --	0.078
High RH	240	141.8	141.7	15.0 --	0.001
Low plus High RH	476	138.2	138.1	11.4 --	0.001

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.

<sup>d</sup> P-value is based on difference of means on square root scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adj. Mean <sup>a</sup>	Difference of Adj. Mean vs. Comparisons (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
Comparison	1,193	120.9		
Background RH	374	129.8	8.9 --	0.014
Low RH	235	127.5	6.6 --	0.118
High RH	238	128.0	7.1 --	0.105
Low plus High RH	473	127.7	6.8 --	0.036

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on square root scale.

<sup>c</sup> P-value is based on difference of means on square root scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 13-57. Analysis of Haptoglobin (mg/dl) (Continuous) (Continued)**

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin +1)		
1987 Dioxin	n	Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	130.4	0.002	0.074 (0.065)	0.254
Medium	285	132.6			
High	284	142.5			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of haptoglobin versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq 7.9$  ppt; Medium =  $> 7.9$ – $19.6$  ppt; High =  $> 19.6$  ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (1987 Dioxin +1)		
1987 Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adjusted Slope (Std. Error) <sup>b</sup>	p-Value
Low	283	127.4	0.055	-0.116 (0.073)	0.114
Medium	283	125.1			
High	281	124.4			

<sup>a</sup> Transformed from square root scale.

<sup>b</sup> Slope and standard error based on square root of haptoglobin versus  $\log_2$  (1987 dioxin + 1).

Note: Low =  $\leq 7.9$  ppt; Medium =  $> 7.9$ – $19.6$  ppt; High =  $> 19.6$  ppt.

The unadjusted and adjusted Model 2 analyses showed no significant relation between initial dioxin and haptoglobin (Table 13-57(c,d):  $p>0.38$  for each analysis). Three significant contrasts were found in the unadjusted Model 3 analysis of haptoglobin: Ranch Hands in the low dioxin category versus Comparisons (Table 13-57(e): difference of means=7.8 mg/dl,  $p=0.078$ ), Ranch Hands in the high dioxin category versus Comparisons (Table 13-57(e): difference of means=15.0 mg/dl,  $p=0.001$ ), and Ranch Hands in the low and high dioxin categories combined versus Comparisons (Table 13-57(e): difference of means=11.4 mg/dl,  $p=0.001$ ).

After adjusting for covariates, two contrasts were found to be significant in the Model 3 analysis: Ranch Hands in the background dioxin category versus Comparisons and Ranch Hands in the low and high dioxin categories combined versus Comparisons (Table 13-57(f): difference of adjusted means=8.9 mg/dl,  $p=0.014$ ; difference of adjusted means=6.8 mg/dl,  $p=0.036$ , respectively). The adjusted mean haptoglobin levels for Ranch Hands in the background dioxin category, Ranch Hands in the low and high dioxin categories combined, and Comparisons were 129.8 mg/dl, 127.7 mg/dl, and 120.9 mg/dl respectively. No significant relation was determined between 1987 dioxin and haptoglobin in either the unadjusted or adjusted Model 4 analysis (Table 13-57(g,h):  $p>0.11$  for each analysis).

**13.2.2.3.49 Haptoglobin (Discrete)**

A significant overall group difference was revealed in both the unadjusted and adjusted Model 1 analyses of haptoglobin in its discrete form (Table 13-58(a,b): Est. RR=1.26,  $p=0.017$ ; Adj. RR=1.26,  $p=0.020$ , respectively). The percentage of Ranch Hands with high haptoglobin levels was 32.7 versus 27.9 for Comparisons. After stratifying by occupation, both the unadjusted and adjusted analyses revealed a marginally significant difference between Ranch Hands and Comparisons among the enlisted groundcrew

(Table 13-58(a,b): Est. RR=1.30, p=0.063; Adj. RR=1.31, p=0.061, respectively). The percentage of high haptoglobin levels among the Ranch Hand enlisted groundcrew was 37.4 versus 31.5 among the Comparison enlisted groundcrew.

**Table 13-58. Analysis of Haptoglobin (Discrete)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%) High	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	859	281 (32.7)	1.26 (1.04,1.52)	0.017
	Comparison	1,231	343 (27.9)		
Officer	Ranch Hand	340	84 (24.7)	1.19 (0.86,1.65)	0.300
	Comparison	490	106 (21.6)		
Enlisted Flyer	Ranch Hand	150	59 (39.3)	1.29 (0.82,2.01)	0.271
	Comparison	185	62 (33.5)		
Enlisted Groundcrew	Ranch Hand	369	138 (37.4)	1.30 (0.99,1.72)	0.063
	Comparison	556	175 (31.5)		

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	1.26 (1.04,1.52)	0.020
Officer	1.18 (0.85,1.64)	0.316
Enlisted Flyer	1.27 (0.81,2.01)	0.295
Enlisted Groundcrew	1.31 (0.99,1.73)	0.061

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for $\log_2$ (Initial Dioxin)*	
Initial Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Low	158	49 (31.0)	1.05 (0.91,1.21)	0.506
Medium	159	57 (35.8)		
High	159	58 (36.5)		

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

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

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Analysis Results for $\log_2$ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
473	0.98 (0.82,1.16)	0.785

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

**Table 13-58. Analysis of Haptoglobin (Discrete) (Continued)**

**(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED**

Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.) <sup>a,b</sup>	p-Value
Comparison	1,194	337 (28.2)		
Background RH	376	115 (30.6)	1.13 (0.88,1.46)	0.338
Low RH	236	78 (33.1)	1.25 (0.93,1.69)	0.140
High RH	240	86 (35.8)	1.41 (1.05,1.89)	0.023
Low plus High RH	476	164 (34.5)	1.33 (1.06,1.67)	0.015

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

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED**

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,193		
Background RH	374	1.32 (1.01,1.72)	0.042
Low RH	235	1.25 (0.92,1.69)	0.160
High RH	238	1.15 (0.84,1.56)	0.382
Low plus High RH	473	1.19 (0.95,1.51)	0.136

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

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin  $\leq$  10 ppt.

Background (Ranch Hand): 1987 Dioxin  $\leq$  10 ppt.

Low (Ranch Hand): 1987 Dioxin  $>$  10 ppt, 10 ppt  $<$  Initial Dioxin  $\leq$  94 ppt.

High (Ranch Hand): 1987 Dioxin  $>$  10 ppt, Initial Dioxin  $>$  94 ppt.

**(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED**

1987 Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	283	86 (30.4)	1.03 (0.94,1.14)
Medium	285	88 (30.9)	
High	284	105 (37.0)	

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

Note: Low =  $\leq$ 7.9 ppt; Medium =  $>$ 7.9–19.6 ppt; High =  $>$ 19.6 ppt.

**(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED**

Analysis Results for $\log_2$ (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
847	0.91 (0.82,1.02)	0.107

<sup>a</sup> Relative risk for a twofold increase in 1987 dioxin.

No significant relation between initial dioxin and haptoglobin in its discrete form was revealed in either the unadjusted or adjusted Model 2 analyses (Table 13-58(c,d):  $p>0.50$  for each analysis). The unadjusted Model 3 analysis of haptoglobin revealed significant differences between Ranch Hands and Comparisons for Ranch Hands in the high dioxin category and Ranch Hands in the low and high dioxin categories combined (Table 13-58(e): Est. RR=1.41,  $p=0.023$ ; Est. RR=1.33,  $p=0.015$ , respectively). The adjusted Model 3 analysis showed a significant difference between Ranch Hands in the background dioxin category and Comparisons (Table 13-58(f): Adj. RR=1.32,  $p=0.042$ ). The percentages of high haptoglobin values for Ranch Hands in the background dioxin category, Ranch Hands in the high dioxin category, Ranch Hands in the low and high dioxin categories combined, and Comparisons were 30.6, 35.8, 34.5, and 28.2, respectively. The unadjusted and adjusted Model 4 analyses were nonsignificant (Table 13-58(g,h):  $p>0.10$  for each analysis).

### 13.2.2.3.50 Transferrin (Continuous)

The unadjusted and adjusted Model 1 analyses each revealed a significant overall group difference in the mean levels of transferrin (Table 13-59(a,b): difference of means=3.1 mg/dl,  $p=0.044$ , for the unadjusted analysis; difference of adjusted means=3.1 mg/dl,  $p=0.037$ , for the adjusted analysis). The adjusted mean level of transferrin was higher for the Ranch Hands than for the Comparisons (246.2 mg/dl vs. 243.1 mg/dl). Stratifying by occupation uncovered a marginally significant group difference within the enlisted groundcrew stratum in both the unadjusted and adjusted analyses (Table 13-59(a,b): difference of means=4.5 mg/dl,  $p=0.056$ , for the unadjusted analysis; difference of adjusted means=4.2 mg/dl,  $p=0.063$ , for the adjusted analysis). The adjusted mean level of transferrin among Ranch Hand enlisted groundcrew was 247.1 mg/dl versus 242.9 mg/dl among the Comparison enlisted groundcrew.

**Table 13-59. Analysis of Transferrin (mg/dl) (Continuous)**

**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Mean <sup>a</sup>	Difference of Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	859	252.7	3.1 --	0.044
	Comparison	1,231	249.6		
Officer	Ranch Hand	340	250.0	1.6 --	0.510
	Comparison	490	248.4		
Enlisted Flyer	Ranch Hand	150	254.5	3.0 --	0.439
	Comparison	185	251.5		
Enlisted	Ranch Hand	369	254.5	4.5 --	0.056
Groundcrew	Comparison	556	250.0		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**Table 13-59. Analysis of Transferrin (Continuous) (mg/dl) (Continued)**

**(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED**

Occupational Category	Group	n	Adj. Mean <sup>a</sup>	Difference of Adj. Means (95% C.I.) <sup>b</sup>	p-Value <sup>c</sup>
All	Ranch Hand	854	246.2	3.1 --	0.037
	Comparison	1,229	243.1		
Officer	Ranch Hand	340	243.5	1.9 --	0.412
	Comparison	489	241.6		
Enlisted Flyer	Ranch Hand	148	247.9	3.1 --	0.404
	Comparison	184	244.8		
Enlisted Groundcrew	Ranch Hand	366	247.1	4.2 --	0.063
	Comparison	556	242.9		

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

<sup>c</sup> P-value is based on difference of means on natural logarithm scale.

**(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>b</sup>			
Initial Dioxin	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	R <sup>2</sup>	Slope (Std. Error) <sup>c</sup>	p-Value
Low	158	251.5	251.5	0.001	0.003 (0.005)	0.594
Medium	159	254.8	254.8			
High	159	255.6	255.5			

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin.

<sup>c</sup> Slope and standard error based on natural logarithm of transferrin versus log<sub>2</sub> (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.

**(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED**

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>2</sub> (Initial Dioxin)			
Initial Dioxin	n	Adj. Mean <sup>a</sup>	R <sup>2</sup>	Adj. Slope (Std. Error) <sup>b</sup>	p-Value	
Low	158	247.6	0.014	-0.001 (0.006)	0.798	
Medium	158	249.2				
High	157	249.2				

<sup>a</sup> Transformed from natural logarithm scale.

<sup>b</sup> Slope and standard error based on natural logarithm of transferrin versus log<sub>2</sub> (initial dioxin).

Note: Low = 27–63 ppt; Medium = >63–152 ppt; High = >152 ppt.