

Table 11-8. Analysis of Visual Fields (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
476	4.37 (0.84,22.64)		0.049

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, industrial chemicals exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with abnormal visual fields.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)^b	p-Value
Comparison	1,207	5 (0.4)		
Background RH	380	1 (0.3)	0.70 (0.08,6.09)	0.746
Low RH	239	0 (0.0)	--	0.694 ^c
High RH	240	1 (0.4)	0.92 (0.11,8.03)	0.940
Low plus High RH	479	1 (0.2)	--	0.853 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with abnormal visual fields.

--: Results not presented because of the sparse number of participants with abnormal visual fields.

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.)^a		
Comparison	1,189			
Background RH	375	0.86 (0.10,7.83)		0.897
Low RH	235	--		--
High RH	236	0.57 (0.06,5.52)		0.629
Low plus High RH	471	--		--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of participants with abnormal visual fields.

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 11-8. Analysis of Visual Fields (Continued)

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

1987 Dioxin Category Summary Statistics			Analysis Results for $\log_2 (1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	287	1 (0.4)	1.43 (0.62,3.31)	0.421
Medium	287	0 (0.0)		
High	285	1 (0.4)		

^a Relative risk for a twofold increase in 1987 dioxin.

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

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

Analysis Results for $\log_2 (1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
853	1.40 (0.58,3.38)	0.456

^a Relative risk for a twofold increase in 1987 dioxin

Note: Results are not adjusted for race, occupation, insecticide exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with abnormal visual fields.

11.2.2.2.3 Light Reaction

More Comparisons than Ranch Hands had an abnormal light reaction, and the unadjusted and adjusted Model 1 analyses combining all occupations were significant (Table 11-9(a,b): Est. RR=0.12, p=0.007 for the unadjusted analysis; and Adj. RR=0.13, p=0.010 for the adjusted analysis). Results were nonsignificant when examined separately for each occupation in both the unadjusted and adjusted analyses (Table 11-9(a,b): p>0.17 for each remaining Model 1 contrast).

Table 11-9. Analysis of Light Reaction

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	861	1 (0.1)	0.12 (0.02,0.92)	0.007
	<i>Comparison</i>	1,247	12 (1.0)		
Officer	Ranch Hand	336	0 (0.0)	--	0.399 ^a
	Comparison	493	3 (0.6)		
Enlisted Flyer	Ranch Hand	151	1 (0.7)	0.31 (0.03,2.76)	0.291
	Comparison	187	4 (2.1)		
Enlisted Groundcrew	Ranch Hand	374	0 (0.0)	--	0.173 ^a
	Comparison	567	5 (0.9)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with an abnormal light reaction.

--: Results not presented because of the sparse number of participants with an abnormal light reaction.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED			
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value	
<i>All</i>	0.13 (0.02,0.98)	0.010	
Officer	--	--	
Enlisted Flyer	0.36 (0.04,3.38)	0.371	
Enlisted Groundcrew	--	--	

--: Results not presented because of the sparse number of participants with an abnormal light reaction.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics	Analysis Results for Log ₂ (Initial Dioxin)			
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.)	p-Value
Low	160	0 (0.0)	--	--
Medium	162	0 (0.0)		
High	156	0 (0.0)		

--: Results not presented because of the sparse number of participants with an abnormal light reaction.

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

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Adjusted Results for Log ₂ (Initial Dioxin)		Adjusted Relative Risk (95% C.I.)	
		Adjusted Relative Risk (95% C.I.)	p-Value
		--	--

--: Results not presented because of the sparse number of participants with an abnormal light reaction.

Table 11-9. Analysis of Light Reaction (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,209	11 (0.9)		
Background RH	376	1 (0.3)	0.30 (0.04,2.35)	0.252
Low RH	239	0 (0.0)	--	0.283 ^c
High RH	239	0 (0.0)	--	0.283 ^c
Low plus High RH	478	0 (0.0)	--	0.079 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with an abnormal light reaction.

--: Results not presented because of the sparse number of participants with an abnormal light reaction.

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.) ^a	p-Value
Comparison	1,191		
Background RH	371	0.38 (0.05,3.03)	0.359
Low RH	235	--	--
High RH	235	--	--
Low plus High RH	470	--	--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of participants with an abnormal light reaction.

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 (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	284	0 (0.0)	0.77 (0.18,3.29)	0.715
Medium	286	1 (0.4)		
High	284	0 (0.0)		

^a 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 11-9. Analysis of Light Reaction (Continued)

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

Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk	
	(95% C.I.) ^a	p-Value
848	0.75 (0.18,3.12)	0.681

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, industrial chemicals exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of participants with an abnormal light reaction.

The Model 2 analysis of light reaction was not possible because of the absence of any Ranch Hands with an abnormal light reaction and an initial dioxin estimate.

The unadjusted Model 3 analysis displayed a marginally significant difference between Ranch Hands in the low plus high dioxin category and Comparisons (Table 11-9(e): $p=0.079$). The percentage of participants with an abnormal light reaction was 0.0 percent for Ranch Hands in the low plus high category and 0.9 percent for Comparisons. All other Model 3 contrasts examined, as well as the Model 4 analysis results, were nonsignificant (Table 11-9(e-h): $p>0.25$ for each remaining Model 3 contrast and Model 4 analysis).

11.2.2.2.4 Ocular Movement

All results from the analyses of ocular movement from Models 1 through 4 were nonsignificant (Table 11-10(a-h): $p>0.15$ for each analysis).

Table 11-10. Analysis of Ocular Movement

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

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	866	14 (1.6)	1.19 (0.58,2.43)	0.632
	<i>Comparison</i>	1,249	17 (1.4)		
Officer	Ranch Hand	340	2 (0.6)	0.58 (0.11,2.99)	0.513
	Comparison	493	5 (1.0)		
Enlisted Flyer	Ranch Hand	151	3 (2.0)	1.87 (0.31,11.37)	0.494
	Comparison	187	2 (1.1)		
Enlisted Groundcrew	Ranch Hand	375	9 (2.4)	1.37 (0.55,3.42)	0.493
	Comparison	569	10 (1.8)		

Table 11-10. Analysis of Ocular Movement (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED			
Occupational Category	Adjusted Relative Risk (95% C.I.)		p-Value
<i>All</i>	<i>1.17 (0.56,2.42)</i>		<i>0.675</i>
Officer	0.56 (0.11,2.90)		0.485
Enlisted Flyer	1.76 (0.29,10.81)		0.543
Enlisted Groundcrew	1.37 (0.54,3.45)		0.508

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED			
Initial Dioxin Category Summary Statistics		Analysis Results for \log_2 (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b
Low	160	4 (2.5)	0.77 (0.44,1.32)
Medium	162	4 (2.5)	
High	157	2 (1.3)	

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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.) ^a	p-Value	
471	0.74 (0.40,1.36)	0.318	

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race and insecticide exposure because of the sparse number of participants with an abnormal ocular movement.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,211	14 (1.2)		
Background RH	380	4 (1.1)	0.93 (0.30,2.85)	0.896
Low RH	239	5 (2.1)	1.82 (0.65,5.10)	0.256
High RH	240	5 (2.1)	1.79 (0.63,5.04)	0.271
Low plus High RH	479	10 (2.1)	1.80 (0.79,4.10)	0.159

^a Relative risk and confidence interval relative to Comparisons.

^b 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 11-10. Analysis of Ocular Movement (Continued)

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

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,193		
Background RH	375	1.18 (0.37,3.73)	0.781
Low RH	235	1.76 (0.61,5.07)	0.291
High RH	236	1.32 (0.45,3.83)	0.614
Low plus High RH	471	1.52 (0.65,3.55)	0.328

^a 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 $\log_2(1987 \text{ Dioxin} + 1)$		
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value	
Low	287	3 (1.1)	1.09 (0.77,1.54)	0.643	
Medium	287	5 (1.7)			
High	285	6 (2.1)			

^a 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.

11-10(f) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED		
Analysis Results for $\log_2(1987 \text{ Dioxin} + 1)$		
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
1.09	0.91 (0.43,1.32)	0.614

^a Relative risk for a twofold increase in 1987 dioxin.

11.2.2.2.5 Facial Sensation

All analyses of facial sensation in Models 1 through 4 were nonsignificant (Table 11-11(a–h): $p > 0.45$ for each analysis).

Table 11-11. Analysis of Facial Sensation**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	865	2 (0.2)	1.44 (0.20,10.27)	0.714
	<i>Comparison</i>	1,248	2 (0.2)		
Officer	Ranch Hand	339	1 (0.3)	1.46 (0.09,23.35)	0.791
	Comparison	493	1 (0.2)		
Enlisted Flyer	Ranch Hand	151	0 (0.0)	--	0.999 ^a
	Comparison	187	1 (0.5)		
Enlisted Groundcrew	Ranch Hand	375	1 (0.3)	--	0.834 ^a
	Comparison	568	0 (0.0)		

^aP-value determined using a chi-square test with continuity correction because of the sparse number of participants with an abnormal facial sensation.

--: Results not presented because of the sparse number of participants with an abnormal facial sensation.

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.38 (0.19,9.87)	0.750
Officer	1.45 (0.09,23.48)	0.792
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with an abnormal facial sensation.

Note: Results are not adjusted for race, insecticide exposure, and diabetic class because of the sparse number of participants with an abnormal facial sensation.

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

Initial Dioxin Category Summary Statistics		Analysis Results for Log ₂ (Initial Dioxin) ^a		
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b	
Low	160	1 (0.6)	0.45 (0.04,5.19)	0.455
Medium	162	0 (0.0)		
High	157	0 (0.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

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

Table 11-11. Analysis of Facial Sensation (Continued)

MOTEL 2: RANCH HANDS: INITIAL DIOXIN: UNADJUSTED			
Adjusted Model for Log (Initial Dioxin)			
		Adjusted Relative Risk	P-Value
	475	0.55 (0.06, 5.16)	0.553

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, industrial chemicals exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with an abnormal facial sensation.

MOTEL 2: RANCH HANDS: INITIAL DIOXIN: UNADJUSTED				
Adjusted Model for Log (Initial Dioxin)				
		Adjusted Relative Risk	P-Value	95% CI
Comparison	1,210	1 (0.2)		
Background RH	379	1 (0.3)	1.77 (0.16,19.96)	0.646
Low RH	239	1 (0.4)	2.46 (0.22,27.39)	0.463
High RH	240	0 (0.0)	--	0.999 ^c
Low plus High RH	479	1 (0.2)	--	0.999 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with an abnormal facial sensation.

--: Results not presented because of the sparse number of participants with an abnormal facial sensation.

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 11-11. Analysis of Facial Sensation (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,209		
Background RH	376	1.70 (0.14,19.96)	0.672
Low RH	238	2.04 (0.18,23.31)	0.564
High RH	238	--	--
Low plus High RH	476	--	--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of participants with an abnormal facial sensation.

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, insecticide exposure, and diabetic class because of the sparse number of participants with an abnormal facial sensation.

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

1987 Dioxin Category Summary Statistics			Analysis Results for $\text{Log}_2(1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	286	1 (0.4)	0.75 (0.27,2.11)	0.572
Medium	287	1 (0.4)		
High	285	0 (0.0)		

^a 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 $\text{Log}_2(1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
852	0.79 (0.23,2.66)	0.694

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, and diabetic class because of the sparse number of Ranch Hands with an abnormal facial sensation.

11.2.2.2.6 Corneal Reflex

Statistical analysis of corneal reflex was not performed because of the absence of abnormalities among Ranch Hands. A corneal reflex abnormality was noted in one Black enlisted groundcrew Comparison.

11.2.2.7 Jaw Clench

Each result obtained from the analyses of jaw clench conducted from Models 1 through 4 was nonsignificant (Table 11-12(a-h): $p>0.32$ for each analysis).

Table 11-12. Analysis of Jaw Clench

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Deviated	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	866	2 (0.2)	--	0.327 ^a
	<i>Comparison</i>	1,249	0 (0.0)		
Officer	Ranch Hand	340	2 (0.6)	--	0.325 ^a
	Comparison	493	0 (0.0)		
Enlisted Flyer	Ranch Hand	151	0 (0.0)	--	--
	Comparison	187	0 (0.0)		
Enlisted	Ranch Hand	375	0 (0.0)	--	--
Groundcrew	Comparison	569	0 (0.0)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a deviated jaw clench.

--: Results not presented because of the sparse number of participants with a deviated jaw clench.

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	--	--
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a deviated jaw clench.

Table 11-12. Analysis of Jaw Clench (Continued)

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

Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Deviated	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	160	0 (0.0)	0.59 (0.09,3.87)	0.539
Medium	162	1 (0.6)		
High	157	0 (0.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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.) ^a	p-Value
476	0.59 (0.08,4.24)	0.562

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, industrial chemicals exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with a deviated jaw clench.

Model 3: RANCH HANDS AND CTE IMPAIRMENTS BY DIOXIN CATEGORIES – UNADJUSTED				
Initial Dioxin	n	Number (%) Deviated	Est. Relative Risk (95% C.I.)	p-Value
Comparison	1,211	0 (0.0)		
Background RH	380	1 (0.3)	--	0.540 ^a
Low RH	239	1 (0.4)	--	0.366 ^a
High RH	240	0 (0.0)	--	--
Low plus High RH	479	1 (0.2)	--	0.631 ^a

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a deviated jaw clench.

--: Results not presented because of the sparse number of participants with a deviated jaw clench.

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 11-12. Analysis of Jaw Clench (Continued)

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

Dioxin Category	n	Adjusted Relative Risk (95% C.I.)	p-Value
Comparison	--	--	--
Background RH	--	--	--
Low RH	--	--	--
High RH	--	--	--
Low plus High RH	--	--	--

--: Results not presented because of the sparse number of participants with a deviated jaw clench.

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 (%) Deviated	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	287	0 (0.0)	0.92 (0.35,2.44)	0.864
Medium	287	2 (0.7)		
High	285	0 (0.0)		

^a 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.) ^a	p-Value
853	1.02 (0.34,3.08)	0.969

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, and diabetic class because of the sparse number of Ranch Hands with a deviated jaw clench.

11.2.2.2.8 Smile

Each result obtained from the analyses of smile conducted from Models 1 through 4 was nonsignificant (Table 11-13(a–h): $p \geq 0.11$ for each analysis).

Table 11-13. Analysis of Smile

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	866	7 (0.8)	2.54 (0.74,8.69)	0.129
	<i>Comparison</i>	1,249	4 (0.3)		
Officer	Ranch Hand	340	1 (0.3)	0.72 (0.07,8.02)	0.793
	Comparison	493	2 (0.4)		
Enlisted Flyer	Ranch Hand	151	1 (0.7)	--	0.915 ^a
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	375	5 (1.3)	3.83 (0.74,19.85)	0.110
	Comparison	569	2 (0.4)		

^aP-value determined using a chi-square test with continuity correction because of the sparse number of participants with an abnormal smile.

--: Results not presented because of the sparse number of participants with an abnormal smile.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	2.45 (0.71,8.50)	0.149
Officer	0.71 (0.06,7.91)	0.777
Enlisted Flyer	--	--
Enlisted Groundcrew	3.62 (0.69,19.00)	0.128

--: Results not presented because of the sparse number of participants with an abnormal smile.

Note: Results are not adjusted for diabetic class because of the sparse number of participants with an abnormal smile.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED		
Initial Dioxin Category Summary Statistics		Analysis Results for Log ₂ (Initial Dioxin) ^a
Initial Dioxin	n	Number (%) Abnormal
Low	160	1 (0.6)
Medium	162	1 (0.6)
High	157	2 (1.3)

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

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

Table 11-13. Analysis of Smile (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log_2 (Initial Dioxin)			
		Adjusted Relative Risk (95% C.I.) ^a	p-Value
	n	1.50 (0.75,3.02)	0.274

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, industrial chemicals exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with an abnormal smile.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,211	4 (0.3)		
Background RH	380	3 (0.8)	2.61 (0.57,11.87)	0.214
Low RH	239	2 (0.8)	2.49 (0.45,13.68)	0.295
High RH	240	2 (0.8)	2.35 (0.42,13.05)	0.328
Low plus High RH	479	4 (0.8)	2.42 (0.60,9.77)	0.215

^a Relative risk and confidence interval relative to Comparisons.

^b 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.) ^a	p-Value
Comparison	1,210		
Background RH	377	3.14 (0.65,15.08)	0.152
Low RH	238	2.38 (0.42,13.43)	0.326
High RH	238	1.80 (0.30,10.67)	0.517
Low plus High RH	476	2.07 (0.50,8.57)	0.315

^a 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 diabetic class because of the sparse number of Ranch Hands with an abnormal smile.

Table 11-13. Analysis of Smile (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 (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value	
Low	287	2 (0.7)	1.16 (0.72,1.88)	0.541	
Medium	287	2 (0.7)			
High	285	3 (1.1)			

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤ 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.) ^a	p-Value		
	853	0.99 (0.59,1.65)	0.972		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for diabetic class because of the sparse number of Ranch Hands with an abnormal smile.

11.2.2.2.9 Palpebral Fissure

All results from the analyses of palpebral fissure from Models 1 through 4 were nonsignificant (Table 11-14(a–h): $p > 0.32$ for each analysis).

Table 11-14. Analysis of Palpebral Fissure

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	866	7 (0.8)	0.84 (0.33,2.14)	0.713
	Comparison	1,249	12 (1.0)		
Officer	Ranch Hand	340	2 (0.6)	0.58 (0.11,2.99)	0.513
	Comparison	493	5 (1.0)		
Enlisted Flyer	Ranch Hand	151	1 (0.7)	1.24 (0.08,19.99)	0.879
	Comparison	187	1 (0.5)		
Enlisted Groundcrew	Ranch Hand	375	4 (1.1)	1.01 (0.28,3.61)	0.986
	Comparison	569	6 (1.1)		

Table 11-14. Analysis of Palpebral Fissure (Continued)

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	0.71 (0.26,1.94)	0.502
Officer	0.63 (0.12,3.31)	0.582
Enlisted Flyer	0.87 (0.05,14.32)	0.921
Enlisted Groundcrew	0.90 (0.25,3.27)	0.876

Note: Results are not adjusted for diabetic class because of the sparse number of participants with an abnormal palpebral fissure. Results for analyses stratified by occupation also are not adjusted for lifetime alcohol history because of the sparse number of participants with an abnormal palpebral fissure.

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

Initial Dioxin	Initial Dioxin Category Summary Statistics		Analysis Results for \log_2 (Initial Dioxin) ^a	
	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	160	2 (1.3)	1.15 (0.50,2.64)	0.750
Medium	162	0 (0.0)		
High	157	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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)	
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
476	1.25 (0.54,2.93)	0.613

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with an abnormal palpebral fissure.

Table 11-14. Analysis of Palpebral Fissure (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,211	12 (1.0)		
Background RH	380	4 (1.1)	1.20 (0.38,3.78)	0.759
Low RH	239	2 (0.8)	0.81 (0.18,3.66)	0.785
High RH	240	1 (0.4)	0.37 (0.05,2.91)	0.347
Low plus High RH	479	3 (0.6)	0.55 (0.14,2.10)	0.381

^a Relative risk and confidence interval relative to Comparisons.

^b 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.)^a	p-Value	
Comparison	1,210			
Background RH	377	0.96 (0.26,3.60)	0.955	
Low RH	238	0.79 (0.17,3.64)	0.761	
High RH	238	0.35 (0.04,2.84)	0.324	
Low plus High RH	476	0.52 (0.13,2.05)	0.352	

^a 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 diabetic class because of the sparse number of participants with an abnormal palpebral fissure.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics		Analysis Results for Log₂ (1987 Dioxin + 1)		
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.)^a	p-Value
Low	287	2 (0.7)	1.05 (0.64,1.73)	0.840
Medium	287	4 (1.4)		
High	285	1 (0.4)		

^a 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 11-14. Analysis of Palpebral Fissure (Continued)

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

Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
853	1.17 (0.65,2.12)	0.598

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, and diabetic class because of the sparse number of participants with an abnormal palpebral fissure.

11.2.2.2.10 Balance

All results from the analyses of balance from Models 1 through 4 were nonsignificant (Table 11-15(a-h): $p>0.12$ for each analysis).

Table 11-15. Analysis of Balance

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

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	866	7 (0.8)	1.44 (0.50,4.13)	0.494
	<i>Comparison</i>	1,248	7 (0.6)		
Officer	Ranch Hand	340	5 (1.5)	3.66 (0.71,19.00)	0.122
	Comparison	493	2 (0.4)		
Enlisted Flyer	Ranch Hand	151	0 (0.0)	--	0.999 ^a
	Comparison	186	1 (0.5)		
Enlisted	Ranch Hand	375	2 (0.5)	0.76 (0.14,4.16)	0.749
Groundcrew	Comparison	569	4 (0.7)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with abnormal balance.

--: Results not presented because of the sparse number of participants with abnormal balance.

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.38 (0.47,4.03)	0.553
Officer	3.37 (0.64,17.73)	0.151
Enlisted Flyer	--	--
Enlisted Groundcrew	0.73 (0.13,4.07)	0.719

--: Results not presented because of the sparse number of participants with abnormal balance.

Table 11-15. Analysis of Balance (Continued)

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

Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	160	0 (0.0)	1.27 (0.48,3.35)	0.638
Medium	162	1 (0.6)		
High	157	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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.) ^a	p-Value
476	1.65 (0.61,4.45)	0.350

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, and diabetic class because of the sparse number of Ranch Hands with abnormal balance.

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

Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^{a,b}	p-Value
Comparison	1,210	7 (0.6)		
Background RH	380	5 (1.3)	2.52 (0.78,8.10)	0.121
Low RH	239	1 (0.4)	0.70 (0.09,5.74)	0.741
High RH	240	1 (0.4)	0.66 (0.08,5.43)	0.699
Low plus High RH	479	2 (0.4)	0.68 (0.14,3.31)	0.633

^a Relative risk and confidence interval relative to Comparisons.

^b 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 11-15. Analysis of Balance (Continued)

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

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,192		
Background RH	375	2.54 (0.74,8.72)	0.138
Low RH	235	0.63 (0.08,5.24)	0.667
High RH	236	0.63 (0.07,5.49)	0.672
Low plus High RH	471	0.63 (0.13,3.11)	0.567

^a 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 $\text{Log}_2(1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	287	3 (1.1)	0.88 (0.52,1.50)	0.642
Medium	287	2 (0.7)		
High	285	2 (0.7)		

^a 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 $\text{Log}_2(1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
846	0.95 (0.52,1.73)	0.860

^a 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 balance.

11.2.2.2.11 Gag Reflex

Because of the absence of gag reflex abnormalities among Ranch Hands, statistical analysis was not performed. One gag reflex abnormality was present for a non-Black enlisted flyer Comparison.

11.2.2.12 Speech

The Model 2 adjusted analysis of speech revealed a marginally significant inverse association between initial dioxin and speech (Table 11-16(d): Adj. RR=0.19, p=0.078). All other analysis results from Models 1 through 4 were nonsignificant (Table 11-16(a-c,e-h): p>0.14 for each remaining analysis).

Table 11-16. Analysis of Speech

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	866	4 (0.5)	0.57 (0.18,1.84)	0.334
	<i>Comparison</i>	1,249	10 (0.8)		
Officer	Ranch Hand	340	1 (0.3)	0.72 (0.07,8.02)	0.793
	Comparison	493	2 (0.4)		
Enlisted Flyer	Ranch Hand	151	0 (0.0)	--	0.999 ^a
	Comparison	187	1 (0.5)		
Enlisted Groundcrew	Ranch Hand	375	3 (0.8)	0.65 (0.17,2.52)	0.531
	Comparison	569	7 (1.2)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with abnormal speech.

--: Results not presented because of the sparse number of participants with abnormal speech.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	0.60 (0.18,1.97)	0.388
Officer	0.76 (0.07,8.59)	0.828
Enlisted Flyer	--	--
Enlisted Groundcrew	0.66 (0.16,2.63)	0.551

--: Results not presented because of the sparse number of participants with abnormal speech.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED			
Initial Dioxin Category Summary Statistics		Analysis Results for Log ₂ (Initial Dioxin)*	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b
Low	160	2 (1.3)	0.29 (0.03,2.42)
Medium	162	0 (0.0)	
High	157	0 (0.0)	

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

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

Table 11-16. Analysis of Speech (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
		Adjusted Relative Risk	
n		(95% C.I.) ^a	p-Value
476		0.19 (0.02,2.32)	0.078

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for occupation and diabetic class because of the sparse number of Ranch Hands with abnormal speech.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
Comparison	1,211	9 (0.7)		
Background RH	380	2 (0.5)	0.81 (0.17,3.83)	0.793
Low RH	239	2 (0.8)	1.07 (0.23,5.02)	0.929
High RH	240	0 (0.0)	--	0.374 ^c
Low plus High RH	479	2 (0.4)	--	0.678 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with abnormal speech.

--: Results not presented because of the sparse number of participants with abnormal speech.

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.) ^a	p-Value
Comparison	1,193		
Background RH	375	1.09 (0.22,5.46)	0.919
Low RH	235	1.38 (0.28,6.71)	0.688
High RH	236	--	--
Low plus High RH	471	--	--

^a 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.

Table 11-16. Analysis of Speech (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED					
1987 Dioxin Category Summary Statistics			Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value	
Low	287	2 (0.7)	0.77 (0.37,1.59)	0.462	
Medium	287	2 (0.7)			
High	285	0 (0.0)			

^a Relative risk for a twofold increase in 1987 dioxin.

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

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED					
Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$			Adjusted Relative Risk		
	n		(95% C.I.) ^a	p-Value	
	853		0.73 (0.36,1.47)	0.370	

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for occupation and diabetic class because of the sparse number of Ranch Hands with abnormal speech.

11.2.2.2.13 Tongue Position Relative to Midline

Each result obtained from the Model 1 through 4 analyses of tongue position relative to midline was nonsignificant (Table 11-17(a–h)): $p > 0.32$ for each analysis).

Table 11-17. Analysis of Tongue Position Relative to Midline

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Deviated	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	866	2 (0.2)	--	0.327 ^a
	Comparison	1,249	0 (0.0)		
Officer	Ranch Hand	340	2 (0.6)	--	0.325 ^a
	Comparison	493	0 (0.0)		
Enlisted Flyer	Ranch Hand	151	0 (0.0)	--	--
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	375	0 (0.0)	--	--
	Comparison	569	0 (0.0)		

^aP-value determined using a chi-square test with continuity correction because of the sparse number of participants with a deviated tongue position relative to midline.

--: Results not presented because of the sparse number of participants with a deviated tongue position relative to midline.

Table 11-17. Analysis of Tongue Position Relative to Midline (Continued)

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	--	--
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a deviated tongue position relative to midline.

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

Initial Dioxin Category Summary Statistics		Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Deviated	Estimated Relative Risk (95% C.I.) ^b
Low	160	0 (0.0)	0.59 (0.09,3.87)
Medium	162	1 (0.6)	
High	157	0 (0.0)	

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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)	
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
476	0.59 (0.08,4.24)	0.562

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, industrial chemicals exposure, degreasers chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with a deviated tongue position relative to midline.

Table 11-17. Analysis of Tongue Position Relative to Midline (Continued)

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

Dioxin Category	n	Number (%) Deviated	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,211	0 (0.0)		
Background RH	380	1 (0.3)	--	0.540 ^c
Low RH	239	1 (0.4)	--	0.366 ^c
High RH	240	0 (0.0)	--	--
Low plus High RH	479	1 (0.2)	--	0.631 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a deviated tongue position relative to midline.

--: Results not presented because of the sparse number of participants with a deviated tongue position relative to midline.

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.)	p-Value
Comparison	--		
Background RH	--	--	--
Low RH	--	--	--
High RH	--	--	--
Low plus High RH	--	--	--

--: Results not presented because of the sparse number of participants with a deviated tongue position relative to midline.

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 (%) Deviated	Estimated Relative Risk (95% C.I.) ^a
Low	287	0 (0.0)	0.92 (0.35,2.44)
Medium	287	2 (0.7)	
High	285	0 (0.0)	

^a 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 11-17. Analysis of Tongue Position Relative to Midline (Continued)

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

Analysis Results for $\log_2 (1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
853	1.02 (0.34,3.08)	0.969

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, and diabetic class because of the sparse number of Ranch Hands with a deviated tongue position relative to midline.

11.2.2.14 Palate and Uvula Movement

Each result obtained from the Model 1 through 4 analyses of the palate and uvula movement was nonsignificant (Table 11-18(a-h): $p>0.36$ for each analysis).

Table 11-18. Analysis of Palate and Uvula Movement

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

Occupational Category	Group	n	Number (%) Deviated	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	866	1 (0.1)	--	0.854 ^a
	Comparison	1,249	0 (0.0)		
Officer	Ranch Hand	340	1 (0.3)	--	0.852 ^a
	Comparison	493	0 (0.0)		
Enlisted Flyer	Ranch Hand	151	0 (0.0)	--	--
	Comparison	187	0 (0.0)		
Enlisted	Ranch Hand	375	0 (0.0)	--	--
Groundcrew	Comparison	569	0 (0.0)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a deviated palate and uvula movement.

--: Results not presented because of the sparse number of participants with a deviated palate and uvula movement.

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	--	--
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a deviated palate and uvula movement.

Table 11-18. Analysis of Palate and Uvula Movement (Continued)

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

Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Deviated	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	160	0 (0.0)	0.59 (0.09,3.87)	0.539
Medium	162	1 (0.6)		
High	157	0 (0.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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.) ^a	p-Value
476	0.59 (0.08,4.24)	0.562

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, industrial chemicals exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with a deviated palate and uvula movement.

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

Dioxin Category	n	Number (%) Deviated	Est. Relative Risk (95% C.I.)	p-Value
Comparison	1,211	0 (0.0)		
Background RH	380	0 (0.0)	--	--
Low RH	239	1 (0.4)	--	0.366 ^a
High RH	240	0 (0.0)	--	--
Low plus High RH	479	1 (0.2)	--	0.631 ^a

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a deviated palate and uvula movement.

--: Results not presented because of the sparse number of participants with a deviated palate and uvula movement.

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 11-18. Analysis of Palate and Uvula Movement (Continued)

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

Dioxin Category	n	Adjusted Relative Risk (95% C.I.)	p-Value
Comparison	--		
Background RH	--	--	--
Low RH	--	--	--
High RH	--	--	--
Low plus High RH	--	--	--

--: Results not presented because of the sparse number of participants with a deviated palate and uvula movement.

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 $\log_2 (1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Number (%) Deviated	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	287	0 (0.0)	1.13 (0.31,4.05)	0.857
Medium	287	1 (0.4)		
High	285	0 (0.0)		

^a 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 $\log_2 (1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
853	1.19 (0.32,4.46)	0.800

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, industrial chemicals exposure, degreasing chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with a deviated palate and uvula movement.

11.2.2.15 Cranial Nerve Index

All results from the analyses of cranial nerve index from Models 1 through 4 were nonsignificant (Table 11-19(a-h): $p \geq 0.11$ for each analysis).

Table 11-19. Analysis of Cranial Nerve Index

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

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	850	56 (6.6)	<i>1.15 (0.80,1.65)</i>	<i>0.452</i>
	<i>Comparison</i>	1,245	72 (5.8)		
Officer	Ranch Hand	329	17 (5.2)	0.98 (0.52,1.83)	0.941
	Comparison	492	26 (5.3)		
Enlisted Flyer	Ranch Hand	151	13 (8.6)	1.66 (0.71,3.89)	0.246
	Comparison	186	10 (5.4)		
Enlisted Groundcrew	Ranch Hand	370	26 (7.0)	1.11 (0.66,1.88)	0.683
	Comparison	567	36 (6.4)		

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.01 (0.69,1.48)</i>	<i>0.940</i>
Officer	0.88 (0.46,1.68)	0.694
Enlisted Flyer	1.23 (0.49,3.08)	0.656
Enlisted Groundcrew	1.05 (0.61,1.80)	0.856

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

Initial Dioxin Category Summary Statistics		Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b
Low	157	13 (8.3)	0.86 (0.63,1.17)
Medium	162	9 (5.6)	
High	153	8 (5.2)	

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

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

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED

Analysis Results for Log ₂ (Initial Dioxin)		
	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.75 (0.53,1.16)</i>	<i>0.110</i>

^a Relative risk for a twofold increase in initial dioxin.

Table 11-19. Analysis of Cranial Nerve Index (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^{a,b}	p-Value
Comparison	1,207	68 (5.6)		
Background RH	371	25 (6.7)	1.27 (0.79,2.05)	0.329
Low RH	236	19 (8.1)	1.45 (0.86,2.47)	0.166
High RH	236	11 (4.7)	0.78 (0.41,1.51)	0.469
Low plus High RH	472	30 (6.4)	1.07 (0.68,1.69)	0.776

^a Relative risk and confidence interval relative to Comparisons.

^b 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.) ^a	p-Value
Comparison	1,189		
Background RH	366	1.20 (0.72,2.02)	0.484
Low RH	232	1.29 (0.74,2.24)	0.369
High RH	232	0.60 (0.30,1.22)	0.158
Low plus High RH	464	0.88 (0.54,1.43)	0.604

^a 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 _e (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a
Low	280	18 (6.4)	0.93 (0.77,1.13)
Medium	282	21 (7.5)	
High	281	16 (5.7)	

^a 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 11-19. Analysis of Cranial Nerve Index (Continued)

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

Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
830	0.88 (0.71,1.10)	0.254

^a Relative risk for a twofold increase in 1987 dioxin.

11.2.2.3 Physical Examination Variables – Musculoskeletal and Vertebral Column Function

11.2.2.3.1 Neck Range of Motion

From the Model 1 unadjusted and adjusted analyses of neck range of motion, differences between Ranch Hands and Comparisons were significant across all occupations and within enlisted flyers (Table 11-20(a,b): Est. RR=1.33, p=0.016, Adj. RR=1.35, p=0.015, respectively, for all occupations combined; Est. RR=2.03, p=0.009; Adj. RR=1.97, p=0.016, respectively, for enlisted flyers). Both contrasts showed more Ranch Hands than Comparisons with a restricted neck range of motion. All other Model 1 contrasts were nonsignificant (Table 11-20(a,b): p>0.12 for each remaining contrast).

Table 11-20. Analysis of Neck Range of Motion

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

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	866	165 (19.1)	1.33 (1.06,1.67)	0.016
	<i>Comparison</i>	1,249	188 (15.1)		
Officer	Ranch Hand	340	70 (20.6)	1.32 (0.92,1.88)	0.126
	Comparison	493	81 (16.4)		
Enlisted Flyer	Ranch Hand	151	41 (27.2)	2.03 (1.19,3.46)	0.009
	Comparison	187	29 (15.5)		
Enlisted Groundcrew	Ranch Hand	375	54 (14.4)	1.06 (0.73,1.54)	0.764
	Comparison	569	78 (13.7)		

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.35 (1.06,1.72)	0.015
Officer	1.31 (0.90,1.89)	0.153
Enlisted Flyer	1.97 (1.13,3.42)	0.016
Enlisted Groundcrew	1.16 (0.78,1.71)	0.466

Table 11-20. Analysis of Neck Range of Motion (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for \log_2 (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	160	38 (23.8)	0.85 (0.72,1.02)	0.069
Medium	162	39 (24.1)		
High	157	26 (16.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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.) ^a	p-Value	
471	0.91 (0.74,1.13)	0.411	

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^b	p-Value
Comparison	1,211	180 (14.9)		
Background RH	380	60 (15.8)	1.16 (0.84,1.60)	0.366
Low RH	239	56 (23.4)	1.73 (1.23,2.43)	0.002
High RH	240	47 (19.6)	1.31 (0.91,1.87)	0.142
Low plus High RH	479	103 (21.5)	1.50 (1.15,1.97)	0.003

^a Relative risk and confidence interval relative to Comparisons.

^b 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 11-20. Analysis of Neck Range of Motion (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,193		
Background RH	375	1.12 (0.80,1.57)	0.523
Low RH	235	1.60 (1.12,2.29)	0.010
High RH	236	1.55 (1.05,2.29)	0.028
Low plus High RH	471	1.57 (1.18,2.11)	0.002

^a 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 (%) Abnormal	Estimated Relative Risk (95% C.I.)^a
Low	287	48 (16.7)	1.03 (0.92,1.15)
Medium	287	60 (20.9)	
High	285	55 (19.3)	

^a 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.)^a	p-Value	
846	1.09 (0.94,1.26)	0.267	

^a Relative risk for a twofold increase in 1987 dioxin.

The unadjusted Model 2 analysis displayed a marginally significant inverse association between neck range of motion and initial dioxin (Table 11-20(c): Est. RR=0.85, p=0.069). After adjustment for covariates, the association was nonsignificant (Table 11-20(d): p=0.411).

Both the unadjusted and adjusted Model 3 analyses of neck range of motion displayed a significant difference between Ranch Hands in the low dioxin category and Comparisons (Table 11-20(e,f): Est. RR=1.73, p=0.002 and Adj. RR=1.60, p=0.010) and between Ranch Hands in the low plus high dioxin category and Comparisons (Table 11-20(e,f): Est. RR=1.50, p=0.003 and Adj. RR=1.57, p=0.002). In addition, the adjusted contrast between Ranch Hands in the high category and Comparisons was significant (Table 11-20(f): Adj. RR=1.55, p=0.028). All significant contrasts showed more Ranch

Hands than Comparisons with neck range of motion abnormalities. Other Model 3 contrasts, as well as the Model 4 analyses of neck range of motion, were nonsignificant (Table 11-20(e-h): $p>0.14$ for each remaining analysis).

11.2.2.4 Physical Examination Variables – Peripheral Nerve Status

11.2.2.4.1 Pinprick

A marginally significant difference between Ranch Hands in the high dioxin category and Comparisons was found in the Model 3 unadjusted analysis of pinprick, showing more Ranch Hands than Comparisons with a pinprick abnormality (Table 11-21(e): Est. RR=1.64, $p=0.062$). After adjustment for covariates, the difference was nonsignificant (Table 11-21(f): $p=0.126$). All other analysis results from Models 1 through 4 for pinprick were nonsignificant (Table 11-21(a-h): $p\geq0.11$ for each remaining analysis).

Table 11-21. Analysis of Pinprick

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

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	822	57 (6.9)	1.24 (0.86,1.79)	0.244
	<i>Comparison</i>	1,185	67 (5.7)		
Officer	Ranch Hand	322	20 (6.2)	1.35 (0.72,2.51)	0.350
	Comparison	469	22 (4.7)		
Enlisted Flyer	Ranch Hand	145	19 (13.1)	1.81 (0.87,3.75)	0.110
	Comparison	182	14 (7.7)		
Enlisted Groundcrew	Ranch Hand	355	18 (5.1)	0.87 (0.48,1.57)	0.638
	Comparison	534	31 (5.8)		

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.19 (0.81,1.76)	0.368
Officer	1.28 (0.67,2.43)	0.451
Enlisted Flyer	1.81 (0.84,3.89)	0.131
Enlisted Groundcrew	0.85 (0.45,1.60)	0.618

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

Initial Dioxin Category	Summary Statistics		Analysis Results for Log ₂ (Initial Dioxin) ^a	
	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	152	11 (7.2)	1.10 (0.86,1.41)	0.460
Medium	151	13 (8.6)		
High	150	12 (8.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

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

Table 11-21. Analysis of Pinprick (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
445	1.29 (0.92,1.81)		0.134

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,149	63 (5.5)		
Background RH	362	19 (5.3)	1.03 (0.61,1.76)	0.900
Low RH	226	15 (6.6)	1.20 (0.67,2.15)	0.542
High RH	227	21 (9.3)	1.64 (0.98,2.76)	0.062
Low plus High RH	453	36 (8.0)	1.40 (0.91,2.16)	0.123

^a Relative risk and confidence interval relative to Comparisons.

^b 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.)^a	p-Value
Comparison	1,132		
Background RH	357	1.11 (0.63,1.95)	0.716
Low RH	222	0.95 (0.51,1.77)	0.868
High RH	223	1.55 (0.88,2.73)	0.126
Low plus High RH	445	1.21 (0.77,1.93)	0.410

^a 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.

Table 11-21. Analysis of Pinprick (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED					
1987 Dioxin Category Summary Statistics			Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value	
Low	272	15 (5.5)	1.15 (0.96,1.37)		0.137
Medium	275	16 (5.8)			
High	268	24 (9.0)			

^a Relative risk for a twofold increase in 1987 dioxin.

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

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED					
Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$					
	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value		
	802	1.12 (0.88,1.42)	0.345		

^a Relative risk for a twofold increase in 1987 dioxin.

11.2.2.4.2 Light Touch

All results from the analyses of light touch from Models 1 through 4 were nonsignificant (Table 11-22(a-h): $p>0.16$ for each analysis).

Table 11-22. Analysis of Light Touch

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	822	38 (4.6)	1.23 (0.79,1.91)	0.363
	<i>Comparison</i>	1,185	45 (3.8)		
Officer	Ranch Hand	322	15 (4.7)	1.71 (0.80,3.65)	0.163
	Comparison	469	13 (2.8)		
Enlisted Flyer	Ranch Hand	145	12 (8.3)	1.55 (0.65,3.70)	0.322
	Comparison	182	10 (5.5)		
Enlisted Groundcrew	Ranch Hand	355	11 (3.1)	0.74 (0.36,1.55)	0.432
	Comparison	534	22 (4.1)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED					
Occupational Category		Adjusted Relative Risk (95% C.I.)	p-Value		
<i>All</i>		1.13 (0.71,1.81)	0.597		
Officer		1.67 (0.77,3.61)		0.193	
Enlisted Flyer		1.40 (0.56,3.50)		0.470	
Enlisted Groundcrew		0.67 (0.31,1.47)		0.321	

Table 11-22. Analysis of Light Touch (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	152	9 (5.9)	0.92 (0.66,1.28)	0.616
Medium	151	7 (4.6)		
High	150	7 (4.7)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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.) ^a		p-Value
	445	1.01 (0.65,1.59)		0.956

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,149	43 (3.7)		
Background RH	362	13 (3.6)	1.01 (0.54,1.92)	0.965
Low RH	226	12 (5.3)	1.42 (0.74,2.74)	0.295
High RH	227	11 (4.9)	1.25 (0.63,2.46)	0.528
Low plus High RH	453	23 (5.1)	1.33 (0.79,2.24)	0.283

^a Relative risk and confidence interval relative to Comparisons.

^b 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 11-22. Analysis of Light Touch (Continued)

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

Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,132		
Background RH	357	1.07 (0.54,2.10)	0.852
Low RH	222	1.12 (0.55,2.27)	0.751
High RH	223	1.09 (0.53,2.26)	0.808
Low plus High RH	445	1.11 (0.64,1.93)	0.718

^a 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 (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	272	11 (4.0)	1.02 (0.81,1.28)	0.865
Medium	275	12 (4.4)		
High	268	13 (4.9)		

^a 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.) ^a	p-Value
802	1.01 (0.75,1.36)	0.940

^a Relative risk for a twofold increase in 1987 dioxin.

11.2.2.4.3 Muscle Status

Both the unadjusted and adjusted Model 1 analyses of muscle status displayed a marginally significant difference between Ranch Hands and Comparisons (Table 11-23(a,b)): Est. RR=1.54, p=0.064 and Adj. RR=1.50, p=0.094). The contrast of Ranch Hand and Comparison enlisted groundcrew revealed a marginally significant result in the unadjusted analysis and a significant result in the adjusted analysis (Table 11-23(a,b)): Est. RR=2.06, p=0.062 and Adj. RR=2.24, p=0.046). Both contrasts showed more Ranch Hands than Comparisons with a muscle status abnormality. All other Model 1 contrasts, as well as the Model 2 analysis of muscle status, were nonsignificant (Table 11-23(a-d): p>0.23 for each remaining Model 1 contrast and each Model 2 analysis).

Table 11-23. Analysis of Muscle Status**(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	866	39 (4.5)	1.54 (0.98,2.44)	0.064
	<i>Comparison</i>	1,248	37 (3.0)		
Officer	Ranch Hand	340	13 (3.8)	1.05 (0.51,2.17)	0.897
	Comparison	493	18 (3.7)		
Enlisted Flyer	Ranch Hand	151	10 (6.6)	1.82 (0.68,4.91)	0.235
	Comparison	187	7 (3.7)		
Enlisted Groundcrew	Ranch Hand	375	16 (4.3)	2.06 (0.97,4.42)	0.062
	Comparison	568	12 (2.1)		

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.50 (0.93,2.40)	0.094
Officer	0.98 (0.47,2.05)	0.960
Enlisted Flyer	1.72 (0.63,4.70)	0.289
Enlisted Groundcrew	2.24 (1.01,4.93)	0.046

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

Initial Dioxin Category Summary Statistics			Analysis Results for \log_2 (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	160	10 (6.3)	0.87 (0.62,1.23)	0.418
Medium	162	9 (5.6)		
High	157	5 (3.2)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.^b 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)		
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
471	0.95 (0.64,1.41)	0.792

^a Relative risk for a twofold increase in initial dioxin.

Table 11-23. Analysis of Muscle Status (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,210	35 (2.9)		
Background RH	380	14 (3.7)	1.23 (0.65,2.31)	0.530
Low RH	239	14 (5.9)	2.11 (1.12,3.99)	0.021
High RH	240	10 (4.2)	1.52 (0.74,3.12)	0.254
Low plus High RH	479	24 (5.0)	1.79 (1.05,3.06)	0.033

^a Relative risk and confidence interval relative to Comparisons.

^b 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.) ^a	p-Value	
Comparison	1,192			
Background RH	375	1.22 (0.63,2.35)	0.550	
Low RH	235	1.90 (0.98,3.66)	0.056	
High RH	236	1.58 (0.73,3.39)	0.242	
Low plus High RH	471	1.73 (0.99,3.04)	0.056	

^a 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			Analysis Results for Log ₂ (1987 Dioxin + 1)	
1987 Dioxin Category	Summary Statistics		Estimated Relative Risk (95% C.I.) ^a	p-Value
1987 Dioxin	n	Number (%) Abnormal		
Low	287	10 (3.5)	1.02 (0.82,1.27)	0.863
Medium	287	15 (5.2)		
High	285	13 (4.6)		

^a 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 11-23. Analysis of Muscle Status (Continued)

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

Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
846	0.98 (0.76,1.27)	0.897

^a Relative risk for a twofold increase in 1987 dioxin.

The Model 3 unadjusted analysis revealed significantly more Ranch Hands in the low dioxin category with an abnormal muscle status than Comparisons (Table 11-23(e): Est. RR=2.11, p=0.021). Significantly more Ranch Hands in the low plus high dioxin category than Comparisons also had an abnormal muscle status (Table 11-23(e): Est. RR=1.79, p=0.033). Both contrasts were marginally significant in the adjusted analysis (Table 11-23(f): Adj. RR=1.90, p=0.056 for the low dioxin category contrast; and Adj. RR=1.73, p=0.056 for the low plus high dioxin category contrast). All other Model 3 contrasts, as well as the Model 4 analysis results, were nonsignificant (Table 11-23(e-h): p>0.24 for each remaining analysis).

11.2.2.4.4 Patellar Reflex

The Model 1 analysis of the patellar reflex revealed a marginally significant difference between Ranch Hands and Comparison enlisted flyers in both the unadjusted and adjusted analyses (Table 11-24(a,b): Est. RR=0.17, p=0.100 and Adj. RR=0.16, p=0.089). The prevalence of a patellar reflex abnormality was higher among Comparisons than Ranch Hands. All other Model 1 contrasts were nonsignificant (Table 11-24(a,b): p>0.40 for each remaining Model 1 contrast).

Table 11-24. Analysis of Patellar Reflex

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

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	865	24 (2.8)	0.99 (0.58,1.67)	0.962
	<i>Comparison</i>	1,246	35 (2.8)		
Officer	Ranch Hand	340	12 (3.5)	1.09 (0.51,2.34)	0.823
	Comparison	493	16 (3.3)		
Enlisted Flyer	Ranch Hand	151	1 (0.7)	0.17 (0.02,1.40)	0.100
	Comparison	186	7 (3.8)		
Enlisted	Ranch Hand	374	11 (2.9)	1.40 (0.61,3.21)	0.425
Groundcrew	Comparison	567	12 (2.1)		

Table 11-24. Analysis of Patellar Reflex (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS - ADJUSTED			
Occupational Category	Adjusted Relative Risk (95% C.I.)		p-Value
All	0.97 (0.56,1.67)		0.910
Officer	1.05 (0.48,2.29)		0.901
Enlisted Flyer	0.16 (0.02,1.32)		0.089
Enlisted Groundcrew	1.43 (0.61,3.34)		0.408

(c) MODEL 2: RANCH HANDS - INITIAL DIOXIN - UNADJUSTED			
Initial Dioxin Category Summary Statistics		Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b
Low	159	5 (3.1)	1.18 (0.82,1.71)
Medium	162	3 (1.9)	
High	157	7 (4.5)	

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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.) ^a	p-Value
	470	1.81 (1.10,2.99)	0.019

^a Relative risk for a twofold increase in initial dioxin.

Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,209	33 (2.7)		
Background RH	380	9 (2.4)	0.91 (0.43,1.93)	0.812
Low RH	238	7 (2.9)	1.06 (0.46,2.44)	0.882
High RH	240	8 (3.3)	1.17 (0.53,2.58)	0.693
Low plus High RH	478	15 (3.1)	1.12 (0.60,2.08)	0.727

^a Relative risk and confidence interval relative to Comparisons.

^b 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 11-24. Analysis of Patellar Reflex (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,191		
Background RH	375	0.88 (0.40,1.91)	0.742
Low RH	234	0.86 (0.37,2.02)	0.737
High RH	236	1.39 (0.60,3.26)	0.446
Low plus High RH	470	1.10 (0.57,2.10)	0.778

^a 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 $\text{Log}_2 (1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a
Low	287	8 (2.8)	1.08 (0.83,1.42)
Medium	286	7 (2.5)	
High	285	9 (3.2)	

^a 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 $\text{Log}_2 (1987 \text{ Dioxin} + 1)$			
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value	
845	1.15 (0.80,1.64)	0.447	

^a Relative risk for a twofold increase in 1987 dioxin.

The unadjusted Model 2 analysis of patellar reflex was nonsignificant (Table 11-24(c): $p=0.374$). After adjustment for covariates, a significant positive association between patellar reflex and initial dioxin was revealed (Table 11-24(d): Adj. RR=1.81, $p=0.019$). As initial dioxin increased in Ranch Hands, the prevalence of an abnormal patellar reflex increased.

All results from the analyses of patellar reflex from Models 3 and 4 were nonsignificant (Table 11-24(e–h): $p>0.44$ for each Model 3 and 4 analysis).

11.2.2.4.5 Achilles Reflex

The Model 2 adjusted analysis revealed a marginally significant association between an abnormal Achilles reflex and initial dioxin (Table 11-25 (d): Adj. RR=1.22, p=0.075). The marginally significant result indicates that Achilles reflex abnormalities increased in Ranch Hands as the initial dioxin levels increased. All other analysis results for Achilles reflex from Models 1 through 4 were nonsignificant (Table 11-25(a-h): p>0.15 for each analysis).

Table 11-25. Analysis of Achilles Reflex

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	865	153 (17.7)	1.10 (0.88,1.39)	0.410
	<i>Comparison</i>	1,244	203 (16.3)		
Officer	Ranch Hand	340	67 (19.7)	1.22 (0.86,1.75)	0.267
	Comparison	491	82 (16.7)		
Enlisted Flyer	Ranch Hand	151	30 (19.9)	1.00 (0.58,1.71)	0.995
	Comparison	186	37 (19.9)		
Enlisted Groundcrew	Ranch Hand	374	56 (15.0)	1.01 (0.70,1.46)	0.947
	Comparison	567	84 (14.8)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED			
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value	
<i>All</i>	1.07 (0.84,1.37)	0.594	
Officer	1.17 (0.80,1.70)	0.413	
Enlisted Flyer	0.91 (0.51,1.60)	0.737	
Enlisted Groundcrew	1.05 (0.71,1.55)	0.815	

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED			
Initial Dioxin Category Summary Statistics		Analysis Results for \log_2 (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b
Low	160	29 (18.1)	1.04 (0.87,1.23)
Medium	162	31 (19.1)	
High	157	33 (21.0)	

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

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

Table 11-25. Analysis of Achilles Reflex (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.) ^a		
471	1.22 (0.98,1.51)		0.075

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,206	197 (16.3)		
Background RH	379	57 (15.0)	0.99 (0.72,1.37)	0.963
Low RH	239	46 (19.3)	1.20 (0.84,1.71)	0.325
High RH	240	47 (19.6)	1.16 (0.81,1.65)	0.425
Low plus High RH	479	93 (19.4)	1.18 (0.89,1.55)	0.247

^a Relative risk and confidence interval relative to Comparisons.

^b 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 5: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value	
Comparison	1,188			
Background RH	374	0.96 (0.68,1.35)	0.811	
Low RH	235	0.97 (0.66,1.42)	0.880	
High RH	236	1.32 (0.89,1.95)	0.168	
Low plus High RH	471	1.13 (0.84,1.52)	0.416	

^a 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.

Table 11-25. Analysis of Achilles Reflex (Continued)

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

1987 Dioxin Category Summary Statistics		Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
1987 Dioxin	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	286	44 (15.4)	1.07 (0.95,1.21)	0.250
Medium	287	49 (17.1)		
High	285	57 (20.0)		

^a Relative risk for a twofold increase in 1987 dioxin.

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

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

Analysis Results for $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
845	1.12 (0.96,1.31)	0.157

^a Relative risk for a twofold increase in 1987 dioxin.

11.2.2.4.6 Biceps Reflex

A significant increase of Ranch Hands in the low dioxin category relative to Comparisons was found from the unadjusted Model 3 analysis of the biceps reflex (Table 11-26(e): Est. RR=2.88, p=0.029). The result was marginally significant in the adjusted analysis (Table 11-26(f): Adj. RR=2.52, p=0.064). All other Model 3 contrasts, as well as all other analysis results from Models 1, 2, and 4, were nonsignificant (Table 11-26(a–h): p ≥ 0.12 for all remaining analyses).

Table 11-26. Analysis of Biceps Reflex

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

Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	866	12 (1.4)	1.45 (0.65,3.24)	0.369
	Comparison	1,248	12 (1.0)		
Officer	Ranch Hand	340	5 (1.5)	1.21 (0.37,4.00)	0.753
	Comparison	493	6 (1.2)		
Enlisted Flyer	Ranch Hand	151	2 (1.3)	1.24 (0.17,8.92)	0.830
	Comparison	187	2 (1.1)		
Enlisted Groundcrew	Ranch Hand	375	5 (1.3)	1.91 (0.51,7.14)	0.339
	Comparison	568	4 (0.7)		

Table 11-26. Analysis of Biceps Reflex (Continued)

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	1.31 (0.57,3.05)	0.527
Officer	1.13 (0.33,3.80)	0.848
Enlisted Flyer	1.34 (0.18,9.89)	0.776
Enlisted Groundcrew	1.61 (0.39,6.58)	0.509

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

Initial Dioxin	Initial Dioxin Category Summary Statistics		Analysis Results for Log ₂ (Initial Dioxin) ^a	
	n	Number (%) Abnormal	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	160	3 (1.9)	0.72 (0.41,1.24)	0.203
Medium	162	6 (3.7)		
High	157	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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)	
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
471	0.87 (0.44,1.70)	0.675

^a Relative risk for a twofold increase in initial dioxin.

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

Dioxin Category	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,210	12 (1.0)		
Background RH	380	2 (0.5)	0.61 (0.14,2.77)	0.524
Low RH	239	7 (2.9)	2.88 (1.12,7.44)	0.029
High RH	240	3 (1.3)	1.10 (0.30,3.96)	0.887
Low plus High RH	479	10 (2.1)	1.78 (0.73,4.35)	0.209

^a Relative risk and confidence interval relative to Comparisons.

^b 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 11-26. Analysis of Biceps Reflex (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,192		
Background RH	375	0.27 (0.03,2.13)	0.213
Low RH	235	2.52 (0.95,6.70)	0.064
High RH	236	1.37 (0.35,5.29)	0.651
Low plus High RH	471	1.85 (0.73,4.69)	0.193

^a 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 $\text{Log}_2(1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	287	0 (0.0)	1.16 (0.80,1.68)
Medium	287	8 (2.8)	0.437
High	285	4 (1.4)	

^a 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 $\text{Log}_2(1987 \text{ Dioxin} + 1)$			
	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
	846	1.52 (0.89,2.61)	0.120

^a Relative risk for a twofold increase in 1987 dioxin.

11.2.2.4.7 Babinski Reflex

All analysis results from Models 1 through 3 for Babinski reflex were nonsignificant (Table 11-27(a–f): $p > 0.23$ for each analysis). The result from the unadjusted Model 4 analysis of Babinski reflex was marginally significant and inverse in direction (Table 11-27(g): Est. RR=0.58, $p=0.056$). After adjustment for covariates, the association between Babinski reflex and the 1987 dioxin levels was nonsignificant (Table 11-27(h): $p=0.223$).

Table 11-27. Analysis of Babinski Reflex

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Abnormal	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	866	8 (0.9)	0.88 (0.36,2.14)	0.785
	Comparison	1,246	13 (1.0)		
Officer	Ranch Hand	340	3 (0.9)	2.18 (0.36,13.12)	0.394
	Comparison	492	2 (0.4)		
Enlisted Flyer	Ranch Hand	151	1 (0.7)	0.40 (0.04,3.93)	0.435
	Comparison	185	3 (1.6)		
Enlisted Groundcrew	Ranch Hand	375	4 (1.1)	0.76 (0.23,2.53)	0.650
	Comparison	569	8 (1.4)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	0.81 (0.31,2.10)	0.666
Officer	2.16 (0.35,13.17)	0.403
Enlisted Flyer	0.36 (0.04,3.59)	0.385
Enlisted Groundcrew	0.64 (0.16,2.51)	0.526

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED		
Initial Dioxin Category Summary Statistics		Analysis Results for \log_2 (Initial Dioxin) ^a
Initial Dioxin	n	Number (%) Abnormal
Low	160	1 (0.6)
Medium	162	0 (0.0)
High	157	1 (0.6)

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b 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.) ^b	p-Value
476	1.08 (0.34,3.42)	0.896

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, insecticide exposure, industrial chemicals exposure, and diabetic class because of the sparse number of Ranch Hands with an abnormal Babinski reflex.