

**Table 10-23. Analysis of Malignant Systemic Neoplasms (Bronchus and Lung)  
(Continued)**

<b>(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED</b>			
<b>Dioxin Category</b>	<b>n</b>	<b>Adjusted Relative Risk</b>	
		<b>(95% C.I.)<sup>a</sup></b>	<b>p-Value</b>
Comparison	1,209		
Background RH	375	1.52 (0.21,11.09)	0.678
Low RH	232	8.67 (1.74,43.23)	0.008
High RH	240	--	--
Low plus High RH	472	--	--

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

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the bronchus and lung.

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 a malignant systemic neoplasm of the bronchus and lung.

<b>(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED</b>			
<b>1987 Dioxin Category Summary Statistics</b>		<b>Analysis Results for Log<sub>2</sub> (1987 Dioxin + 1)</b>	
<b>1987 Dioxin</b>	<b>n</b>	<b>Number (%)</b>	<b>Estimated Relative Risk</b>
		<b>Yes</b>	<b>(95% C.I.)<sup>a</sup></b>
Low	286	1 (0.4)	0.98 (0.64,1.50)
Medium	282	6 (2.1)	
High	286	3 (1.1)	

<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.

<b>(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED</b>			
<b>Analysis Results for Log<sub>2</sub> (1987 Dioxin + 1)</b>			
<b>n</b>	<b>Adjusted Relative Risk</b>		<b>p-Value</b>
	<b>(95% C.I.)<sup>a</sup></b>		
847	1.15 (0.63,2.11)		0.638

<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 a malignant systemic neoplasm of the bronchus and lung. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The Model 2 analysis of a malignant systemic neoplasm of the bronchus and lung revealed a significant inverse association with initial dioxin (Table 10-23(c): Est. RR=0.46, p=0.030). After adjustment for covariates, the association was nonsignificant (Table 10-23(d): p=0.144).

A significantly greater percentage of Ranch Hands in the low dioxin category had a malignant systemic neoplasm of the bronchus and lung than Comparisons in both the unadjusted and adjusted Model 3 analyses (Table 10-23(e): Est. RR=14.26, p<0.001; Adj. RR=8.67, p=0.008, respectively). The Model 4 unadjusted and adjusted analyses of malignant systemic neoplasms of the bronchus and lung revealed nonsignificant results (Table 10-23(g,h): p=0.638).

#### 10.2.2.1.24 Malignant Systemic Neoplasms (Liver)

Because of the sparse number of participants with a malignant systemic neoplasm of the liver, analysis was limited. All Model 1 analyses were nonsignificant (Table 10-24(a,b): p>0.65). Results from the Model 2 analysis of malignant systemic neoplasms of the liver also were nonsignificant (Table 10-24(c,d): p≥0.14 for all analyses).

**Table 10-24. Analysis of Malignant Systemic Neoplasms (Liver)**

<b>(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED</b>					
Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	861	2 (0.2)	1.45 (0.20,10.33)	0.710
	<i>Comparison</i>	1,249	2 (0.2)		
Officer	Ranch Hand	335	0 (0.0)	--	0.999 <sup>a</sup>
	Comparison	494	1 (0.2)		
Enlisted Flyer	Ranch Hand	149	1 (0.7)	--	0.909 <sup>a</sup>
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	1 (0.3)	1.51 (0.09,24.18)	0.772
	Comparison	568	1 (0.2)		

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the liver.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the liver.

<b>(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED</b>		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.57 (0.22,11.35)	0.655
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	1.72 (0.11,27.93)	0.703

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the liver.

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of the liver. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

**Table 10-24. Analysis of Malignant Systemic Neoplasms (Liver) (Continued)**

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

Initial Dioxin	n	Initial Dioxin Category Summary Statistics		Analysis Results for $\text{Log}_2$ (Initial Dioxin) <sup>a</sup>	
		Number (%)	Yes	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Low	156	0 (0.0)		1.76 (0.73,4.22)	0.231
Medium	161	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**

n	Analysis Results for $\text{Log}_2$ (Initial Dioxin)		p-Value
	Adjusted Relative Risk (95% C.I.) <sup>a</sup>		
472	2.06 (0.82,5.15)		0.140

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

Note: Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of participants with a malignant systemic neoplasm of the liver. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

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

Dioxin Category	n	Number (%)	Est. Relative Risk (95% C.I.) <sup>a,b</sup>	p-Value
		Yes		
Comparison	1,211	2 (0.2)		
Background RH	378	0 (0.0)	--	0.999 <sup>c</sup>
Low RH	234	0 (0.0)	--	0.999 <sup>c</sup>
High RH	242	2 (0.8)	5.70 (0.78,41.53)	0.086
Low plus High RH	476	2 (0.4)	--	0.680 <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 malignant systemic neoplasm of the liver.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the liver.

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 10-24. Analysis of Malignant Systemic Neoplasms (Liver) (Continued)**

<b>(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED</b>			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,209		
Background RH	375	--	--
Low RH	232	--	--
High RH	240	7.06 (0.70,71.25)	0.098
Low plus High RH	472	--	--

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

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the liver.

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 Ranch Hands with a malignant systemic neoplasm of the liver. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

<b>(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED</b>			
1987 Dioxin Category Summary Statistics		Analysis Results for $\text{Log}_2(1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	286	0 (0.0)	2.10 (0.92,4.78)
Medium	282	0 (0.0)	
High	286	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.

<b>(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED</b>			
Analysis Results for $\text{Log}_2(1987 \text{ Dioxin} + 1)$			
Adjusted Relative Risk			
n		(95% C.I.) <sup>a</sup>	p-Value
847		2.52 (1.03,6.15)	0.042

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

Note: Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of participants with a malignant systemic neoplasm of the liver. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The unadjusted and adjusted Model 3 analyses displayed a marginally significant difference between Ranch Hands in the high dioxin category and Comparisons (Table 10-24(e,f): Est. RR=5.70, p=0.086; Adj. RR=7.06, p=0.098, respectively). The percentage of Ranch Hands in the high dioxin category with a malignant systemic neoplasm of the liver was greater than the percentage of Comparisons. The results in all other Model 3 unadjusted analyses were nonsignificant (Table 10-24(e): p≥0.68).

The Model 4 unadjusted analysis revealed a marginally significant positive association between 1987 dioxin levels and a malignant systemic neoplasm of the liver (Table 10-24(g): Est. RR=2.10, p=0.080). After adjustment for covariates, the result was significant (Table 10-24(h): Est. RR=2.52, p=0.042).

#### 10.2.2.1.25 *Malignant Systemic Neoplasms (Colon and Rectum)*

All results from the analyses of malignant systemic neoplasms of the colon and rectum from Models 1, 2, and 4 were nonsignificant (Table 10-25(a-d,g-h): p>0.29 for each analysis).

**Table 10-25. Analysis of Malignant Systemic Neoplasms (Colon and Rectum)**

<b>(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED</b>					
Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	861	7 (0.8)	1.27 (0.46,3.52)	0.645
	Comparison	1,249	8 (0.6)		
Officer	Ranch Hand	335	3 (0.9)	2.22 (0.37,13.38)	0.383
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	2 (1.3)	1.26 (0.18,9.04)	0.819
	Comparison	187	2 (1.1)		
Enlisted	Ranch Hand	377	2 (0.5)	0.75 (0.14,4.13)	0.743
Groundcrew	Comparison	568	4 (0.7)		

#### Adjusted Relative Risk

Occupational Category	(95% C.I.)	p-Value
All	1.50 (0.41,5.47)	0.536
Officer	2.59 (0.37,17.95)	0.335
Enlisted Flyer	1.57 (0.19,13.30)	0.678
Enlisted Groundcrew	0.85 (0.13,5.78)	0.872

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of the colon and rectum.

**Table 10-25. Analysis of Malignant Systemic Neoplasms (Colon and Rectum) (Continued)**

**(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
Low	156	0 (0.0)	0.76 (0.39,1.49)	0.405
Medium	161	5 (3.1)		
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)		p-Value
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	
472	0.93 (0.42,2.07)	0.855

<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 a malignant systemic neoplasm of the colon and rectum. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

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

Dioxin Category	n	Number (%)	Est. Relative Risk (95% C.I.) <sup>a,b</sup>	p-Value
Comparison	1,211	8 (0.7)		
Background RH	378	1 (0.3)	0.49 (0.06,3.94)	0.500
Low RH	234	5 (2.1)	3.02 (0.97,9.45)	0.057
High RH	242	1 (0.4)	0.51 (0.06,4.15)	0.528
Low plus High RH	476	6 (1.3)	1.22 (0.33,4.51)	0.764

<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 10-25. Analysis of Malignant Systemic Neoplasms (Colon and Rectum) (Continued)**

**(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	1,209			
Background RH	375	0.60 (0.06,5.76)		0.658
Low RH	232	3.28 (0.77,13.90)		0.107
High RH	240	0.57 (0.05,5.85)		0.632
Low plus High RH	472	1.34 (0.27,6.56)		0.717

<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 a malignant systemic neoplasm of the colon and rectum.

**(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 (%) Yes	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Low	286	1 (0.4)	1.18 (0.74,1.91)	0.495
Medium	282	2 (0.7)		
High	286	4 (1.4)		

<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	1.44 (0.72,2.86)	0.291

<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 a malignant systemic neoplasm of the colon and rectum. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The Model 3 unadjusted analysis of malignant systemic neoplasms of the colon and rectum displayed a marginally significant difference between Ranch Hands in the low dioxin category and Comparisons. The occurrence of a malignant systemic neoplasm of the colon and rectum was higher for Ranch Hands in the low dioxin category than for Comparisons (Table 10-25(e): Est. RR=3.02, p=0.057). The result was

nonsignificant after adjustment for covariates (Table 10-25(f):  $p=0.107$ ). All other Model 3 contrasts were nonsignificant (Table 10-25(e,f):  $p\geq0.50$ ).

#### 10.2.2.1.26 *Malignant Systemic Neoplasms (Kidney and Bladder)*

Because of the sparse number of participants with a history of a malignant systemic neoplasm of the kidney or bladder, analysis was limited. Across all occupations, the difference between Ranch Hands and Comparisons was significant, with more malignant systemic neoplasms of the kidney and bladder occurring in Ranch Hands than in Comparisons (Table 10-26(a): Est. RR=2.68,  $p=0.046$ ). After adjustment for covariates, the result was marginally significant (Table 10-26(b): Adj. RR=3.12,  $p=0.061$ ). All other Model 1 contrasts, as well as the results from the Model 2 and Model 4 analyses, were nonsignificant (Table 10-26(a-d,g-h):  $p>0.17$ ).

**Table 10-26. Analysis of Malignant Systemic Neoplasms (Kidney and Bladder)**

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

Occupational Category	Group	n	Number (%)		Est. Relative Risk (95% C.I.)	p-Value
			Yes	No		
<i>All</i>	<i>Ranch Hand</i>	861	11 (1.3)	849 (98.7)	2.68 (0.99,7.28)	0.046
	<i>Comparison</i>	1,249	6 (0.5)	1,243 (99.5)		
Officer	Ranch Hand	335	5 (1.5)	330 (98.5)	1.48 (0.43,5.16)	0.537
	Comparison	494	5 (1.0)	489 (99.0)		
Enlisted Flyer	Ranch Hand	149	3 (2.0)	146 (98.0)	--	0.172 <sup>a</sup>
	Comparison	187	0 (0.0)	187		
Enlisted Groundcrew	Ranch Hand	377	3 (0.8)	374 (99.2)	4.55 (0.47,43.89)	0.190
	Comparison	568	1 (0.2)	567 (99.8)		

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the kidney and bladder.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the kidney and bladder.

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

Occupational Category	Adjusted Relative Risk (95% C.I.)		p-Value
	Estimate	(95% C.I.)	
<i>All</i>	3.12	(0.88,11.04)	0.061
Officer	1.86	(0.43,8.16)	0.409
Enlisted Flyer	--	--	--
Enlisted Groundcrew	4.20	(0.36,49.46)	0.254

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the kidney and bladder.

**Table 10-26. Analysis of Malignant Systemic Neoplasms (Kidney and Bladder)  
(Continued)**

<b>(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED</b>			
Initial Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (Initial Dioxin) <sup>a</sup>	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) <sup>b</sup>
Low	156	2 (1.3)	0.72 (0.37,1.41)
Medium	161	4 (2.5)	
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.

<b>(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED</b>			
Analysis Results for $\log_2$ (Initial Dioxin) Adjusted Relative Risk			
n		(95% C.I.) <sup>a</sup>	p-Value
472		1.05 (0.47,2.38)	0.899

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

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.) <sup>a,b</sup>	p-Value
Comparison	1,211	6 (0.5)		
Background RH	378	4 (1.1)	2.04 (0.57,7.34)	0.273
Low RH	234	5 (2.1)	4.44 (1.34,14.69)	0.015
High RH	242	2 (0.8)	1.75 (0.35,8.75)	0.497
Low plus High RH	476	7 (1.5)	2.76 (0.87,8.80)	0.085

<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 10-26. Analysis of Malignant Systemic Neoplasma (Kidney and Bladder)  
(Continued)**

<b>(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED</b>			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,209		
Background RH	375	2.26 (0.49,10.35)	0.292
Low RH	232	4.44 (1.04,18.95)	0.044
High RH	240	3.26 (0.46,23.17)	0.237
Low plus High RH	472	3.80 (0.88,16.46)	0.075

<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.

<b>(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED</b>				
1987 Dioxin Category Summary Statistics		Analysis Results for $\log_2(1987 \text{ Dioxin} + 1)$		
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Low	286	3 (1.1)	1.03 (0.69,1.53)	0.902
Medium	282	5 (1.8)		
High	286	3 (1.1)		

<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.

<b>(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED</b>			
Analysis Results for $\log_2(1987 \text{ Dioxin} + 1)$			
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
847	1.14 (0.66,1.96)	0.634	

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

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

A significantly greater percentage of Ranch Hands in the low dioxin category had a malignant systemic neoplasm of the kidney and bladder than Comparisons in both the unadjusted and adjusted Model 3 analyses (Table 10-26(e,f): Est. RR=4.44, p=0.015; Adj. RR=4.44, p=0.044, respectively). The results were marginally significant when Ranch Hands in the low and high dioxin categories were combined (Table 10-26(e,f): Est. RR=2.76, p=0.085; Adj. RR=3.80, p=0.075, respectively). All other Model 3 contrasts were nonsignificant (Table 10-26(e,f): p>0.23).

### 10.2.2.1.27 Malignant Systemic Neoplasms (Prostate)

All results from the Model 1 analysis of malignant systemic neoplasms of the prostate were nonsignificant (Table 10-27(a,b):  $p>0.15$ ).

A significant inverse association between initial dioxin and malignant systemic neoplasms of the prostate was found in the unadjusted Model 2 analysis (Table 10-27(c): Est. RR=0.52,  $p=0.007$ ). After adjustment for covariates, the association was nonsignificant (Table 10-27(d):  $p=0.254$ ).

**Table 10-27. Analysis of Malignant Systemic Neoplasms (Prostate)**

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

Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	861	26 (3.0)	0.97 (0.58,1.60)	0.893
	Comparison	1,249	39 (3.1)		
Officer	Ranch Hand	335	13 (3.9)	0.76 (0.38,1.50)	0.427
	Comparison	494	25 (5.1)		
Enlisted Flyer	Ranch Hand	149	7 (4.7)	2.26 (0.65,7.86)	0.201
	Comparison	187	4 (2.1)		
Enlisted	Ranch Hand	377	6 (1.6)	0.90 (0.33,2.50)	0.844
Groundcrew	Comparison	568	10 (1.8)		

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	0.69 (0.38,1.25)	0.219
Officer	0.58 (0.27,1.22)	0.151
Enlisted Flyer	1.54 (0.41,5.75)	0.521
Enlisted Groundcrew	0.59 (0.19,1.84)	0.360

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

Initial Dioxin Category Summary Statistics			Analysis Results for Log <sub>e</sub> (Initial Dioxin) <sup>a</sup>		
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value	
Low	156	8 (5.1)	0.52 (0.30,0.89)	0.007	
Medium	161	7 (4.4)			
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.

**Table 10-27. Analysis of Malignant Systemic Neoplasms (Prostate) (Continued)**

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

Analysis Results for $\log_2$ (Initial Dioxin)			
Adjusted Relative Risk			
n	(95% C.I.) <sup>a</sup>	p-Value	
472	0.68 (0.33,1.37)	0.254	

<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 a malignant systemic neoplasm of the prostate. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

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

Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Comparison	1,211	39 (3.2)		
Background RH	378	9 (2.4)	0.73 (0.35,1.52)	0.398
Low RH	234	12 (5.1)	1.63 (0.84,3.16)	0.150
High RH	242	4 (1.7)	0.51 (0.18,1.44)	0.202
Low plus High RH	476	16 (3.4)	0.90 (0.46,1.75)	0.757

<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	1,209		
Background RH	375	0.48 (0.21,1.07)	0.072
Low RH	232	0.91 (0.42,1.97)	0.818
High RH	240	0.61 (0.19,1.93)	0.404
Low plus High RH	472	0.75 (0.35,1.60)	0.453

<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.

**Table 10-27. Analysis of Malignant Systemic Neoplasms (Prostate) (Continued)**

<b>(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED</b>			
1987 Dioxin Category Summary Statistics		Analysis Results for $\log_2(1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	286	7 (2.5)	0.82 (0.62,1.10)
Medium	282	12 (4.3)	
High	286	6 (2.1)	

<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 $\log_2(1987 \text{ Dioxin} + 1)$			
Adjusted Relative Risk (95% C.I.) <sup>a</sup>			
n			p-Value
847		0.83 (0.56,1.23)	0.353

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

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The Model 3 adjusted analysis revealed a marginally significant difference in malignant systemic neoplasms of the prostate between Ranch Hands in the background dioxin category and Comparisons (Table 10-27(f): Adj. RR=0.48, p=0.072). More Comparisons than Ranch Hands had a malignant systemic neoplasm of the prostate. All other Model 3 contrasts and the results from the Model 4 analyses were nonsignificant (Table 10-27(e-h):  $p \geq 0.15$  for all remaining analyses).

#### *10.2.2.1.28 Malignant Systemic Neoplasms (Testicles)*

Because of the sparse number of participants with a malignant systemic neoplasm of the testicles, analysis was limited. All Model 1 analyses were nonsignificant (Table 10-28(a):  $p > 0.13$  for each contrast examined). Results from Model 2 analyses also were nonsignificant (Table 10-28(c,d):  $p > 0.41$ ).

**Table 10-28. Analysis of Malignant Systemic Neoplasms (Testicles)**

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

Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
Yes					
<i>All</i>	<i>Ranch Hand</i>	861	3 (0.4)	--	0.134 <sup>a</sup>
	<i>Comparison</i>	1,249	0 (0.0)		
Officer	Ranch Hand	335	1 (0.3)	--	0.845 <sup>a</sup>
	Comparison	494	0 (0.0)		
Enlisted Flyer	Ranch Hand	149	1 (0.7)	--	0.909 <sup>a</sup>
	Comparison	187	0 (0.0)		
Enlisted	Ranch Hand	377	1 (0.3)	--	0.836 <sup>a</sup>
Groundcrew	Comparison	568	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 malignant systemic neoplasm of the testicles.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

**(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 malignant systemic neoplasm of the testicles.

**(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
		Yes		
Low	156	1 (0.6)		
Medium	161	2 (1.2)	0.65 (0.21,1.98)	0.413
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.

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

**Table 10-28. Analysis of Malignant Systemic Neoplasms (Testicles) (Continued)**

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

Analysis Results for $\text{Log}_2$ (Initial Dioxin)			
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>		p-Value
	472	0.77 (0.22, 2.64)	
			0.663

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

Note: Results are not adjusted for race and ionizing radiation exposure because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the testicles. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

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

Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.)	
Comparison	1,211	0 (0.0)		
Background RH	378	0 (0.0)	--	--
Low RH	234	2 (0.9)	--	
High RH	242	1 (0.4)	--	0.371 <sup>a</sup>
Low plus High RH	476	3 (0.6)	--	0.034 <sup>a</sup>

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

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

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

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 10-28. Analysis of Malignant Systemic Neoplasms (Testicles) (Continued)**

<b>(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED</b>			
1987 Dioxin Category Summary Statistics		Analysis Results for Log <sub>e</sub> (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	286	0 (0.0)	1.22 (0.59,2.50)
Medium	282	1 (0.4)	
High	286	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.

<b>(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED</b>			
Analysis Results for Log <sub>e</sub> (1987 Dioxin + 1)			
		Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
n			
847		1.35 (0.54,3.37)	0.517

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

Note: Results are not adjusted for race and ionizing radiation exposure because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the testicles. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Significant differences were found in the unadjusted Model 3 analysis between Ranch Hands in the low dioxin category and Comparisons, and between Ranch Hands in the low plus high dioxin category and Comparisons (Table 10-28(e,f):  $p=0.024$  and  $p=0.034$ , respectively). More Ranch Hands had a malignant systemic neoplasm of the testicles than did Comparisons. The adjusted Model 3 analysis was not possible because of the sparse number of neoplasms of the testicles. The remaining unadjusted Model 3 contrast and the Model 4 analyses were nonsignificant (Table 10-28(e,g-h):  $p>0.37$  for each remaining analysis).

#### *10.2.2.1.29 Malignant Systemic Neoplasms (Extrahepatic Bile Duct)*

Because of the presence of a malignant systemic neoplasm of the extrahepatic bile duct in only one Ranch Hand, statistical analysis was not possible. This participant was a non-Black enlisted flyer.

#### *10.2.2.1.30 Malignant Systemic Neoplasms (Ill-Defined Sites)*

Only one Comparison had a malignant systemic neoplasm of ill-defined sites, which precluded statistical analysis. This Comparison was a non-Black enlisted flyer.

#### *10.2.2.1.31 Malignant Systemic Neoplasms (Connective and Other Soft Tissues)*

Because of the sparse number of participants with a malignant systemic neoplasm of the connective or other soft tissues, analysis was limited. All results from the analyses performed were nonsignificant (Table 10-29(a-h):  $p>0.15$  for each analysis).

**Table 10-29. Analysis of Malignant Systemic Neoplasms (Connective and Other Soft Tissues)****(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED**

Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
			Yes		
<i>All</i>	<i>Ranch Hand</i>	861	1 (0.1)	0.73 (0.07,8.01)	0.790
	<i>Comparison</i>	1,249	2 (0.2)		
Officer	Ranch Hand	335	0 (0.0)	--	--
	Comparison	494	0 (0.0)		
Enlisted Flyer	Ranch Hand	149	1 (0.7)	--	0.909 <sup>a</sup>
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	0 (0.0)	--	0.667 <sup>a</sup>
	Comparison	568	2 (0.4)		

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

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

Occupational Category	Adjusted Relative Risk (95% C.I.)		p-Value
<i>All</i>	0.79 (0.05,12.82)		0.870
Officer	--		--
Enlisted Flyer	--		--
Enlisted Groundcrew	--		--

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

**(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	Number (%)	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Low	156	0 (0.0)	2.44 (0.70,8.47)	0.168
Medium	161	0 (0.0)		
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.

**Table 10-29. Analysis of Malignant Systemic Neoplasms (Connective and Other Soft Tissues) (Continued)**

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

Analysis Results for $\text{Log}_2$ (Initial Dioxin)			
Adjusted Relative Risk			
n	(95% C.L.) <sup>a</sup>	p-Value	
475	2.39 (0.68,8.37)	0.179	

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

Note: Results are not adjusted for age, race, occupation, ionizing radiation exposure, and lifetime alcohol history because of the sparse number of Ranch Hands with a malignant systemic neoplasm of connective and other soft tissues. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

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

Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.) <sup>ab</sup>	
Comparison	1,211	2 (0.2)		
Background RH	378	0 (0.0)	--	0.999 <sup>c</sup>
Low RH	234	0 (0.0)	--	0.999 <sup>c</sup>
High RH	242	1 (0.4)	2.34 (0.21,26.43)	0.493
Low plus High RH	476	1 (0.2)	--	0.999 <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 malignant systemic neoplasm of connective and other soft tissues.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of connective and other soft tissues.

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 10-29. Analysis of Malignant Systemic Neoplasms (Connective and Other Soft Tissues) (Continued)**

<b>(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED</b>			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,209		
Background RH	375	--	--
Low RH	232	--	--
High RH	240	3.17 (0.17,57.71)	0.436
Low plus High RH	472	--	--

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

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of connective and other soft tissues.

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 Dioxin + 1)		
1987 Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
Low	286	0 (0.0)	2.36 (0.73,7.65)	0.151	
Medium	282	0 (0.0)			
High	286	1 (0.4)			

<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)		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
852	2.36 (0.72,7.79)	0.155

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

Note: Results are not adjusted for age, race, occupation, ionizing radiation exposure, and lifetime alcohol history because of the sparse number of Ranch Hands with a malignant systemic neoplasm of connective and other soft tissues. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

#### 10.2.2.1.32 *Carcinoma In Situ (Penis)*

Because of the presence of carcinoma in situ of the penis in only one Comparison and no Ranch Hands, statistical analysis was not performed. The Comparison was a non-Black enlisted groundcrew.

#### 10.2.2.1.33 *Hodgkin's Disease*

Because of the sparse number of participants with a history of Hodgkin's disease, analysis was limited. All results were nonsignificant (Table 10-30(a-h):  $p>0.29$  for each analysis).

**Table 10-30. Analysis of Hodgkin's Disease**

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

Occupational Category	Group	n	Number (%)		Est. Relative Risk (95% C.I.)	p-Value
			Yes	No		
<i>All</i>	<i>Ranch Hand</i>	861	1 (0.1)	860 (99.9)	0.48 (0.05,4.65)	0.507
	<i>Comparison</i>	1,249	3 (0.2)	1,246 (99.8)		
Officer	Ranch Hand	335	1 (0.3)	334 (99.7)	0.74 (0.07,8.16)	0.803
	Comparison	494	2 (0.4)	492 (99.6)		
Enlisted Flyer	Ranch Hand	149	0 (0.0)	149 (100.0)	--	--
	Comparison	187	0 (0.0)	187 (100.0)		
Enlisted Groundcrew	Ranch Hand	377	0 (0.0)	377 (100.0)	--	0.999 <sup>a</sup>
	Comparison	568	1 (0.2)	567 (99.8)		

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with Hodgkin's disease.

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

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

Occupational Category	Adjusted Relative Risk (95% C.I.)		p-Value
	Estimate	(95% C.I.)	
<i>All</i>	0.29	(0.03,3.23)	0.291
Officer	0.47	(0.04,5.86)	0.554
Enlisted Flyer	--	--	--
Enlisted Groundcrew	--	--	--

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

Note: Results are not adjusted for race because of the sparse number of participants with Hodgkin's disease. Results for all occupations combined also are not adjusted for occupation because of the sparse number of participants with Hodgkin's disease.

**Table 10-30. Analysis of Hodgkin's Disease (Continued)**

**(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	Number (%)	Estimated Relative Risk (95% C.I.)	p-Value
Low	156	0 (0.0)	--	--
Medium	161	0 (0.0)	--	--
High	159	0 (0.0)	--	--

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

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

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

Analysis Results for Log <sub>2</sub> (Initial Dioxin)			
Adjusted Relative Risk			
n	95% C.I.)	p-Value	
--	--	--	--

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

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

Dioxin Category	n	Number (%)	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,211	3 (0.3)		
Background RH	378	1 (0.3)	0.92 (0.09, 9.02)	0.945
Low RH	234	0 (0.0)	--	0.999 <sup>c</sup>
High RH	242	0 (0.0)	--	0.999 <sup>c</sup>
Low plus High RH	476	0 (0.0)	--	0.656 <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 Hodgkin's disease.

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

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 10-30. Analysis of Hodgkin's Disease (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	1,209		
Background RH	375	0.55 (0.05,6.15)	0.624
Low RH	232	--	--
High RH	240	--	--
Low plus High RH	472	--	--

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

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

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 occupation and race because of the sparse number of participants with Hodgkin's disease.

**(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 (%) Yes	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Low	286	1 (0.4)	0.67 (0.15,2.97)	0.583
Medium	282	0 (0.0)		
High	286	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 $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
848	0.70 (0.08,6.51)	0.745

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

Note: Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of Ranch Hands with Hodgkin's disease. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

### 10.2.2.1.34 Non-Hodgkin's Lymphoma

Because of the sparse number of participants with non-Hodgkin's lymphoma, analysis was limited. All results were nonsignificant (Table 10-31(a-h):  $p>0.18$  for each analysis).

**Table 10-31. Analysis of Non-Hodgkin's Lymphoma**

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

Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	861	1 (0.1)	0.48 (0.05,4.65)	0.507
	Comparison	1,249	3 (0.2)		
Officer	Ranch Hand	335	0 (0.0)	--	0.657 <sup>a</sup>
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	0 (0.0)	--	--
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	1 (0.3)	1.51 (0.09,24.18)	0.772
	Comparison	568	1 (0.2)		

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	0.18 (0.01,2.61)	0.186
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	0.61 (0.02,15.18)	0.762

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

Note: Results are not adjusted for race because of the sparse number of participants with non-Hodgkin's lymphoma. Results for all occupations combined also are not adjusted for occupation because of the sparse number of participants with non-Hodgkin's lymphoma.

**(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	Number (%) Yes	Estimated Relative Risk (95% C.I.)	p-Value
Low	156	0 (0.0)	--	--
Medium	161	0 (0.0)		
High	159	0 (0.0)		

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

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

**Table 10-31. Analysis of Non-Hodgkin's Lymphoma (Continued)**

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

Analysis Results for $\text{Log}_2$ (Initial Dioxin) Adjusted Relative Risk			
n	(95% C.I.)	p-Value	
--	--	--	--

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

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

Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Comparison	1,211	3 (0.3)		
Background RH	378	1 (0.3)	0.92 (0.09, 9.02)	0.944
Low RH	234	0 (0.0)	--	0.999 <sup>c</sup>
High RH	242	0 (0.0)	--	0.999 <sup>c</sup>
Low plus High RH	476	0 (0.0)	--	0.656 <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 non-Hodgkin's lymphoma.

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

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	1,209		
Background RH	375	0.24 (0.01, 4.90)	0.351
Low RH	232	--	--
High RH	240	--	--
Low plus High RH	472	--	--

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

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

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 and occupation because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

**Table 10-31. Analysis of Non-Hodgkin's Lymphoma (Continued)**

<b>(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED</b>					
1987 Dioxin Category Summary Statistics			Analysis Results for $\text{Log}_2$ (1987 Dioxin + 1)		
1987 Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
Low	286	1 (0.4)	0.60 (0.13,2.70)	0.491	
Medium	282	0 (0.0)			
High	286	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.

<b>(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED</b>					
Analysis Results for $\text{Log}_2$ (1987 Dioxin + 1)			Adjusted Relative Risk (95% C.I.) <sup>a</sup>		
	n		Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
	852		0.31 (0.01,7.88)	0.443	

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

Note: Results are not adjusted for race, occupation, ionizing radiation exposure, and lifetime alcohol history because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

#### 10.2.2.1.35 Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue

Because of the sparse number of participants with other malignant systemic neoplasms of lymphoid and histiocytic tissue, analysis was limited. All results were nonsignificant (Table 10-32 (a-h):  $p>0.33$  for each analysis).

**Table 10-32. Analysis of Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue**

<b>(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED</b>					
Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	861	2 (0.2)	0.72 (0.13,3.97)	0.706
	<i>Comparison</i>	1,249	4 (0.3)		
Officer	Ranch Hand	335	1 (0.3)	0.74 (0.07,8.16)	0.803
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	0 (0.0)	--	0.999 <sup>a</sup>
	Comparison	187	1 (0.5)		
Enlisted	Ranch Hand	377	1 (0.3)	1.51 (0.09,24.18)	0.772
Groundcrew	Comparison	568	1 (0.2)		

<sup>a</sup> P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

**Table 10-32. Analysis of Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue (Continued)**

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

Occupational Category	Adjusted Relative Risk	
	(95% C.I.)	p-Value
<i>All</i>	<b>0.70 (0.10,5.03)</b>	<b>0.724</b>
Officer	0.69 (0.05,9.34)	0.781
Enlisted Flyer	--	--
Enlisted Groundcrew	<b>1.57 (0.08,31.01)</b>	<b>0.767</b>

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

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

Initial Dioxin Category	Summary Statistics		Analysis Results for $\log_2$ (Initial Dioxin)		
	n	Number (%)	Estimated Relative Risk	(95% C.I.)	p-Value
Low	160	0 (0.0)	--	--	--
Medium	162	0 (0.0)	--	--	--
High	160	0 (0.0)	--	--	--

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

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.)	p-Value
--	--	--	--

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

**Table 10-32. Analysis of Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue (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
	n	Yes		
Comparison	1,211	2 (0.2)		
Background RH	378	2 (0.5)	2.64 (0.37,19.03)	0.336
Low RH	234	0 (0.0)	--	0.999 <sup>c</sup>
High RH	242	0 (0.0)	--	0.999 <sup>c</sup>
Low plus High RH	476	0 (0.0)	--	0.919 <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 malignant systemic neoplasm of lymphoid and histiocytic tissue.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

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	1,209		
Background RH	375	1.90 (0.15,23.45)	0.618
Low RH	232	--	--
High RH	240	--	--
Low plus High RH	472	--	--

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

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

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 because of the sparse number of participants with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

**Table 10-32. Analysis of Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue (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 (%) Yes	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Low	286	1 (0.4)	0.68 (0.24,1.96)	0.466
Medium	282	1 (0.4)		
High	286	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 $\text{Log}_2 (1987 \text{ Dioxin} + 1)$		
Adjusted Relative Risk		
n	(95% C.I.) <sup>a</sup>	p-Value
847	0.63 (0.09,4.17)	0.580

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

Note: Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

#### 10.2.2.1.36 All Malignant Skin and Systemic Neoplasms

A marginally significant difference between Ranch Hands and Comparisons was found in the unadjusted Model 1 analysis of all skin and systemic neoplasms for all occupations combined (Table 10-33(a): Est. RR=1.20, p=0.099). The contrast of Ranch Hand and Comparisons enlisted flyers was significant in the unadjusted Model 1 analysis (Table 10-33(a): Est. RR=1.78, p=0.034). More Ranch Hands than Comparisons exhibited a history of a malignant skin or systemic neoplasm. After adjustment for covariates, both results were nonsignificant (Table 10-33(b): p>0.10 for each contrast). All other Model 1 contrasts were nonsignificant (Table 10-33(a,b): p>0.11).

**Table 10-33. Analysis of All Malignant Skin and Systemic Neoplasms**

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

Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
All	Ranch Hand	851	186 (21.9)	1.20 (0.97,1.49)	0.099
	Comparison	1,238	234 (18.9)		
Officer	Ranch Hand	330	95 (28.8)	1.29 (0.94,1.77)	0.112
	Comparison	487	116 (23.8)		
Enlisted Flyer	Ranch Hand	148	39 (26.4)	1.78 (1.04,3.02)	0.034
	Comparison	185	31 (16.8)		
Enlisted Groundcrew	Ranch Hand	373	52 (13.9)	0.89 (0.62,1.29)	0.546
	Comparison	566	87 (15.4)		

**Table 10-33. Analysis of All Malignant Skin and Systemic Neoplasms (Continued)**

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

Occupational Category	Adjusted Relative Risk		p-Value
		(95% C.I.)	
All		1.06 (0.80,1.41)	0.668
Officer		1.14 (0.79,1.65)	0.470
Enlisted Flyer		1.63 (0.91,2.92)	0.103
Enlisted Groundcrew		0.78 (0.51,1.19)	0.247

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

Initial Dioxin Category	Summary Statistics		Analysis Results for $\log_2$ (Initial Dioxin) <sup>a</sup>	
	n	Number (%)	Estimated Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Low	150	41 (27.3)	0.74 (0.62,0.89)	0.001
Medium	160	45 (28.1)		
High	159	23 (14.5)		

<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**

n	Analysis Results for $\log_2$ (Initial Dioxin)		p-Value
	Adjusted Relative Risk (95% C.I.) <sup>a</sup>		
465	0.91 (0.72,1.14)		0.396

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

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

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

Dioxin Category	n	Number (%)		p-Value
		Yes	Est. Relative Risk (95% C.I.) <sup>b</sup>	
Comparison	1,200	226 (18.8)		
Background RH	375	76 (20.3)	1.12 (0.83,1.49)	0.464
Low RH	228	68 (29.8)	1.82 (1.33,2.51)	<0.001
High RH	241	41 (17.0)	0.87 (0.60,1.26)	0.457
Low plus High RH	469	109 (23.2)	1.25 (0.96,1.62)	0.103

<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 10-33. Analysis of All Malignant Skin and Systemic Neoplasms (Continued)**

**(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	1,196			
Background RH	372	0.84 (0.60,1.20)		0.339
Low RH	226	1.51 (1.03,2.21)		0.035
High RH	239	1.01 (0.66,1.57)		0.952
Low plus High RH	465	1.23 (0.88,1.71)		0.221

<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 $\text{Log}_2(1987 \text{ Dioxin} + 1)$	
1987 Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) <sup>a</sup>	p-Value
Low	284	57 (20.1)	0.94 (0.84,1.05)	0.281
Medium	275	74 (26.9)		
High	285	54 (19.0)		

<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 $\text{Log}_2(1987 \text{ Dioxin} + 1)$		
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value
837	1.10 (0.94,1.27)	0.227

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

The unadjusted analysis of Model 2 displayed a significant inverse relation between initial dioxin and malignant skin and systemic neoplasms (Table 10-33(c): Est. RR=0.74, p=0.001). After adjustment for covariates, the association was nonsignificant (Table 10-33(d): p=0.396).

Both the unadjusted and adjusted Model 3 analyses revealed a significant difference in malignant skin and systemic neoplasms between Ranch Hands in the low dioxin category and Comparisons (Table 10-33(e,f): Est. RR=1.82, p<0.001; Adj. RR=1.51, p=0.035, respectively). More Ranch Hands in the low dioxin category than Comparisons had a malignant skin and systemic neoplasm. All other Model 3 contrasts and all results from the Model 4 analysis were nonsignificant (Table 10-33(e-h): p>0.10 for each analysis).

### 10.2.2.1.37 All Skin and Systemic Neoplasms

The Model 1 unadjusted analysis of all skin and systemic neoplasms revealed a significant difference between Ranch Hands and Comparisons when examined across all occupations (Table 10-34(a): Est. RR=1.25, p=0.014). A marginally significant difference within officers also was found in the unadjusted analysis (Table 10-34(a): Est. RR=1.29, p=0.079). Both contrasts showed more Ranch Hands than Comparisons with a history of a skin or systemic neoplasm. The contrasts were nonsignificant after adjustment for covariates (Table 10-34(b): p>0.72 for each contrast). All other Model 1 contrasts were also nonsignificant (Table 10-34(a,b): p>0.15).

A significant inverse association between initial dioxin and the occurrence of a skin or systemic neoplasm was found in the Model 2 unadjusted analysis (Table 10-34(c): Est. RR=0.84, p=0.017). After adjustment for covariates, the result was nonsignificant (Table 10-34(d): p=0.244).

**Table 10-34. Analysis of All Skin and Systemic Neoplasms**

<b>(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED</b>					
Occupational Category	Group	n	Number (%)	Est. Relative Risk (95% C.I.)	p-Value
			Yes		
<i>All</i>	<i>Ranch Hand</i>	847	473 (55.8)	1.25 (1.05,1.49)	0.014
	<i>Comparison</i>	1,231	620 (50.4)		
Officer	Ranch Hand	329	202 (61.4)	1.29 (0.97,1.72)	0.079
	Comparison	482	266 (55.2)		
Enlisted Flyer	Ranch Hand	146	84 (57.5)	1.37 (0.88,2.12)	0.158
	Comparison	185	92 (49.7)		
Enlisted Groundcrew	Ranch Hand	372	187 (50.3)	1.17 (0.90,1.51)	0.253
	Comparison	564	262 (46.5)		

  

<b>(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED</b>		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.04 (0.83,1.30)	0.756
Officer	1.06 (0.77,1.46)	0.725
Enlisted Flyer	1.15 (0.72,1.84)	0.557
Enlisted Groundcrew	0.98 (0.72,1.33)	0.881

  

<b>(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED</b>		
Initial Dioxin Category Summary Statistics		Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>a</sup>
Initial Dioxin	Number (%)	Estimated Relative Risk (95% C.I.) <sup>b</sup>
Low	150 92 (61.3)	0.84 (0.73,0.97)
Medium	159 95 (59.8)	
High	157 72 (45.9)	

<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 10-34. Analysis of All Skin and Systemic Neoplasms (Continued)**

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

Analysis Results for $\text{Log}_2$ (Initial Dioxin)			
Adjusted Relative Risk			
n	(95% C.I.) <sup>a</sup>	p-Value	
463	0.90 (0.76,1.07)	0.244	

<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 (%)	Est. Relative Risk (95% C.I.) <sup>b</sup>	p-Value
		Yes		
Comparison	1,193	602 (50.5)		
Background RH	374	211 (56.4)	1.30 (1.03,1.64)	0.030
Low RH	227	137 (60.4)	1.49 (1.11,1.99)	0.007
High RH	239	122 (51.1)	1.01 (0.76,1.33)	0.969
Low plus High RH	466	259 (55.6)	1.22 (0.98,1.51)	0.076

<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	1,189		
Background RH	371	1.01 (0.76,1.33)	0.956
Low RH	225	1.15 (0.83,1.61)	0.396
High RH	238	0.93 (0.67,1.30)	0.684
Low plus High RH	463	1.04 (0.79,1.35)	0.799

<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.

**Table 10-34. Analysis of All Skin and Systemic Neoplasms (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 (%) Yes	Estimated Relative Risk (95% C.I.) <sup>a</sup>
Low	283	161 (56.9)	0.93 (0.85,1.02)
Medium	275	163 (59.3)	
High	282	146 (51.8)	

<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.

**(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.) <sup>a</sup>	p-Value
834	0.99 (0.88,1.11)	0.854

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

In the Model 3 unadjusted analysis, a significantly higher percentage of Ranch Hands in the background, low, and low plus high dioxin categories had an occurrence of a skin or systemic neoplasm, relative to Comparisons (Table 10-34(e): Est. RR=1.30; p=0.030; Est. RR=1.49, p=0.007; and Est. RR=1.22, p=0.076, respectively). After adjustment for covariates, results were nonsignificant for each contrast (Table 10-34(f): p>0.39 for each adjusted contrast). All other Model 3 contrasts and the results from the Model 4 analysis were nonsignificant (Table 10-34(e-h): p>0.14 for each remaining analysis).

### 10.2.2.2 Laboratory Examination Variables

#### 10.2.2.2.1 Prostate-Specific Antigen (PSA) (Continuous)

All results from the Model 1 unadjusted and adjusted analyses of continuous PSA were nonsignificant (Table 10-35(a,b): p $\geq 0.59$  for all Model 1 analyses).

**Table 10-35. Analysis of PSA (ng/ml) (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>	829	1.104	-0.016 --	0.671
	<i>Comparison</i>	1,190	1.120		
Officer	Ranch Hand	320	1.195	-0.034 --	0.613
	Comparison	458	1.229		
Enlisted Flyer	Ranch Hand	141	1.241	0.007 --	0.949
	Comparison	180	1.234		
Enlisted Groundcrew	Ranch Hand	368	0.985	-0.020 --	0.693
	Comparison	552	1.005		

<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	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>	823	1.202	0.003 --	0.946
	<i>Comparison</i>	1,188	1.199		
Officer	Ranch Hand	319	1.157	-0.037 --	0.590
	Comparison	457	1.194		
Enlisted Flyer	Ranch Hand	139	1.289	0.040 --	0.719
	Comparison	179	1.249		
Enlisted Groundcrew	Ranch Hand	365	1.177	0.028 --	0.668
	Comparison	552	1.149		

<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 $\log_2$ (Initial Dioxin) <sup>b</sup>		
	n	Mean <sup>a</sup>	Adj. Mean <sup>ab</sup>	R <sup>2</sup>	Slope (Std. Error) <sup>c</sup>	p-Value
Low	148	1.305	1.288	0.037	-0.071 (0.027)	0.010
Medium	154	1.037	1.036			
High	156	0.979	0.992			

<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 PSA versus  $\log_2$  (initial dioxin).

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

Table 10-35. Analysis of PSA (ng/ml) (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	147	0.975	0.114	-0.045 (0.031)	0.152
Medium	154	0.806			
High	154	0.811			

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

<sup>b</sup> Slope and standard error based on natural logarithm of PSA 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	1,152	1.125	1.127		
Background RH	365	1.118	1.099	-0.028 --	0.587
Low RH	222	1.199	1.205	0.078 --	0.227
High RH	236	1.006	1.023	-0.104 --	0.079
Low plus High RH	458	1.095	1.108	-0.019 --	0.692

<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 10-35. Analysis of PSA (ng/ml) (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		p-Value <sup>c</sup>
			(95% C.I.) <sup>b</sup>		
Comparison	1,151	1.201			
Background RH	362	1.163	-0.038 --		0.527
Low RH	221	1.258	0.057 --		0.441
High RH	234	1.209	0.008 --		0.919
Low plus High RH	455	1.232	0.031 --		0.600

<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	276	1.133	0.005	-0.037 (0.018)	0.043
Medium	268	1.192			
High	279	1.003			

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

<sup>b</sup> Slope and standard error based on natural logarithm of PSA 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	275	1.111	0.076	-0.021 (0.020)	0.312
Medium	265	1.135			
High	277	1.033			

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

<sup>b</sup> Slope and standard error based on natural logarithm of PSA 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 inverse association between initial dioxin and continuous PSA (Table 10-35(c): slope=-0.071, p=0.010). After adjustment for covariates, the association was nonsignificant (Table 10-35(d): p=0.152).

A marginally significant difference in mean continuous PSA levels was found between Ranch Hands in the high dioxin category and Comparisons in the Model 3 unadjusted analysis (Table 10-35(e): difference of means=-0.104, p=0.079). After adjustment for covariates, the difference was nonsignificant (Table 10-35(f): p=0.919). All other Model 3 contrasts were also nonsignificant (Table 10-35(e,f): p>0.22).

A significant inverse association between 1987 dioxin and continuous PSA levels was revealed from the unadjusted Model 4 analysis (Table 10-35(g): adjusted slope=-0.037, p=0.043). After adjustment for covariates, the association was nonsignificant (Table 10-35(h): p=0.312).

#### 10.2.2.2.2 PSA (Discrete)

A marginally significant difference in the percentage of participants with abnormally high PSA levels between Ranch Hand and Comparison officers was found in the Model 1 unadjusted analysis (Table 10-36(a): Est. RR=1.59, p=0.086). After adjustment for covariates, the contrast was nonsignificant (Table 10-36(b): p=0.216). All other Model 1 contrasts were nonsignificant (Table 10-36(a,b): p>0.21).

**Table 10-36. Analysis of PSA (Discrete)**

<b>(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED</b>					
Occupational Category	Group	n	Number (%)	Est. Relative Risk	p-Value
			High	(95% C.I.)	
<i>All</i>	<i>Ranch Hand</i>	829	54 (6.5)	<i>1.07 (0.74,1.53)</i>	<i>0.730</i>
	<i>Comparison</i>	1,190	73 (6.1)		
Officer	Ranch Hand	320	31 (9.7)	1.59 (0.94,2.69)	0.086
	Comparison	458	29 (6.3)		
Enlisted Flyer	Ranch Hand	141	10 (7.1)	0.84 (0.37,1.93)	0.681
	Comparison	180	15 (8.3)		
Enlisted Groundcrew	Ranch Hand	368	13 (3.5)	0.66 (0.34,1.29)	0.223
	Comparison	552	29 (5.3)		

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

Occupational Category	Adjusted Relative Risk	p-Value
	(95% C.I.)	
<i>All</i>	<i>1.02 (0.64,1.60)</i>	<i>0.947</i>
Officer	1.45 (0.80,2.63)	0.216
Enlisted Flyer	0.78 (0.32,1.90)	0.578
Enlisted Groundcrew	0.68 (0.33,1.41)	0.302

**Table 10-36. Analysis of PSA (Discrete) (Continued)**

<b>(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED</b>				
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>	p-Value
Low	148	19 (12.8)	0.53 (0.37,0.77)	<0.001
Medium	154	13 (8.4)		
High	156	2 (1.3)		

<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.

<b>(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED</b>			
Analysis Results for $\log_2$ (Initial Dioxin)			
n	Adjusted Relative Risk (95% C.I.) <sup>a</sup>	p-Value	
455	0.61 (0.40,0.93)	0.014	

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

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.) <sup>a,b</sup>	p-Value
Comparison	1,152	71 (6.2)		
Background RH	365	20 (5.5)	0.85 (0.51,1.42)	0.526
Low RH	222	22 (9.9)	1.69 (1.02,2.79)	0.040
High RH	236	12 (5.1)	0.85 (0.45,1.59)	0.603
Low plus High RH	458	34 (7.4)	1.18 (0.76,1.84)	0.454

<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 10-36. Analysis of PSA (Discrete) (Continued)**

**(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	1,151			
Background RH	362	0.76 (0.43,1.37)		0.368
Low RH	221	1.42 (0.79,2.56)		0.246
High RH	234	1.04 (0.51,2.16)		0.907
Low plus High RH	455	1.21 (0.71,2.08)		0.484

<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 (%) High	Estimated Relative Risk (95% C.I.) <sup>a</sup>		p-Value
Low	276	15 (5.4)	0.91 (0.75,1.10)		
Medium	268	26 (9.7)			0.313
High	279	13 (4.7)			

<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 <sub>2</sub> (1987 Dioxin + 1)		p-Value
	Adjusted Relative Risk (95% C.I.) <sup>a</sup>		
817	1.05 (0.81,1.35)		0.735

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

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The Model 2 unadjusted and adjusted analyses of discrete PSA revealed a significant inverse relation between initial dioxin and discrete PSA levels (Table 10-36(c,d): Est. RR=0.53, p<0.001; Adj. RR=0.61, p=0.014, respectively). As initial dioxin in Ranch Hands increased, the prevalence of abnormally high PSA levels decreased.

A significant difference in the percentage of Ranch Hands in the low dioxin category with abnormally high PSA levels and Comparisons was observed in the unadjusted Model 3 analysis (Table 10-36(e): Est. RR=1.69, p=0.040). After adjustment for covariates, the result was nonsignificant (Table 10-36(f):

$p=0.246$ ). All other Model 3 analysis results, as well as Model 4 results, were also nonsignificant (Table 10-36(e-h):  $p>0.31$  for each).

### 10.2.3 Longitudinal Analysis

Longitudinal analyses were conducted on three variables—malignant skin neoplasms, malignant systemic neoplasms, and benign systemic neoplasms—to examine whether changes across time differed with respect to group membership (Model 1), initial dioxin (Model 2), and categorized dioxin (Model 3). Model 4 was not examined in longitudinal analyses because 1987 dioxin, the measure of exposure in these models, changes over time and is not available for all participants for 1982 or 1997.

The longitudinal analyses for all of these variables investigated the difference between the 1982 examination and the 1997 examination. These analyses were used to investigate the temporal effects of herbicide or dioxin exposure during the 15-year period between 1982 and 1997. Participants who were abnormal in 1982 were not included in the analyses. The purpose of the longitudinal analysis was to examine the effects of dioxin exposure across time. Participants who were abnormal in 1982 were not considered to be at risk for developing neoplasms, because the condition already existed at the time of the first collection of data for the AFHS (1982). Only participants considered normal at the 1982 examination (i.e., no neoplasm) were considered to be at risk when the effects of herbicide or dioxin exposure over this period of time were explored; therefore, the rate of abnormalities under this restriction approximates an incidence rate between 1982 and 1997. That is, an incidence rate is a measure of the rate at which people without a condition develop the condition during a specified period of time (81). Summary statistics are provided for reference purposes for the 1985, 1987, and 1992 examinations. All three models were adjusted for age; Models 2 and 3 also were adjusted for the percentage of body fat at the time of the blood measurement of dioxin.

#### *10.2.3.1 Medical Records Review*

##### *10.2.3.1.1 Malignant Skin Neoplasms*

The longitudinal analysis results for participants with no malignant skin neoplasms in 1982 were nonsignificant for Models 1, 2, and 3 (Table 10-37(a-c):  $p>0.31$  for each analysis).

**Table 10-37. Longitudinal Analysis of Malignant Skin Neoplasms**

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

Occupational Category	Group	Number (%) Yes/(n) Examination				
		1982	1985	1987	1992	1997
<i>All</i>	<i>Ranch Hand</i>	41 (5.1) (809)	62 (7.8) (791)	82 (10.5) (783)	114 (14.5) (788)	137 (16.9) (809)
	<i>Comparison</i>	31 (3.2) (967)	60 (6.3) (949)	70 (7.4) (942)	113 (11.9) (948)	157 (16.2) (967)
Officer	Ranch Hand	21 (6.8) (307)	33 (10.9) (303)	44 (14.7) (300)	61 (20.1) (303)	71 (23.1) (307)
	Comparison	15 (4.0) (374)	31 (8.4) (368)	36 (9.9) (362)	64 (17.3) (370)	83 (22.2) (374)
Enlisted Flyer	Ranch Hand	9 (6.1) (147)	12 (8.3) (144)	16 (11.3) (142)	24 (16.7) (144)	29 (19.7) (147)
	Comparison	3 (2.1) (144)	7 (4.9) (143)	9 (6.3) (142)	15 (10.6) (142)	19 (13.2) (144)
Enlisted Groundcrew	Ranch Hand	11 (3.1) (355)	17 (4.9) (344)	22 (6.5) (341)	29 (8.5) (341)	37 (10.4) (355)
	Comparison	13 (2.9) (449)	22 (5.0) (438)	25 (5.7) (438)	34 (7.8) (436)	55 (12.3) (449)
No in 1982						
Occupational Category	Group	n in 1997	Number (%) Yes in 1997	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value <sup>a</sup>	
	<i>Ranch Hand</i>	768	96 (12.5)	0.92 (0.69,1.23)	0.594	
<i>All</i>	<i>Comparison</i>	936	126 (13.5)			
Officer	Ranch Hand	286	50 (17.5)	0.90 (0.60,1.36)	0.628	
	Comparison	359	68 (18.9)			
Enlisted Flyer	Ranch Hand	138	20 (14.5)	1.33 (0.66,2.70)	0.427	
	Comparison	141	16 (11.4)			
Enlisted Groundcrew	Ranch Hand	344	26 (7.6)	0.78 (0.47,1.31)	0.348	
	Comparison	436	42 (9.6)			

<sup>a</sup> Relative risk, confidence interval, and p-values are in reference to a contrast of 1982 and 1997 results; results adjusted for age in 1997.

Note: Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant skin neoplasm in 1982 (see Chapter 7, Statistical Methods).

**Table 10-37. Longitudinal Analysis of Malignant Skin Neoplasms (Continued)**

**(b) MODEL 2: RANCH HANDS — INITIAL DIOXIN**

Initial Dioxin	Number (%) Yes(n) Examination				
	1982	1985	1987	1992	1997
Low	11 (7.4) (148)	19 (13.1) (145)	21 (14.3) (147)	27 (18.8) (144)	30 (20.3) (148)
Medium	9 (5.7) (158)	11 (7.1) (155)	15 (9.7) (155)	22 (14.2) (155)	30 (19.0) (158)
High	4 (2.6) (153)	6 (4.0) (150)	9 (6.1) (148)	13 (8.7) (150)	17 (11.1) (153)

  

Initial Dioxin Category Summary Statistics		Analysis Results for Log <sub>2</sub> (Initial Dioxin) <sup>a</sup>	
Initial Dioxin	n in 1997	Number (%) Yes in 1997	
		Adj. Relative Risk (95% C.I.) <sup>b</sup>	p-Value
Low	137	19 (13.9)	0.88 (0.69,1.13)
Medium	149	21 (14.1)	0.313
High	149	13 (8.7)	

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

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

Notes: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant skin neoplasm in 1982 (see Chapter 7, Statistical Methods).

**Table 10-37. Longitudinal Analysis of Malignant Skin Neoplasms (Continued)**

<b>(c) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY</b>					
Dioxin Category	Number (%) Yes/(n)				
	1982	1985	1987	1992	1997
Comparison	29 (3.1) (939)	58 (6.3) (924)	67 (7.3) (916)	108 (11.7) (921)	151 (16.1) (939)
Background RH	17 (4.9) (344)	26 (7.7) (336)	37 (11.3) (328)	52 (15.6) (334)	60 (17.4) (344)
Low RH	17 (7.6) (224)	26 (11.9) (218)	28 (12.7) (221)	40 (18.4) (218)	46 (20.5) (224)
High RH	7 (3.0) (235)	10 (4.3) (232)	17 (7.4) (229)	22 (9.5) (231)	31 (13.2) (235)
Low plus High RH	24 (5.2) (459)	36 (8.0) (450)	45 (10.0) (450)	62 (13.8) (449)	77 (16.8) (459)

  

No in 1982					
Dioxin Category	n in 1997	Number (%) Yes	Adj. Relative Risk		p-Value <sup>b</sup>
		in 1997	(95% C.I.) <sup>ab</sup>		
Comparison	910	122 (13.4)			
Background RH	327	43 (13.2)	0.94 (0.65,1.38)		0.770
Low RH	207	29 (14.0)	0.98 (0.63,1.53)		0.936
High RH	228	24 (10.5)	0.87 (0.54,1.40)		0.571
Low plus High RH	435	53 (12.2)	0.92 (0.65,1.31)		0.655

<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 and age in 1997.

Notes: 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.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant skin neoplasm in 1982 (see Chapter 7, Statistical Methods).

#### 10.2.3.1.2 Malignant Systemic Neoplasms

For participants with no malignant systemic neoplasms in 1982, differences between Ranch Hands and Comparisons examined within the enlisted flyer stratum were marginally significant (Table 10-38(a): Adj. RR=2.43, p=0.062). The percentage of participants who developed a malignant systemic neoplasm after 1982 was higher for Ranch Hand enlisted flyers than for Comparison enlisted flyers (11.0% vs. 4.8%, respectively). All other Model 1 contrasts were nonsignificant (Table 10-38(a): p>0.11).

**Table 10-38. Longitudinal Analysis of Malignant Systemic Neoplasms****(a) MODEL 1: RANCH HANDS VS. COMPARISONS**

Occupational Category	Group	Number (%) Yes/(n) Examination				
		1982	1985	1987	1992	1997
All	Ranch Hand	7 (0.9) (810)	13 (1.6) (792)	19 (2.4) (784)	31 (3.9) (788)	63 (7.8) (810)
	Comparison	10 (1.0) (974)	13 (1.4) (956)	16 (1.7) (949)	32 (3.4) (954)	62 (6.4) (974)
Officer	Ranch Hand	4 (1.3) (306)	8 (2.7) (302)	11 (3.7) (299)	15 (5.0) (301)	31 (10.1) (306)
	Comparison	5 (1.3) (380)	8 (2.1) (374)	9 (2.5) (368)	19 (5.1) (375)	36 (9.5) (380)
Enlisted Flyer	Ranch Hand	1 (0.7) (146)	2 (1.4) (143)	2 (1.4) (141)	8 (5.6) (143)	17 (11.6) (146)
	Comparison	0 (0.0) (145)	0 (0.0) (144)	1 (0.7) (143)	4 (2.8) (143)	7 (4.8) (145)
Enlisted Groundcrew	Ranch Hand	2 (0.6) (358)	3 (0.9) (347)	6 (1.7) (344)	8 (2.3) (344)	15 (4.2) (358)
	Comparison	5 (1.1) (449)	5 (1.1) (438)	6 (1.4) (438)	9 (2.1) (436)	19 (4.2) (449)

Occupational Category	Group	No in 1982		Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value <sup>a</sup>
		n in 1997	Number (%) Yes in 1997		
All	Ranch Hand	803	56 (7.0)	1.38 (0.92,2.06)	0.118
	Comparison	964	52 (5.4)		
Officer	Ranch Hand	302	27 (8.9)	1.11 (0.64,1.93)	0.716
	Comparison	375	31 (8.3)		
Enlisted Flyer	Ranch Hand	145	16 (11.0)	2.43 (0.96,6.19)	0.062
	Comparison	145	7 (4.8)		
Enlisted Groundcrew	Ranch Hand	356	13 (3.7)	1.30 (0.59,2.87)	0.509
	Comparison	444	14 (3.2)		

<sup>a</sup> Relative risk, confidence interval, and p-values are in reference to a contrast of 1982 and 1997 results; results adjusted for age in 1997.

Note: Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

**Table 10-38. Longitudinal Analysis of Malignant Systemic Neoplasms (Continued)**

**(b) MODEL 2: RANCH HANDS — INITIAL DIOXIN**

Initial Dioxin	Number (%) Yes/(n)				
	1982	1985	1987	1992	1997
Low	1 (0.7) (150)	2 (1.4) (147)	5 (3.4) (149)	7 (4.8) (145)	19 (12.7) (150)
Medium	4 (2.5) (158)	7 (4.5) (155)	7 (4.5) (155)	13 (8.4) (155)	19 (12.0) (158)
High	0 (0.0) (152)	0 (0.0) (149)	0 (0.0) (147)	0 (0.0) (149)	5 (3.3) (152)

  

Initial Dioxin Category Summary Statistics		Analysis Results for Log <sub>e</sub> (Initial Dioxin) <sup>a</sup>		
Initial Dioxin	No in 1982	Number (%) Yes in 1997	Adj. Relative Risk (95% C.I.) <sup>b</sup>	p-Value
	n in 1997			
Low	149	18 (12.1)	0.71 (0.50, 1.00)	0.036
Medium	154	15 (9.7)		
High	152	5 (3.3)		

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

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

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

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

**(c) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY**

Dioxin Category	Number (%) Yes/(n)				
	1982	1985	1987	1992	1997
Comparison	10 (1.1) (946)	13 (1.4) (931)	16 (1.7) (923)	31 (3.3) (927)	61 (6.5) (946)
Background RH	2 (0.6) (344)	4 (1.2) (336)	7 (2.1) (328)	11 (3.3) (334)	20 (5.8) (344)
Low RH	3 (1.3) (225)	6 (2.7) (219)	9 (4.1) (222)	16 (7.3) (218)	33 (14.7) (225)
High RH	2 (0.9) (235)	3 (1.3) (232)	3 (1.3) (229)	4 (1.7) (231)	10 (4.3) (235)
Low plus High RH	5 (1.1) (460)	9 (2.0) (451)	12 (2.7) (451)	20 (4.5) (449)	43 (9.4) (460)

**Table 10-38. Longitudinal Analysis of Malignant Systemic Neoplasms (Continued)**

Dioxin Category	No in 1982		Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value <sup>b</sup>
	n in 1997	Number (%) Yes in 1997		
Comparison	936	51 (5.5)		
Background RH	342	18 (5.3)	0.89 (0.50,1.57)	0.687
Low RH	222	30 (13.5)	2.58 (1.57,4.25)	<0.001
High RH	233	8 (3.4)	0.88 (0.40,1.91)	0.740
Low plus High RH	455	38 (8.4)	1.48 (0.89,2.48)	0.132

<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 and age in 1997.

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.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

The Model 2 longitudinal analysis revealed a significant inverse association between initial dioxin and malignant systemic neoplasms after 1982 (Table 10-38(b): Adj. RR=0.71, p=0.036). The percentage of Ranch Hands at the 1997 follow-up examination with a malignant systemic neoplasm since 1982 decreased as initial dioxin levels increased.

A significantly higher percentage of malignant systemic neoplasms in Ranch Hands in the low dioxin category than Comparisons was found from the Model 3 analysis (Table 10-38(c): Adj. RR=2.58, p<0.001). All other Model 3 longitudinal contrasts were nonsignificant (Table 10-38(c): p>0.13).

#### 10.2.3.1.3 Benign Systemic Neoplasms

All longitudinal analysis results for a history of benign systemic neoplasms since 1982 were nonsignificant for Models 1, 2, and 3 (Table 10-39(a-c): p>0.11).

**Table 10-39. Longitudinal Analysis of Benign Systemic Neoplasms**

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

Occupational Category	Group	Number (%) Yes/(n) Examination				
		1982	1985	1987	1992	1997
All	Ranch Hand	44 (5.4) (810)	69 (8.7) (792)	111 (14.2) (784)	145 (18.4) (788)	213 (26.3) (810)
	Comparison	69 (7.1) (974)	98 (10.3) (956)	132 (13.9) (949)	178 (18.7) (954)	259 (26.6) (974)
Officer	Ranch Hand	19 (6.2) (306)	27 (8.9) (302)	45 (15.1) (299)	53 (17.6) (301)	81 (26.5) (306)
	Comparison	35 (9.2) (380)	46 (12.3) (374)	56 (15.2) (368)	74 (19.7) (375)	115 (30.3) (380)
Enlisted Flyer	Ranch Hand	10 (6.9) (146)	14 (9.8) (143)	24 (17.0) (141)	33 (23.1) (143)	42 (28.8) (146)
	Comparison	8 (5.5) (145)	12 (8.3) (144)	24 (16.8) (143)	30 (21.0) (143)	40 (27.6) (145)
Enlisted Groundcrew	Ranch Hand	15 (4.2) (358)	28 (8.1) (347)	42 (12.2) (344)	59 (17.2) (344)	90 (25.1) (358)
	Comparison	26 (5.8) (449)	40 (9.1) (438)	52 (11.9) (438)	74 (17.0) (436)	104 (23.2) (449)

Occupational Category	Group	No in 1982			Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value <sup>a</sup>
		n in 1997	Number (%) Yes in 1997	Adj. Relative Risk (95% C.I.) <sup>a</sup>		
All	Ranch Hand	766	169 (22.1)	1.07 (0.84,1.35)	0.585	
	Comparison	905	190 (21.0)			
Officer	Ranch Hand	287	62 (21.6)	0.90 (0.62,1.32)	0.601	
	Comparison	345	80 (23.2)			
Enlisted Flyer	Ranch Hand	136	32 (23.5)	1.02 (0.58,1.78)	0.953	
	Comparison	137	32 (23.4)			
Enlisted Groundcrew	Ranch Hand	343	75 (21.9)	1.26 (0.88,1.80)	0.202	
	Comparison	423	78 (18.4)			

<sup>a</sup> Relative risk, confidence interval, and p-values are in reference to a contrast of 1982 and 1997 results; results adjusted for age in 1997.

Note: Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a benign systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

**Table 10-39. Longitudinal Analysis of Benign Systemic Neoplasms (Continued)**

**(b) MODEL 2: RANCH HANDS — INITIAL DIOXIN**

Initial Dioxin	Number (%) Yes/(n)				
	1982	1985	1987	1992	1997
Low	11 (7.3) (150)	15 (10.2) (147)	24 (16.1) (149)	25 (17.2) (145)	41 (27.3) (150)
Medium	11 (7.0) (158)	16 (10.3) (155)	18 (11.6) (155)	27 (17.4) (155)	38 (24.1) (158)
High	5 (3.3) (152)	14 (9.4) (149)	20 (13.6) (147)	27 (18.1) (149)	42 (27.6) (152)

  

Initial Dioxin Category Summary Statistics		Analysis Results for $\log_2$ (Initial Dioxin) <sup>a</sup>			
Initial Dioxin	n in 1982	Number (%) Yes		Adj. Relative Risk (95% C.I.) <sup>b</sup>	p-Value
		n in 1997	In 1997		
Low	139	30 (21.6)		1.16 (0.97, 1.38)	0.114
Medium	147	27 (18.4)			
High	147	37 (25.2)			

<sup>a</sup> Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

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

Notes: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a benign systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

**(c) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY**

Dioxin Category	Number (%) Yes/(n)				
	1982	1985	1987	1992	1997
Comparison	66 (7.0) (946)	95 (10.2) (931)	128 (13.9) (923)	172 (18.6) (927)	251 (26.5) (946)
Background RH	17 (4.9) (344)	24 (7.1) (336)	48 (14.6) (328)	65 (19.5) (334)	90 (26.2) (344)
Low RH	17 (7.6) (225)	25 (11.4) (219)	34 (15.3) (222)	37 (17.0) (218)	57 (25.3) (225)
High RH	10 (4.3) (235)	20 (8.6) (232)	28 (12.2) (229)	42 (18.2) (231)	64 (27.2) (235)
Low plus High RH	27 (5.9) (460)	45 (10.0) (451)	62 (13.8) (451)	79 (17.6) (449)	121 (26.3) (460)

**Table 10-39. Longitudinal Analysis of Benign Systemic Neoplasms (Continued)**

Dioxin Category	No in 1982		Adj. Relative Risk (95% C.I.) <sup>ab</sup>	p-Value <sup>b</sup>
	n in 1997	Number (%) Yes in 1997		
Comparison	880	185 (21.0)		
Background RH	327	73 (22.3)	1.05 (0.77,1.43)	0.754
Low RH	208	40 (19.2)	0.85 (0.58,1.25)	0.413
High RH	225	54 (24.0)	1.30 (0.91,1.85)	0.144
Low plus High RH	433	94 (21.7)	1.06 (0.80,1.41)	0.679

<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 and age in 1997.

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.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a benign systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

### 10.3 DISCUSSION

In ambulatory medicine, the recommendation that asymptomatic individuals undergo periodic physical examinations is based largely on the assumption that such screening may reveal occult malignancy. Although the guidelines for the frequency and content of such examinations are subject to debate, there is no doubt that early detection affords the best and, in most forms of cancer, the only chance for cure. While no one screening test is absolutely reliable, the scope and depth of the protocol employed in this longitudinal study far exceed that considered routine in clinical practice.

As the anatomic point of contact with industrial toxins and as the only organ system with a clearly defined clinical endpoint (i.e., chloracne) for dioxin exposure, the skin deserves the special emphasis it has received in this study. Although there is no evidence that dioxin exposure causes—or that chloracne is associated with—basal cell carcinomas, the Ranch Hand cohort was found to be at increased risk for the occurrence of these skin cancers in the 1982, 1985, 1987, and 1992 AFHS examinations. As in previous examinations, skin lesions considered to be suggestive of skin cancer were biopsied. Although blind to the participant exposure status, examiners performed a similar number of biopsies in the Ranch Hand (54 out of 869, or 6.2%) and Comparison (68 out of 1,251, or 5.4%) cohorts.

Consistent with each of the preceding examinations, Ranch Hands continued to have a slightly higher history of benign and malignant skin neoplasms than Comparisons, including that of basal cell skin cancers at all sites (15.0% of Ranch Hands vs. 13.3% of Comparisons). In neither the current nor the 1992 examination were the group differences significant. Further, although the statistical significance varied, in all of the exposure analyses employing initial and 1987 serum dioxin levels, an inverse dose-response relation was documented with basal cell skin cancers decreasing as the level of serum dioxin

increased. The current results are consistent with results of the exposure analyses from both the 1987 and 1992 examinations. Once again, although group differences were not statistically significant, cutaneous melanoma and squamous cell skin cancers were greater in Ranch Hands than in Comparisons.

In the 1987 examination, one of the few statistically significant findings was an increase of benign systemic neoplasms in the Ranch Hand cohort relative to Comparisons (10.2% vs. 4.1%) in a pattern consistent with a dose-response effect. In the 1992 and 1997 examinations, the occurrence of benign systemic neoplasms was close to equal in both cohorts (16.4% vs. 15.6% and 25.4% vs. 24.1%, respectively), and in neither study did the exposure analyses reveal any association with either initial or 1987 serum dioxin levels.

Consistent with all previous examinations, the overall history of systemic malignancies at all sites combined was similar in the Ranch Hand and Comparison cohorts. In two specific diagnostic categories, statistically significant group differences were noted to the adverse effect of Ranch Hands. Malignancies of the kidney and bladder and of the bronchus and lung were more common in Ranch Hands than in Comparisons (1.3% vs. 0.5% and 1.2% vs. 0.2%, respectively). In neither case did the exposure analyses reveal any evidence for a dose-response effect associated with prior exposure to dioxin. Hodgkin's disease, non-Hodgkin's lymphoma, and STS, widely regarded as related to dioxin exposure, were both rare and less prevalent in Ranch Hands than in Comparisons (0.1% vs. 0.2% of each of Hodgkin's disease and non-Hodgkin's lymphoma). Five participants in the 1997 examination (two Ranch Hands and three Comparisons) had been diagnosed as having STS. One of the Ranch Hands was an officer with a dioxin level of 9.7 ppt measured in blood collected in 1987 and the other was an enlisted groundcrew member with a dioxin level of 124.9 ppt measured in blood collected in 1982. The three Comparisons were an enlisted flyer with a dioxin level of 4.9 ppt measured in blood collected in 1992, an enlisted groundcrew member with a dioxin level of 2.4 ppt measured in blood collected in 1987, and an officer with a dioxin level of 6.7 ppt measured in blood collected in 1987. An additional Ranch Hand with STS died subsequent to the 1985 AFHS physical examination and had no dioxin measurement. The prevalence of STS among participants who attended the 1997 physical is 2 out of 870 (0.23%) among Ranch Hands and 3 out of 1,251 (0.24%) among Comparisons. The prevalence of STS among all participants who were compliant to at least one examination, regardless of the presence or absence of dioxin levels (Ranch Hand n=1,111, Comparison n=1,571), is 3 out of 1,111, (0.27%) among Ranch Hands and 3 out of 1,571 (0.19%) among Comparisons (relative risk=1.41, 95% confidence interval: [0.29,6.99]).

The 1992 examination was the first to incorporate PSA into the study protocol. This diagnostic test has proven highly valuable in the early detection of silent prostate cancer. Related to development of benign enlargement of the prostate gland, with age a gradual rise in this index over time would be anticipated and was documented in current PSA levels relative to 1992. By discrete and continuous analyses, PSA levels were similar in Ranch Hands and Comparisons and prostate cancer in the two cohorts was nearly identical. Further, in all exposure analyses, there was no association between prostate cancer and either initial or 1987 serum dioxin levels.

Dependent variable-covariate associations confirm the increased risk of various systemic cancers in association with well established risk factors including age, cigarette use, and alcohol consumption. Eye and hair color, fair complexion, age, and residence in southern latitudes all contributed strongly to risk for the development of basal cell skin cancers. Cigarette use and alcohol consumption were strongly associated with the occurrence of bladder and lung cancer. A significant increase in prostate and basal cell skin cancers was noted in officers relative to the enlisted occupational strata. These findings are more likely to have a socio-economic than biologic basis and may reflect more frequent dermatological examinations and PSA screenings by officers relative to enlisted men.