

**TABLE 7-12. (Continued)**

**Analysis of Sun Exposure-Related Malignant Skin Neoplasm by Occupation  
(Officer—Other Sites versus None)  
(Verified)**

**i2) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	261	1.9	All Categories		0.555
Unknown	192	4.2	Unknown vs. Background	2.23 (0.72,6.93)	0.258
Low	36	2.8	Low vs. Background	1.46 (0.17,12.89)	0.999
High	2	0.0	High vs. Background	--	0.999
Total	491				

**j2) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	260	All Categories		0.508	SUNRPT (p=0.010)
Unknown	192	Unknown vs. Background	2.34 (0.75,7.31)	0.144	
Low	36	Low vs. Background	1.51 (0.17,13.40)	0.709	
High	2	High vs. Background	--	--	
Total	490				

--: Relative risk/confidence interval/p-value not given due to the sparse number of abnormalities.

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt  $<$  Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin  $>$ 33.3 ppt.

TABLE 7-12. (Continued)

**Analysis of Sun Exposure-Related Malignant Skin Neoplasm by Occupation  
(Enlisted Flyer—Ear, Face, Head, and Neck versus None)  
(Verified)**

**i3) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	114	7.0	All Categories		0.779
Unknown	39	7.7	Unknown vs. Background	1.10 (0.28,4.42)	0.999
Low	50	4.0	Low vs. Background	0.55 (0.11,2.72)	0.728
High	29	3.4	High vs. Background	0.47 (0.06,3.99)	0.842
Total	232				

**j3) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	109	All Categories		0.668	AGE (p=0.019)
Unknown	36	Unknown vs. Background	1.81 (0.41,8.10)	0.434	ETHBACK (p=0.020)
Low	49	Low vs. Background	0.75 (0.14,3.97)	0.735	SUN2HR (p=0.016)
High	28	High vs. Background	0.45 (0.05,4.12)	0.476	SUNRPT (p=0.049)
Total	222				LAT (p=0.020) HAIR (p=0.035)

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt  $<$  Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin  $>$ 33.3 ppt.

**TABLE 7-12. (Continued)**

**Analysis of Sun Exposure-Related Malignant Skin Neoplasm by Occupation  
(Enlisted Flyer—Other Sites versus None)  
(Verified)**

**i4) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	108	1.9	All Categories	1.0 (0.0,2.0)	0.010
Unknown	36	0.0	Unknown vs. Background	--	0.999
Low	49	2.0	Low vs. Background	1.10 (0.10,12.47)	0.999
High	32	12.5	High vs. Background	7.57 (1.31,43.46)	0.049
Total	225				

**j4) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	108	All Categories	1.0 (0.0,2.0)	0.055	SUNRPT (p=0.010)
Unknown	36	Unknown vs. Background	--	--	
Low	49	Low vs. Background	1.20 (0.10,13.75)	0.882	
High	32	High vs. Background	7.29 (1.23,42.71)	0.028	
Total	225				

--: Relative risk/confidence interval/p-value not given due to the sparse number of abnormalities.

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt  $<$  Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin  $>$ 33.3 ppt.

TABLE 7-12. (Continued)

**Analysis of Sun Exposure-Related Malignant Skin Neoplasm by Occupation  
(Enlisted Groundcrew—Ear, Face, Head, and Neck versus None)  
(Verified)**

**i5) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	338	3.8	All Categories		0.114
Unknown	84	4.8	Unknown vs. Background	1.25 (0.40,3.94)	0.896
Low	91	7.7	Low vs. Background	2.08 (0.81,5.39)	0.214
High	143	1.4	High vs. Background	0.36 (0.08,1.60)	0.256
Total	656				

**j5) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	329	All Categories		0.149	AGE (p=0.019)
Unknown	81	Unknown vs. Background	1.17 (0.36,3.85)	0.792	ETHBACK (p=0.020)
Low	89	Low vs. Background	2.17 (0.82,5.78)	0.119	SUN2HR (p=0.016)
High	140	High vs. Background	0.39 (0.09,1.80)	0.230	SUNRPT (p=0.049)
Total	639				LAT (p=0.020)
					HAIR (p=0.035)

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.  
 Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.  
 Low (Ranch Hands): 15 ppt < Current Dioxin  $\leq$ 33.3 ppt.  
 High (Ranch Hands): Current Dioxin >33.3 ppt.

**TABLE 7-12. (Continued)**

## **Analysis of Sun Exposure-Related Malignant Skin Neoplasm by Occupation (Enlisted Groundcrew—Other Sites versus None) (Verified)**

**i6) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	331	1.8	All Categories		0.091
Unknown	80	0.0	Unknown vs. Background	--	0.540
Low	88	4.5	Low vs. Background	2.58 (0.71,9.37)	0.274
High	142	0.7	High vs. Background	0.38 (0.05,3.23)	0.654
Total	641				

#### j6) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	331	All Categories		0.082	SUNRPT (p=0.010)
Unknown	80	Unknown vs. Background	--	--	
Low	88	Low vs. Background	2.47 (0.67,9.08)	0.171	
High	142	High vs. Background	0.37 (0.04,3.12)	0.360	
Total	641				

--- Relative risk/confidence interval/p-value not given due to the sparse number of abnormalities.

Note: Background (Comparisons): Current Dioxin  $\leq 10$  ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq 10$  ppt.

Low (Ranch Hands): 15 ppt < Current Dioxin  $\leq$  33.3 ppt.

High (Ranch Hands): Current Dioxin >33.3 ppt.

without a sun exposure-related malignant skin neoplasm produced nonsignificant relative risks that were less than 1 (Table 7-12 [a3-d3]:  $p>0.10$  for all analyses).

Under the minimal assumption, the unadjusted analysis of the frequency of Ranch Hand enlisted flyers with a sun exposure-related malignant skin neoplasm on other sites versus Ranch Hand enlisted flyers without a sun exposure-related malignant skin neoplasm yielded a marginally significant relative risk greater than 2 (Table 7-12 [a4]: Est. RR=2.27,  $p=0.052$ ). For this analysis, the relative frequencies of Ranch Hand enlisted flyers for low, medium, and high initial dioxin were 5.6, 1.7, and 18.2 percent. After adjusting for skin reaction to repeated sun exposure, the relative risk remained greater than 1 but became nonsignificant (Table 7-12 [c4]:  $p=0.128$ ). Under the maximal assumption, the unadjusted relative risk for Ranch Hand enlisted flyers was significant with a relative risk greater than 2 (Table 7-12 [b4]: Est. RR=2.47,  $p=0.015$ ) and associated relative frequencies of 0.0, 2.9, and 11.8 percent for low, medium, and high initial dioxin. Under the maximal assumption, the adjusted relative risk remained significant and greater than 2 (Table 7-12 [d4]: Adj. RR=2.14,  $p=0.049$ ) after covariate adjustment.

Under the minimal assumption, the unadjusted analysis of the frequency of Ranch Hand enlisted groundcrew with a sun exposure-related malignant skin neoplasm on the ear, face, head, and neck versus Ranch Hand enlisted groundcrew without a sun exposure-related malignant skin neoplasm produced a relative risk that was significant but less than 1 (Table 7-12 [a5]: Est. RR=0.54,  $p=0.022$ ). For this analysis, the relative frequencies of Ranch Hand enlisted groundcrew for low, medium, and high initial dioxin were 5.9, 6.0, and 1.9 percent. Under the maximal assumption, the unadjusted analysis produced a nonsignificant relative risk that also was less than 1 (Table 7-12 [b5]:  $p=0.133$ ). After adjusting for age, ethnic background, and skin reaction after at least 2 hours of sun exposure, the relative risk under the minimal assumption became marginally significant (Table 7-12 [c5]: Adj. RR=0.56,  $p=0.063$ ) but it was still less than 1. Under the maximal assumption, the adjusted relative risk remained nonsignificant (Table 7-12 [d5]:  $p=0.265$ ).

Under the minimal assumption, the unadjusted analysis of the frequency of Ranch Hand enlisted groundcrew with a sun exposure-related malignant skin neoplasm for other sites versus Ranch Hand enlisted groundcrew without a sun exposure-related malignant skin neoplasm was marginally significant with a relative risk less than 1 (Table 7-12 [a6]: Est. RR=0.57,  $p=0.098$ ) with relative frequencies for Ranch Hand enlisted groundcrew of 5.9, 3.1, and 1.0 for low, medium, and high initial dioxin. Under the maximal assumption, the unadjusted relative risk was nonsignificant (Table 7-12 [b6]:  $p=0.507$ ). Under both assumptions, after adjusting for skin reaction to repeated sun exposure, the adjusted relative risks for Ranch Hand enlisted groundcrew were nonsignificant (Table 7-12 [c6] and [d6]:  $p=0.104$  and  $p=0.485$ ).

#### ***Model 2: Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time***

Under both assumptions, the unadjusted and the adjusted analyses of the frequency of Ranch Hand officers with a sun exposure-related malignant skin neoplasm on the ear, face, head, and neck versus Ranch Hand officers without a sun exposure-related malignant skin neoplasm exhibited nonsignificant interactions between current dioxin and time since tour (Table 7-12 [e1-h1]:  $p>0.55$  for each interaction).

Under the minimal assumption, the unadjusted analysis of the frequency of Ranch Hand officers with a sun exposure-related malignant skin neoplasm for other sites versus Ranch Hand officers without a sun exposure-related malignant skin neoplasm displayed a nonsignificant risk for time over 18.6 years (Table 7-12 [e2]:  $p=0.777$ ). The interaction and other time stratum were not evaluated for significance due to the sparse number of Ranch Hands with the neoplasms of interest in the later time stratum. Also, an adjusted analysis was not performed under the minimal assumption due to sparse data. Under the maximal assumption, the unadjusted and the adjusted analyses contained nonsignificant current dioxin-by-time interactions (Table 7-12 [f2] and [h2]:  $p=0.861$  and  $p=0.811$ , respectively).

Under both assumptions, the unadjusted and the adjusted analyses of the frequency of Ranch Hand enlisted flyers with a sun exposure-related malignant skin neoplasm on the ear, face, head, and neck versus Ranch Hand enlisted flyers without a sun exposure-related malignant skin neoplasm were limited to the later time since tour stratum (18.6 years or less) because of the sparse number of Ranch Hands with the neoplasm of interest in the other time stratum. Under each assumption and for each analysis, the relative risks were nonsignificant (Table 7-12 [e3-h3]:  $p>0.30$  for each analysis).

Under the minimal assumption, the unadjusted analysis of the frequency of Ranch Hand enlisted flyers with a sun exposure-related malignant skin neoplasm on other sites versus Ranch Hand enlisted flyers without a sun exposure-related malignant skin neoplasm contained a significant interaction between current dioxin and time (Table 7-12 [e4]:  $p=0.010$ ). Ranch Hand enlisted flyers with the later tours (18.6 years or less) displayed a nonsignificant relative risk greater than 1 ( $p=0.955$ ) and a significant relative risk greater than 1 for the other time stratum (Est. RR=29.36,  $p=0.037$ ). The relative frequencies of Ranch Hand enlisted flyers for the earlier time stratum were 0.0, 0.0, and 23.1 percent for the low, medium, and high current dioxin categories.

Under the maximal assumption, the current dioxin-by-time interaction of the unadjusted analysis was also significant (Table 7-12 [f4]:  $p=0.017$ ) with a nonsignificant relative risk greater than 1 for Ranch Hands with later tours ( $p=0.459$ ) and a significant relative risk greater than 1 for Ranch Hands with earlier tours (Est. RR=29.37,  $p=0.038$ ). The corresponding relative frequencies of Ranch Hand enlisted flyers within the earlier time stratum were 0.0, 0.0, and 16.7 percent. Significant interactions between current dioxin and time (Table 7-12 [g4] and [h4]:  $p=0.017$  and  $p=0.026$ ), and marginally significant relative risks (Adj. RR=37.63 and  $p=0.056$  for minimal and maximal analyses) for the enlisted flyers with earlier tours also were found in the adjusted analyses. Ranch Hands with later tours exhibited nonsignificant relative risks (minimal assumption,  $p=0.794$ ; maximal assumption,  $p=0.349$ ).

Under the minimal assumption, the unadjusted analysis of the frequency of Ranch Hand enlisted groundcrew with a sun exposure-related malignant skin neoplasm on the ear, face, head, and neck versus Ranch Hand enlisted groundcrew without a sun exposure-related malignant skin neoplasm contained a nonsignificant interaction between current dioxin and time (Table 7-12 [e5]:  $p=0.430$ ). However, for time 18.6 years or less, the relative risk was marginally significant (Est. RR=0.30,  $p=0.051$ ) but less than 1. The corresponding relative frequencies of Ranch Hand enlisted groundcrew within that time stratum were 4.5, 7.2, and 0.0 percent.

Under the maximal assumption, the unadjusted analysis also contained a nonsignificant interaction between current dioxin and time (Table 7-12 [f5]:  $p=0.314$ ). Within the later time stratum, the relative risk was marginally significant but less than 1 (Est. RR=0.53,  $p=0.086$ ) with relative frequencies of Ranch Hand enlisted groundcrew for that time stratum being 5.3, 7.5, and 0.0 percent. Under both assumptions, the adjusted analyses displayed nonsignificant interactions (Table 7-12 [g5] and [h5]:  $p=0.336$  and  $p=0.221$ ). Under the minimal assumption, however, the later time stratum contained a marginally significant relative risk that was less than 1 (Adj. RR=0.32,  $p=0.066$ ).

Under each assumption, the unadjusted and the adjusted analyses of the frequency of Ranch Hand enlisted groundcrew with a sun exposure-related malignant skin neoplasm on other sites versus Ranch Hand enlisted groundcrew without a sun exposure-related malignant skin neoplasm contained nonsignificant interactions between current dioxin and time (Table 7-12 [e6]:  $p>0.85$  for each interaction). The stratum-specific analyses were nonsignificant.

### ***Model 3: Ranch Hands and Comparisons by Current Dioxin Category***

The frequencies of study participants with a sun exposure-related malignant skin neoplasm on the ear, face, head, and neck versus the frequencies of study participants without a sun exposure-related malignant skin neoplasm were compared for Ranch Hand officers in the unknown, low, and high current dioxin categories and for Comparison officers in the background category. The unadjusted and the adjusted analyses contained nonsignificant overall contrasts (Table 7-12 [i1] and [j1]:  $p=0.723$  and  $p=0.686$ , respectively). Ranch Hand versus Comparison contrasts were nonsignificant.

The frequencies of study participants with a sun exposure-related malignant skin neoplasm on other sites versus the frequencies of study participants without a sun exposure-related malignant skin neoplasm were compared for Ranch Hand officers in the unknown, low, and high current dioxin categories and for Comparison officers in the background category. The unadjusted and the adjusted analyses displayed nonsignificant overall contrasts (Table 7-12 [i2] and [j2]:  $p=0.555$  and  $p=0.508$ , respectively). Ranch Hand versus Comparison contrasts were nonsignificant.

The frequencies of study participants with a sun exposure-related malignant skin neoplasm on the ear, face, head, and neck versus the frequencies of study participants without a sun exposure-related malignant skin neoplasm were compared for Ranch Hand enlisted flyers in the unknown, low, and high current dioxin categories and for Comparison enlisted flyers in the background category. The unadjusted and the adjusted analyses exhibited nonsignificant overall contrasts (Table 7-12 [i3] and [j3]:  $p=0.779$  and  $p=0.668$ , respectively). Ranch Hand versus Comparison contrasts were nonsignificant.

The frequencies of study participants with a sun exposure-related malignant skin neoplasm on other sites versus the frequencies of study participants without a sun exposure-related malignant skin neoplasm were compared for Ranch Hand enlisted flyers in the unknown, low, and high current dioxin categories and for Comparison enlisted flyers in the background category. The unadjusted analysis displayed a significant overall contrast (Table 7-12 [i4]:  $p=0.010$ ). The relative frequencies of enlisted flyers with a sun exposure-related

malignant skin neoplasm on other sites for the background, unknown, low, and high current dioxin categories were 1.9, 0.0, 2.0, and 12.5 percent. The high versus background contrast was significant (Est. RR=7.57, 95% C.I.: [1.31,43.46],  $p=0.049$ ). The unknown versus background and the low versus background contrasts were nonsignificant ( $p=0.999$  for both contrasts). After adjusting for skin reaction after repeated sun exposure, the overall contrast was found to be marginally significant (Table 7-2 [j4]:  $p=0.055$ ) with the high versus background contrast being significant (Adj. RR=7.29, 95% C.I.: [1.23,42.71],  $p=0.028$ ) and the low versus background contrast being nonsignificant ( $p=0.882$ ).

The frequencies of study participants with a sun exposure-related malignant skin neoplasm on the ear, face, head, and neck versus the frequencies of study participants without a sun exposure-related malignant skin neoplasm were compared for Ranch Hand enlisted groundcrew in the unknown, low, and high current dioxin categories and for Comparison enlisted groundcrew in the background category. The unadjusted and the adjusted analyses exhibited nonsignificant overall contrasts (Table 7-12 [i5] and [j5]:  $p=0.114$  and  $p=0.149$ , respectively). The Ranch Hand versus Comparison contrasts were nonsignificant.

The frequencies of study participants with a sun exposure-related malignant skin neoplasm on other sites versus the frequencies of study participants without a sun exposure-related malignant skin neoplasm were compared for Ranch Hand enlisted groundcrew in the unknown, low, and high current dioxin categories and for Comparison enlisted groundcrew in the background category. The unadjusted analysis displayed a marginally significant overall contrast (Table 7-12 [i6]:  $p=0.091$ ). The relative frequencies of participants within the background, unknown, low, and high current dioxin categories were 1.8, 0.0, 4.5, and 0.7 percent. None of the Ranch Hand versus Comparison contrasts was significant ( $p>0.25$  for each contrast). The adjusted analysis also contained a marginally significant overall contrast (Table 7-12 [j6]:  $p=0.082$ ) with nonsignificant Ranch Hand versus Comparison contrasts for low versus background ( $p=0.171$ ) and high versus background ( $p=0.360$ ).

### Multiple Basal Cell Carcinoma

For the analyses focusing on multiple basal cell carcinomas, mutually exclusive categories were constructed consisting of participants with only one basal cell carcinoma, two or more basal cell carcinomas, and no basal cell carcinomas. Logistic regression models were then used to estimate and evaluate relative risks based only on the participants with one basal cell carcinoma versus no basal cell carcinomas and on those participants with two or more basal cell carcinomas versus none.

#### *Model 1: Ranch Hands - Log<sub>2</sub> (Initial Dioxin)*

In the unadjusted and the adjusted analyses of the frequency of Ranch Hands with one or no basal cell carcinomas, the relative risks were found to be nonsignificant and less than 1 using models with initial dioxin (Table 7-13 [a1-d1]:  $p>0.20$  for each analysis).

In the unadjusted analysis of the frequency of Ranch Hands with multiple basal cell carcinomas versus no basal cell carcinomas, the relative risk was significant but less than 1 (Table 7-13 [a2]: Est. RR=0.49,  $p=0.026$ ) under the minimal assumption. The relative frequencies of Ranch Hands with multiple basal cell carcinoma within the low, medium, and

TABLE 7-13.

**Analysis of Basal Cell Carcinoma  
(One versus None)**

<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted</b>					
Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a1) Minimal (n=478)	Low	113	7.1	0.82 (0.58,1.16)	0.244
	Medium	238	5.5		
	High	127	4.7		
b1) Maximal (n=689)	Low	178	6.7	0.89 (0.69,1.13)	0.314
	Medium	333	6.0		
	High	178	4.5		
<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted</b>					
Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>		p-Value		Covariate Remarks
c1) Minimal (n=466)	0.84 (0.59,1.20)		0.321		ETHBACK (p=0.107) SUN2HR (p=0.031) SUNRPT (p=0.064)
d1) Maximal (n=673)	0.94 (0.73,1.21)		0.629		AGE (p=0.092) ETHBACK (p=0.067) SUN2HR (p=0.091) SUNRPT (p=0.084)

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

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-13. (Continued)

Analysis of Basal Cell Carcinoma  
(Multiple versus None)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a2) Minimal (n=462)	Low	110	4.5	0.49 (0.24,1.01)	0.026
	Medium	230	2.2		
	High	122	0.8		
b2) Maximal (n=664)	Low	169	1.8	0.74 (0.48,1.14)	0.147
	Medium	324	3.4		
	High	171	0.6		

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c2) Minimal (n=462)	0.59 (0.28,1.26)	0.127	AGE (p=0.084) HAIR (p=0.062)
d2) Maximal (n=664)	0.80 (0.49,1.28)	0.324	AGE (p=0.032) SUNRPT (p=0.117) HAIR (p=0.070)

<sup>a</sup>Relative risk for a twofold increase in dioxin.Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.  
Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.<sup>a</sup>Relative risk for a twofold increase in dioxin.p-Value for significance of relative risk for a twofold increase in dioxin:  
Test of significance for homogeneity of relative risk (current dioxin versus historical dioxin):  
Test of significance for difference in relative risk between current dioxin and historical dioxin:  
Note: Minimal--Low: >52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.  
Maximal--Low: >25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-13. (Continued)

Analysis of Basal Cell Carcinoma  
(One versus None)Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Percent Yes/(n) Current Dioxin			Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
		Low	Medium	High		
<b>e1) Minimal</b>						
(n=478)	≤18.6	7.8 (64)	6.0 (117)	5.6 (54)	0.77 (0.45,1.33)	0.926 <sup>b</sup> 0.347 <sup>c</sup>
	>18.6	7.8 (51)	4.2 (119)	4.1 (73)	0.80 (0.48,1.33)	0.388 <sup>c</sup>
<b>f1) Maximal</b>						
(n=689)	≤18.6	6.1 (99)	8.0 (174)	3.7 (81)	0.90 (0.63,1.28)	0.874 <sup>b</sup> 0.544 <sup>c</sup>
	>18.6	6.4 (78)	5.6 (160)	3.1 (97)	0.86 (0.60,1.24)	0.419 <sup>c</sup>

Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
<b>g1) Minimal</b>				
(n=466)	≤18.6	0.80 (0.47,1.37)	0.967 <sup>b</sup> 0.418 <sup>c</sup>	ETHBACK (p=0.111) SUN2HR (p=0.033)
	>18.6	0.82 (0.49,1.35)	0.428 <sup>c</sup>	SUNRPT (p=0.063)
<b>h1) Maximal</b>				
(n=673)	≤18.6	0.99 (0.68,1.43)	0.776 <sup>b</sup> 0.949 <sup>c</sup>	AGE (p=0.074) ETHBACK (p=0.064)
	>18.6	0.92 (0.63,1.34)	0.652 <sup>c</sup>	SUN2HR (p=0.098) SUNRPT (p=0.081)

<sup>a</sup>Relative risk for a twofold increase in dioxin.<sup>b</sup>Test of significance for homogeneity of relative risks (current dioxin continuous, time categorized).<sup>c</sup>Test of significance for relative risk equal to 1 (current dioxin continuous, time categorized).Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 7-13. (Continued)

Analysis of Basal Cell Carcinoma  
(Multiple versus None)Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Percent Yes/(n) Current Dioxin			Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
		Low	Medium	High		
e2) Minimal (n=462)	≤18.6	1.7 (60)	3.5 (114)	0.0 (51)	0.50 (0.16,1.60)	0.866 <sup>b</sup> 0.247 <sup>c</sup>
	>18.6	6.0 (50)	1.7 (116)	1.4 (71)	0.44 (0.16,1.24)	0.121 <sup>c</sup>
f2) Maximal (n=664)	≤18.6	3.1 (96)	3.0 (165)	0.0 (78)	0.69 (0.35,1.36)	0.731 <sup>b</sup> 0.282 <sup>c</sup>
	>18.6	0.0 (73)	3.8 (157)	1.1 (95)	0.81 (0.45,1.45)	0.471 <sup>c</sup>

Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
g2) Minimal (n=462)	≤18.6	0.66 (0.20,2.22)	0.911 <sup>b</sup>	AGE (p=0.100)
	>18.6	0.61 (0.22,1.65)	0.506 <sup>c</sup> 0.327 <sup>c</sup>	HAIR (p=0.062)
h2) Maximal (n=664)	≤18.6	0.79 (0.37,1.68)	0.772 <sup>b</sup>	AGE (p=0.029)
	>18.6	0.92 (0.49,1.73)	0.546 <sup>c</sup> 0.788 <sup>c</sup>	SUNRPT (p=0.117) HAIR (p=0.067)

<sup>a</sup>Relative risk for a twofold increase in dioxin.<sup>b</sup>Test of significance for homogeneity of relative risks (current dioxin continuous, time categorized).<sup>c</sup>Test of significance for relative risk equal to 1 (current dioxin continuous, time categorized).Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 7-13. (Continued)

**Analysis of Basal Cell Carcinoma  
(One versus None)  
(Verified)**

**i1) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	732	5.7	All Categories		0.524
Unknown	324	6.5	Unknown vs. Background	1.14 (0.66,1.96)	0.732
Low	179	6.1	Low vs. Background	1.08 (0.54,2.13)	0.950
High	178	3.4	High vs. Background	0.57 (0.24,1.37)	0.276
Total	1,413				

**j1) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	712	All Categories		0.515	ETHBACK (p=0.097)
Unknown	315	Unknown vs. Background	1.13 (0.64,1.98)	0.672	SUN2HR (p=0.035)
Low	175	Low vs. Background	1.18 (0.59,2.36)	0.646	SUNRPT (p=0.027)
High	174	High vs. Background	0.60 (0.25,1.44)	0.250	LAT (p=0.120)
Total	1,376				XRAY (p=0.042)

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt < Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin >33.3 ppt.

**TABLE 7-13. (Continued)**  
**Analysis of Basal Cell Carcinoma**  
**(Multiple versus None)**  
**(Verified)**

**j2) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	697	1.0	All Categories		0.053
Unknown	312	2.9	Unknown vs. Background	2.93 (1.08,7.93)	0.060
Low	173	2.9	Low vs. Background	2.93 (0.92,9.36)	0.139
High	173	0.6	High vs. Background	0.57 (0.07,4.69)	0.999
Total	1,355				

**j2) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	691	All Categories		0.078	AGE (p=0.012) SUN2HR (p=0.048)
Unknown	311	Unknown vs. Background	2.95 (1.05,8.29)	0.039	SUNRPT (p=0.038)
Low	173	Low vs. Background	3.59 (1.07,12.04)	0.038	LAT (p=0.026)
High	173	High vs. Background	0.89 (0.11,7.56)	0.915	HAIR (p<0.001)
Total	1,348				

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt  $<$  Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin  $>$ 33.3 ppt.

high initial dioxin categories were 4.5, 2.2, and 0.8 percent. Under the maximal assumption, the unadjusted relative risk was nonsignificant (Table 7-13 [b2]:  $p=0.147$ ). After adjusting for age and hair color in the minimal analysis, the adjusted relative risk became nonsignificant (Table 7-13 [c2]:  $p=0.127$ ). In the maximal analysis, the adjusted relative risk remained nonsignificant (Table 7-13 [d2]:  $p=0.324$ ).

#### ***Model 2: Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time***

In the unadjusted and the adjusted analyses of the frequency of Ranch Hands with one or no basal cell carcinomas, the interactions between current dioxin and time since tour were nonsignificant under both the minimal and maximal assumption (Table 7-13 [e1-h1]:  $p>0.75$  for each interaction). Corresponding unadjusted and adjusted analyses of the frequency of Ranch Hands with multiple basal cell carcinomas versus no basal cell carcinomas also found nonsignificant current dioxin-by-time interactions (Table 7-13 [e2-h2]:  $p>0.70$  for each interaction). All relative risks within each time stratum were less than 1 and nonsignificant.

#### ***Model 3: Ranch Hands and Comparisons by Current Dioxin Category***

In the unadjusted and the adjusted analyses of the frequency of participants with one basal cell carcinoma versus no basal cell carcinomas, the overall contrasts of Ranch Hands in the unknown, low, and high current dioxin categories and Comparisons in the background current dioxin category were nonsignificant (Table 7-13 [i1] and [j1]:  $p=0.524$  and  $p=0.515$ , respectively). All Ranch Hand versus Comparison contrasts were nonsignificant.

In the unadjusted analysis of the frequency of participants with multiple basal cell carcinomas versus no basal cell carcinomas, the overall contrast was marginally significant (Table 7-13 [i2]:  $p=0.053$ ). The relative frequencies of participants with multiple basal cell carcinomas were 1.0, 2.9, 2.9, and 0.6 percent for the background, unknown, low, and high current dioxin categories. The unknown versus background contrast was marginally significant with a relative risk greater than 1 (Est.  $RR=2.93$ , 95% C.I.: [1.08,7.93],  $p=0.060$ ). The low versus background contrast was nonsignificant ( $p=0.139$ ) as was the high versus background contrast ( $p=0.999$ ). After adjusting for age, average lifetime residential latitude, hair color, and the two skin reaction to sun exposure covariates, the overall contrast remained marginally significant (Table 7-13 [j2]:  $p=0.078$ ). The unknown versus background contrast became significant (Adj.  $RR=2.95$ , 95% C.I.: [1.05,8.29],  $p=0.039$ ) as did the low versus background contrast (Adj.  $RR=3.59$ , 95% C.I.: [1.07,12.04],  $p=0.038$ ). The high versus background contrast remained nonsignificant ( $p=0.915$ ) in the adjusted analysis.

### **All Systemic Neoplasms**

#### ***Model 1: Ranch Hands - Log<sub>2</sub> (Initial Dioxin)***

Under the minimal assumption, the unadjusted analysis of the frequency of Ranch Hands with a verified systemic neoplasm (malignant plus benign) exhibited a nonsignificant relative risk greater than 1 with respect to initial dioxin (Table 7-14 [a]:  $p=0.319$ ). Under the maximal assumption, the unadjusted analysis revealed a significant relative risk greater than 1 (Table 7-14 [b]: Est.  $RR=1.28$ ,  $p=0.009$ ). The relative frequencies of Ranch Hands with a verified systemic neoplasm under the maximal assumption were 2.2, 9.7, and 10.2 percent for the low, medium, and high initial dioxin category. Under the minimal assumption, the relative risk remained nonsignificant after covariate adjustment (Table 7-14 [c]:  $p=0.109$ ). Under the

**TABLE 7-14.**  
**Analysis of All Systemic Neoplasms**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a) Minimal (n=521)	Low	130	7.7	1.13 (0.89,1.42)	0.319
	Medium	260	8.8		
	High	131	13.0		
b) Maximal (n=742)	Low	185	2.2	1.28 (1.07,1.53)	0.009
	Medium	371	9.7		
	High	186	10.2		

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c) Minimal (n=515)	1.22 (0.96,1.55)	0.109	AGE (p=0.005) RACE (p=0.147) CARCIN (p=0.121)
d) Maximal (n=722)	1.32 (1.09,1.61)	0.006	AGE (p=0.002) RACE (p=0.118) CARCIN (p=0.041) DRKYR (p=0.082)

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

Note: Minimal-Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal-Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-14. (Continued)

## Analysis of All Systemic Neoplasms

Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Percent Yes/(n) Current Dioxin			Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
		Low	Medium	High		
e) Minimal (n=521)	≤18.6	11.1 (72)	7.0 (128)	9.3 (54)	0.97 (0.64,1.47)	0.445 <sup>b</sup> 0.868 <sup>c</sup>
	>18.6	5.2 (58)	10.6 (132)	14.3 (77)	1.18 (0.88,1.58)	0.277 <sup>c</sup>
f) Maximal (n=742)	≤18.6	2.8 (106)	8.4 (191)	7.2 (83)	1.26 (0.93,1.70)	0.860 <sup>b</sup> 0.139 <sup>c</sup>
	>18.6	6.3 (79)	8.4 (179)	13.5 (104)	1.22 (0.96,1.53)	0.098 <sup>c</sup>

Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
g) Minimal (n=515)	≤18.6	1.14 (0.74,1.76)	0.635 <sup>b</sup>	AGE (p=0.006)
	>18.6	1.29 (0.95,1.75)	0.565 <sup>c</sup> 0.105 <sup>c</sup>	CARCIN (p=0.133)
h) Maximal (n=722)	≤18.6	1.42 (1.02,1.98)	0.564 <sup>b</sup>	AGE (p=0.001)
	>18.6	1.26 (0.99,1.62)	0.036 <sup>c</sup> 0.065 <sup>c</sup>	RACE (p=0.116) DRKYR (p=0.073) CARCIN (p=0.038)

<sup>a</sup>Relative risk for a twofold increase in dioxin.<sup>b</sup>Test of significance for homogeneity of relative risks (current dioxin continuous, time categorized).<sup>c</sup>Test of significance for relative risk equal to 1 (current dioxin continuous, time categorized).Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

**TABLE 7-14. (Continued)**
**Analysis of All Systemic Neoplasms  
(Verified)**
*Model 2: Ranch Hands*

In the unadjusted minimum contrast analyses of the frequency of systemic neoplasms with a defined systemic neoplasia, the contrast between the current dioxin category and the background was nonsignificant (Table 7-14 [i1]).

**j1) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	786	8.3	All Categories		0.087
Unknown	345	5.2	Unknown vs. Background	0.61 (0.36,1.05)	0.072
Low	196	9.7	Low vs. Background	1.19 (0.70,2.04)	0.524
High	187	10.7	High vs. Background	1.33 (0.78,2.25)	0.294
Total	1,514				

**j1) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	786	All Categories		0.021	AGE (p<0.001)
Unknown	345	Unknown vs. Background	0.59 (0.35,1.02)	0.057	
Low	196	Low vs. Background	1.21 (0.70,2.08)	0.488	
High	187	High vs. Background	1.65 (0.96,2.83)	0.072	
Total	1,514				

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt < Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin >33.3 ppt.

For the unadjusted minimum contrast analyses, the background, unknown, low, and high current dioxin categories versus background contrast was also marginally significant with a relative risk less than 1 (Est. RR=0.60, 95% C.I.: [0.35,1.03], p=0.063). The other two Ranch Hand contrasts were nonsignificant (p>0.30). Adjusting for age, the overall contrast was significant (Table 7-14 [j2], p=0.022). The unknown versus background contrast was significant with an adjusted relative risk less than 1 (Adj. RR=0.58, 95% C.I.: [0.34,1.00], p=0.050) and the high versus background contrast was marginally significant with an adjusted relative risk greater than 1 (Adj. RR=1.61, 95% C.I.: [0.94, 2.77], p=0.085). The low versus background contrast had an adjusted relative risk that was greater than 1 but nonsignificant (p=0.528).

TABLE 7-14. (Continued)

Analysis of All Systemic Neoplasms  
(Verified and Suspected)

## i2) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	786	8.4	All Categories		0.084
Unknown	345	5.2	Unknown vs. Background	0.60 (0.35,1.03)	0.063
Low	196	9.7	Low vs. Background	1.17 (0.69,2.00)	0.564
High	187	10.7	High vs. Background	1.31 (0.77,2.22)	0.321
Total	1,514				

## j2) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	786	All Categories		0.022	AGE (p<0.001)
Unknown	345	Unknown vs. Background	0.58 (0.34,1.00)	0.050	
Low	196	Low vs. Background	1.19 (0.69,2.04)	0.528	
High	187	High vs. Background	1.61 (0.94,2.77)	0.085	
Total	1,514				

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.Low (Ranch Hands): 15 ppt < Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin &gt;33.3 ppt.

\*Relative risk for a twofold increase in dioxin.

\*\*Test of significance for homogeneity of relative risks (Current dioxin categories).

\*\*\*Test of significance for relative risk equal to 1 (Current dioxin categories).

Note: Minimal=Low &lt;10-14.65 ppt; Medium =14.65-45.75 ppt; High =45.75-100 ppt.

Maximal=Low &gt;100 ppt; Medium =45.75-133.3 ppt; High =133.3 ppt.

maximal assumption, the relative risk remained significant and greater than 1 in the adjusted analysis (Table 7-14 [d]: Adj. RR=1.32, p=0.006).

### ***Model 2: Ranch Hands - Log2 (Current Dioxin) and Time***

In the unadjusted minimal and maximal analyses of the frequency of Ranch Hands with a verified systemic neoplasm, the interactions between current dioxin and time since tour were nonsignificant (Table 7-14 [e] and [f]: p=0.445 and p=0.860, respectively). Under the maximal assumption, Ranch Hands whose time since tour exceeded 18.6 years displayed a marginally significant relative risk greater than 1 (Est. RR=1.22, p=0.098). For that time stratum, the relative frequencies of Ranch Hands with low, medium, and high current dioxin were 6.3, 8.4, and 13.5 percent. Under the minimal and maximal assumptions, the interactions between current dioxin and time in the adjusted analyses were nonsignificant (Table 7-14 [g] and [h]: p=0.635 and p=0.564, respectively); thus the relative risks of the two time strata were not significantly different. However, under the maximal assumption, Ranch Hands with later tours displayed a significant adjusted relative risk greater than 1 (Adj. RR=1.42, p=0.036) and Ranch Hands with earlier tours displayed a marginally significant adjusted relative risk greater than 1 (Adj. RR=1.26, p=0.065) also.

### ***Model 3: Ranch Hands and Comparisons by Current Dioxin Category***

In the unadjusted analysis of the relative frequency of participants with a verified systemic neoplasm, the overall contrast of Ranch Hands in the unknown, low, and high current dioxin categories and Comparisons in the background current dioxin category was marginally significant (Table 7-14 [i1]: p=0.087). The relative frequencies of participants with a verified systemic neoplasm for the background, unknown, low, and high current dioxin categories were 8.3, 5.2, 9.7, and 10.7 percent. The unknown versus background contrast was also marginally significant (p=0.072) with a relative risk less than 1 (Est. RR=0.61, 95% C.I.: [0.36,1.05]). The low versus background and the high versus background contrasts were nonsignificant (p=0.524 and p=0.294, respectively). After adjusting for age, the overall contrast became significant (Table 7-14 [j1]: p=0.021). The unknown versus background contrast displayed a marginally significant adjusted relative risk that was less than 1 (Adj. RR=0.59, 95% C.I.: [0.35,1.02], p=0.057); the high versus background contrast exhibited a marginally significant relative risk greater than 1 (Adj. RR=1.65, 95% C.I.: [0.96,2.83], p=0.072); and the low versus background contrast was nonsignificant (p=0.488).

The corresponding unadjusted analysis of the combination of verified and suspected systemic neoplasms was also marginally significant (Table 7-14 [i2]: p=0.084) with relative frequencies of 8.4, 5.2, 9.7, and 10.7 percent for the background, unknown, low, and high current dioxin categories. The unknown versus background contrast was also marginally significant with a relative risk less than 1 (Est. RR=0.60, 95% C.I.: [0.35,1.03], p=0.063). The other two Ranch Hand contrasts were nonsignificant (p>0.30). Adjusting for age, the overall contrast was significant (Table 7-14 [j2]: p=0.022). The unknown versus background contrast was significant with an adjusted relative risk less than 1 (Adj. RR=0.58, 95% C.I.: [0.34,1.00], p=0.050) and the high versus background contrast was marginally significant with an adjusted relative risk greater than 1 (Adj. RR=1.61, 95% C.I.: [0.94, 2.77], p=0.085). The low versus background contrast had an adjusted relative risk that was greater than 1 but nonsignificant (p=0.528).

## Malignant Systemic Neoplasms

### *Model 1: Ranch Hands - Log2 (Initial Dioxin)*

Under the minimal assumption, the unadjusted analysis of the frequency of Ranch Hands with a verified malignant systemic neoplasm exhibited a significant relative risk with respect to initial dioxin (Table 7-15 [a]: Est. RR=0.56, p=0.048). However, the relative risk was less than 1. For that analysis, the relative frequencies of Ranch Hands with a verified malignant systemic neoplasm within the low, medium, and high initial dioxin categories were 1.5, 3.8, and 0.0 percent. Under the maximal assumption, the unadjusted analysis revealed a nonsignificant relative risk that also was less than 1 (Table 7-15 [b]: p=0.598). Under each assumption, the adjusted relative risk was nonsignificant (Table 7-15 [c] and [d]: p=0.144 and p=0.859).

### *Model 2: Ranch Hands - Log2 (Current Dioxin) and Time*

Under both assumptions, the unadjusted analyses of the frequency of Ranch Hands with a verified malignant systemic neoplasm displayed nonsignificant interactions between current dioxin and time since tour (Table 7-15 [e] and [f]: p=0.908 and p=0.352). The corresponding adjusted analyses also displayed nonsignificant interactions between current dioxin and time since tour (Table 7-15 [g] and [h]: p=0.899 and p=0.317). Associations with current dioxin were not significant within each time stratum.

### *Model 3: Ranch Hands and Comparisons by Current Dioxin Category*

In the unadjusted analysis of the relative frequency of participants with a verified malignant systemic neoplasm, the overall contrast of Ranch Hands in the unknown, low, and high current dioxin categories and Comparisons in the background current dioxin category was significant (Table 7-15 [i]: p=0.001). The relative frequencies of participants with a verified malignant systemic neoplasm for the background, unknown, low, and high categories were 1.7, 1.2, 5.1, and 0.0 percent. The low versus background contrast was also significant with a relative risk greater than 1 (Est. RR=3.20, 95% C.I.: [1.38,7.40], p=0.016). The other two Ranch Hand versus Comparison contrasts were nonsignificant (p=0.740 and p=0.122 for the unknown versus background and high versus background contrasts). The adjusted analysis for verified malignant systemic neoplasms also contained a significant overall contrast (Table 7-15 [j]: p=0.002) with a nonsignificant unknown versus background contrast (p=0.502) and a significant low versus background contrast (Adj. RR=3.51, 95% C.I.: [1.50,8.25], p=0.004).

## Benign Systemic Neoplasms

Among the 42 Ranch Hands with nonmalignant systemic cancer, 45 different benign systemic neoplasms were identified. Lipomas accounted for 75.6 percent (34/45) of the total; 91.2 percent (31/34) of the lipomas were found in the subcutaneous tissues at various body locations. Three hemangiomas, two dermoid cysts, two fibromas, one benign adenolymphoma, one neurofibroma, one facial fibroma, and one adenoma were also found.

Among the 47 Comparisons with benign systemic cancer, 47 different systemic neoplasms were identified. Lipomas accounted for 70.2 percent (33/47). Of these, 90.9 percent (30/33) were in the subcutaneous tissue of various body locations. Also identified were five benign neoplasms where the cell type was not specified (one each in maxillary

**TABLE 7-15.**  
**Analysis of Malignant Systemic Neoplasms**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a) Minimal (n=521)	Low	130	1.5	0.56 (0.29,1.07)	0.048
	Medium	260	3.8		
	High	131	0.0		
b) Maximal (n=742)	Low	185	0.5	0.90 (0.60,1.35)	0.598
	Medium	371	3.5		
	High	186	0.0		

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c) Minimal (n=521)	0.63 (0.32,1.25)	0.144	AGE (p=0.019)
d) Maximal (n=733)	0.96 (0.63,1.48)	0.859	AGE (p=0.027) DRKYR (p=0.135)

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

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.  
Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-15. (Continued)

## Analysis of Malignant Systemic Neoplasms

Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Percent Yes/(n)			Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
		Low	Medium	High		
e) Minimal (n=521)	≤18.6	2.8 (72)	3.1 (128)	0.0 (54)	0.53 (0.19,1.52)	0.908 <sup>b</sup>
	>18.6	0.0 (58)	4.5 (132)	0.0 (77)	0.49 (0.18,1.31)	0.238 <sup>c</sup>
f) Maximal (n=742)	≤18.6	0.0 (106)	3.1 (191)	0.0 (83)	1.06 (0.56,2.00)	0.352 <sup>b</sup>
	>18.6	2.5 (79)	3.4 (179)	0.0 (104)	0.70 (0.38,1.28)	0.858 <sup>c</sup>

Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
g) Minimal (n=521)	≤18.6	0.66 (0.22,1.94)	0.899 <sup>b</sup>	AGE (p=0.026)
	>18.6	0.60 (0.23,1.59)	0.448 <sup>c</sup>	
h) Maximal (n=742)	≤18.6	1.24 (0.63,2.44)	0.317 <sup>b</sup>	AGE (p=0.014)
	>18.6	0.78 (0.41,1.47)	0.525 <sup>c</sup>	

<sup>a</sup>Relative risk for a twofold increase in dioxin.<sup>b</sup>Test of significance for homogeneity of relative risks (current dioxin continuous, time categorized).<sup>c</sup>Test of significance for relative risk equal to 1 (current dioxin continuous, time categorized).Note: Minimal-Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.Maximal-Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

**TABLE 7-15. (Continued)****Analysis of Malignant Systemic Neoplasms  
(Verified)****i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	786	1.7	All Categories		0.001
Unknown	345	1.2	Unknown vs. Background	0.70 (0.23,2.16)	0.740
Low	196	5.1	Low vs. Background	3.20 (1.38,7.40)	0.016
High	187	0.0	High vs. Background	--	0.122
Total	1,514				

**j) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	784	All Categories		0.002	AGE (p=0.003) DRKYR (p=0.128)
Unknown	342	Unknown vs. Background	0.68 (0.22,2.11)	0.502	
Low	194	Low vs. Background	3.51 (1.50,8.25)	0.004	
High	183	High vs. Background	--	--	
Total	1,503				

--: Relative risk/confidence interval/p-value not given due to the sparse number of abnormalities.

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt  $<$  Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin  $>$ 33.3 ppt.

sinus, connective tissue of the breast, spermatic cord, urinary bladder, and thyroid gland), two hemangiomas, two papillomas, one benign mesothelioma, one fibroma, one neurilemmoma, one intradermal nevus, and one adenomatous polyp.

#### ***Model 1: Ranch Hands - Log<sub>2</sub> (Initial Dioxin)***

Under the minimal and maximal assumptions, the unadjusted analysis of the frequency of Ranch Hands with a verified benign systemic neoplasm exhibited a significant relative risk that was greater than 1 (Table 7-16 [a] and [b]: Est. RR=1.36, p=0.022 and Est. RR=1.41, p=0.001, respectively). In the minimal analysis, the relative frequencies of Ranch Hands with a verified benign systemic neoplasm for the low, medium, and high initial dioxin categories were 5.4, 4.6, and 12.2 percent. In the maximal analysis, the corresponding relative frequencies were 1.6, 5.7, and 9.7 percent. The adjusted analyses also produced significant relative risks that were greater than 1 under both assumptions (Table 7-16 [c] and [d]: Adj. RR=1.40, p=0.015 and Adj. RR=1.49, p<0.001).

#### ***Model 2: Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time***

Under the minimal and maximal assumptions, the unadjusted analysis for verified benign systemic neoplasms displayed nonsignificant current dioxin-by-time since tour interactions (Table 7-16 [e] and [f]: p=0.583 and p=0.879, respectively). For both assumptions, Ranch Hands with earlier tours (i.e., over 18.6 years) had significant relative risks that exceeded 1 (minimal assumption, Est. RR=1.42, p=0.035; maximal assumption, Est. RR=1.39, p=0.013). In the minimal analysis, the relative frequencies of participants with a verified benign systemic neoplasm for low, medium, and high current dioxin were 3.4, 6.1, and 13.0 percent for the earlier tour stratum. In the maximal analysis, the corresponding relative frequencies were 3.8, 4.5, and 12.5 percent for the same time stratum. Under the maximal assumption, the relative risk for Ranch Hands with later tours (i.e.,  $\leq 18.6$  years) also displayed a marginally significant relative risk greater than 1 (Est. RR=1.35, p=0.095). The associated relative frequencies were 2.8, 4.7, and 7.2 percent for low, medium, and high current dioxin.

Under the minimal assumption, an adjusted model produced a nonsignificant interaction between current dioxin and time (Table 7-16 [g]: p=0.610) and a significant relative risk (Adj. RR=1.45, p=0.026) greater than 1 for Ranch Hands with earlier tours (over 18.6 years). Under the maximal assumption, an adjusted model containing the covariates of age and race also displayed a nonsignificant interaction between current dioxin and time (Table 7-16 [h]: p=0.964); although there were significant relative risks greater than 1 for each time stratum ( $\leq 18.6$  years: Adj. RR=1.50, p=0.030;  $> 18.6$  years: Adj. RR=1.52, p=0.003).

#### ***Model 3: Ranch Hands and Comparisons by Current Dioxin Category***

In the unadjusted analysis, the overall contrast of the relative frequencies of participants with a verified benign systemic neoplasm for Ranch Hands in the unknown, low, and high current dioxin categories and Comparisons in the background current dioxin category was significant (Table 7-16 [i]: p=0.044). The relative frequencies of participants with a verified benign systemic neoplasm within the background, unknown, low, and high current dioxin categories were 6.0, 4.1, 4.6, and 10.2 percent. Of the three Ranch Hand versus Comparison contrasts, only the high versus background contrast was significant with a relative risk greater than 1 (Est. RR=1.78, 95% C.I.: [1.02,3.11], p=0.043). The other two contrasts had relative risks less than 1 and were nonsignificant (p>0.15).

**TABLE 7-16.**  
**Analysis of Benign Systemic Neoplasms**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a) Minimal (n=521)	Low	130	5.4	1.36 (1.05,1.76)	0.022
	Medium	260	4.6		
	High	131	12.2		
b) Maximal (n=742)	Low	185	1.6	1.41 (1.15,1.72)	0.001
	Medium	371	5.7		
	High	186	9.7		

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c) Minimal (n=521)	1.40 (1.07,1.81)	0.015	RACE (p=0.136)
d) Maximal (n=731)	1.49 (1.20,1.84)	<0.001	AGE (p=0.019) RACE (p=0.135) CARCIN (p=0.133)

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

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.  
Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

**TABLE 7-16. (Continued)****Analysis of Benign Systemic Neoplasms****Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Unadjusted**

Assumption	Time (Yrs.)	Percent Yes/(n)			Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
		Low	Medium	High		
e) Minimal (n=521)	≤18.6	6.9 (72)	3.9 (128)	9.3 (54)	1.21 (0.76,1.93)	0.583 <sup>b</sup> 0.414 <sup>c</sup>
	>18.6	3.4 (58)	6.1 (132)	13.0 (77)	1.42 (1.03,1.96)	0.035 <sup>c</sup>
f) Maximal (n=742)	≤18.6	2.8 (106)	4.7 (191)	7.2 (83)	1.35 (0.95,1.91)	0.879 <sup>b</sup> 0.095 <sup>c</sup>
	>18.6	3.8 (79)	4.5 (179)	12.5 (104)	1.39 (1.07,1.81)	0.013 <sup>c</sup>

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Adjusted**

Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
g) Minimal (n=521)	≤18.6	1.26 (0.79,2.00)	0.610 <sup>b</sup>	RACE (p=0.148)
	>18.6	1.45 (1.04,2.02)	0.340 <sup>c</sup> 0.026 <sup>c</sup>	
h) Maximal (n=742)	≤18.6	1.50 (1.04,2.17)	0.964 <sup>b</sup>	AGE (p=0.016)
	>18.6	1.52 (1.15,2.00)	0.030 <sup>c</sup> 0.003 <sup>c</sup>	RACE (p=0.125)

<sup>a</sup>Relative risk for a twofold increase in dioxin.<sup>b</sup>Test of significance for homogeneity of relative risks (current dioxin continuous, time categorized).<sup>c</sup>Test of significance for relative risk equal to 1 (current dioxin continuous, time categorized).Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

**TABLE 7-16. (Continued)****Analysis of Benign Systemic Neoplasms  
(Verified)****i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	786	6.0	All Categories		
Unknown	345	4.1	Unknown vs. Background	0.67 (0.36,1.23)	0.190
Low	196	4.6	Low vs. Background	0.76 (0.36,1.57)	0.455
High	187	10.2	High vs. Background	1.78 (1.02,3.11)	0.043
Total	1,514				

**j) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	786	All Categories		0.011	AGE (p=0.001)
Unknown	345	Unknown vs. Background	0.65 (0.35,1.20)	0.165	
Low	196	Low vs. Background	0.76 (0.37,1.59)	0.472	
High	187	High vs. Background	2.13 (1.20,3.79)	0.010	
Total	1,514				

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt  $<$  Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin  $>$ 33.3 ppt.

In the adjusted analysis of the frequency of participants with a verified benign systemic neoplasm, the overall contrast was also significant ( $p=0.011$ ) as was the high versus background contrast (Adj. RR=2.13, 95% C.I.: [1.20,3.79],  $p=0.010$ ). The other two Ranch Hand versus Comparison relative risks were nonsignificant and less than 1 ( $p>0.15$  for both contrasts).

### Systemic Neoplasms of Uncertain Behavior or Unspecified Nature

#### *Model 1: Ranch Hands - Log<sub>2</sub> (Initial Dioxin)*

Under the minimal and the maximal assumptions, the unadjusted analysis of the frequency of Ranch Hands with a verified systemic neoplasm of uncertain behavior or unspecified nature was nonsignificant with respect to initial dioxin (Table 7-17 [a] and [b]:  $p=0.693$  and  $p=0.691$ , respectively). Both analyses were based on three Ranch Hands with a systemic neoplasm of uncertain behavior or unspecified nature. Because of the sparse number of Ranch Hands with these neoplasms, the adjusted analyses considered only the age covariate. The adjusted relative risk under each assumption was nonsignificant (Table 7-17 [c] and [d]:  $p=0.947$  and  $p=0.498$ ).

#### *Model 2: Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time*

Under each assumption, three Ranch Hands had a verified systemic neoplasm of uncertain behavior or unspecified nature (one Ranch Hand within time less than or equal to 18.6 years and two Ranch Hands within time over 18.6 years). Due to the sparse number of Ranch Hands with these neoplasms, the interaction and relative risk for the later time since tour stratum were not evaluated for significance under either assumption. Under the minimal and maximal assumptions, the relative risks for time over 18.6 years were nonsignificant (Table 7-17 [e] and [f]:  $p=0.865$  and  $p=0.696$ , respectively). Because of the sparse numbers of Ranch Hands with these neoplasms, adjusted analyses were not performed.

#### *Model 3: Ranch Hands and Comparisons by Current Dioxin Category*

The overall contrast of the relative frequencies of Ranch Hands and Comparisons with a verified systemic neoplasm of uncertain behavior or unspecified nature was nonsignificant (Table 7-17 [i1]:  $p=0.253$ ). In this analysis, six Comparisons and one Ranch Hand had a verified systemic neoplasm. In the adjusted analysis, age was not retained in the final model; hence, the unadjusted and the adjusted results were the same. The overall contrast was also nonsignificant after including one suspected neoplasm (from a Comparison) with the preceding verified neoplasms (Table 7-17 [i2]:  $p=0.184$ ). No covariates were retained in the final adjusted model; therefore, the unadjusted and the adjusted results were identical.

### Systemic Neoplasms by Location/Site

The specified locations/sites used in the analyses of systemic neoplasms were determined from the locations/sites that were presented in the preceding AFHS report on the 1987 examination study (80). In many of these analyses, the number of participants with a systemic neoplasm for a specified location/site was very small or zero, thereby precluding an unadjusted and/or adjusted analysis. For completeness of documentation on analyses affected by sparse data, the relative frequencies and sample sizes are provided without the associated relative risks, confidence intervals, and p-values. Because of sparse numbers,

**TABLE 7-17.**  
**Analysis of Systemic Neoplasms of Uncertain  
Behavior or Unspecified Nature**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a) Minimal (n=521)	Low	130	0.8	0.82 (0.28,2.34)	0.693
	Medium	260	0.4		
	High	131	0.8		
b) Maximal (n=742)	Low	185	0.0	1.17 (0.55,2.52)	0.691
	Medium	371	0.5		
	High	186	0.5		

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c) Minimal (n=521)	0.97 (0.33,2.81)	0.947	AGE (p=0.124)
d) Maximal (n=742)	1.33 (0.61,2.93)	0.498	AGE (p=0.110)

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

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

**TABLE 7-17. (Continued)**

In the adjusted analysis of the six systemic neoplasms, the overall comparison of the high versus background control group was significant for all other two Ranch Hand versus Comparison groups (Table 7-17) ( $p < 0.15$  for both contrasts).

**Analysis of Systemic Neoplasms of Uncertain Behavior or Unspecified Nature**

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Unadjusted**

Assumption	Time (Yrs.)	Percent Yes/(n)			Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
		Low	Medium	High		
e) Minimal (n=521)	$\leq 18.6$	1.4 (72)	0.0 (128)	0.0 (54)	--	--
	$> 18.6$	1.7 (58)	0.0 (132)	1.3 (77)	0.90 (0.28,2.90)	0.865 <sup>b</sup>
f) Maximal (n=742)	$\leq 18.6$	0.0 (106)	0.5 (191)	0.0 (83)	--	--
	$> 18.6$	0.0 (79)	0.6 (179)	1.0 (104)	1.19 (0.49,2.91)	0.696 <sup>b</sup>

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time - Adjusted**

Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
g) Minimal (n=521)	$\leq 18.6$	--	--	--
	$> 18.6$	--	--	--
h) Maximal (n=742)	$\leq 18.6$	--	--	--
	$> 18.6$	--	--	--

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

<sup>b</sup>Test of significance for relative risk equal to 1 (current dioxin continuous, time categorized).

--: Relative risk/confidence interval/p-value not given due to the sparse number of abnormalities; adjusted analysis not performed due to the sparse number of abnormalities.

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.

Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

**TABLE 7-17. (Continued)**

**Analysis of Systemic Neoplasms of Uncertain  
Behavior or Unspecified Nature  
(Verified)**

**Model 1: Ranch Hands**

Under the minimal and maximal assumptions, all four Ranch Hands had a verified malignant systemic neoplasm of lymphoid and histiocytic tissue.

**i1) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	786	0.8	All Categories		0.253
Unknown	345	0.0	Unknown vs. Background	--	0.224
Low	196	0.0	Low vs. Background	--	0.524
High	187	0.5	High vs. Background	0.70 (0.08,5.84)	0.999
Total	1,514				

**j1) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	786	All Categories		0.253	--
Unknown	345	Unknown vs. Background	--	0.224	
Low	196	Low vs. Background	--	0.524	
High	187	High vs. Background	0.70 (0.08,5.84)	0.999	
Total	1,514				

--: Relative risk and confidence interval not given due to the sparse number of abnormalities.

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt < Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin >33.3 ppt.

Under the minimal assumption, only one Ranch Hand had a verified malignant systemic neoplasm of lymphoid and histiocytic tissue (Table 7-18 [a16]). Under the maximal assumption, two Ranch Hands had verified malignant systemic neoplasms of lymphoid and histiocytic tissue. In the maximal analysis, the relative risk was nonsignificant (Table 7-18 [b16]; p=0.745). No adjusted analyses were performed due to the sparse number of Ranch Hands with these neoplasms.

Under the minimal assumption, only one Ranch Hand had a verified malignant systemic neoplasm of lymphoid and histiocytic tissue (Table 7-18 [a16]). Under the maximal assumption, two Ranch Hands had verified malignant systemic neoplasms of lymphoid and histiocytic tissue. In the maximal analysis, the relative risk was nonsignificant (Table 7-18 [b16]; p=0.745). No adjusted analyses were performed due to the sparse number of Ranch Hands with these neoplasms.

TABLE 7-17. (Continued)

**Analysis of Systemic Neoplasms of Uncertain  
Behavior or Unspecified Nature  
(Verified and Suspected)**

**i2) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted**

Current Dioxin Category	n	Percent Yes	Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	786	0.9	All Categories		0.184
Unknown	345	0.0	Unknown vs. Background	--	0.155
Low	196	0.0	Low vs. Background	--	0.418
High	187	0.5	High vs. Background	0.60 (0.07,4.89)	0.999
Total	1,514				

**j2) Ranch Hands and Comparisons by Current Dioxin Category - Adjusted**

Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	786	All Categories		0.184	--
Unknown	345	Unknown vs. Background	--	0.155	
Low	196	Low vs. Background	--	0.418	
High	187	High vs. Background	0.60 (0.07,4.89)	0.999	
Total	1,514				

--: Relative risk and confidence interval not given due to the sparse number of abnormalities.

Note: Background (Comparisons): Current Dioxin  $\leq$ 10 ppt.

Unknown (Ranch Hands): Current Dioxin  $\leq$ 10 ppt.

Low (Ranch Hands): 15 ppt < Current Dioxin  $\leq$ 33.3 ppt.

High (Ranch Hands): Current Dioxin >33.3 ppt.

Relative risk for a profound increase in dioxin.

Type of sign: none for relative risk equal to 1 (current dioxin reference, this categorized).

--: Relative risk/confidence interval/p-value not given due to the sparse number of abnormalities, not performed due to the sparse number of abnormalities.

Note: Minimal-Low: <10-46.65 ppt; Medium: >14.45-33.3 ppt; High: >46.25 ppt.

Maximal-Low: >0-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

age was the only covariate used as a candidate covariate for any adjusted analysis that was undertaken in this section.

#### ***Model 1: Ranch Hands - Log2 (Initial Dioxin)***

Under the minimal and maximal assumptions, no Ranch Hands had a verified malignant systemic neoplasm for the ear, face, head, and neck (Table 7-18 [a1-d1]); oral cavity, pharynx, and larynx (Table 7-18 [a2-d2]); brain (Table 7-18 [a3-d3]); thymus and mediastinum (Table 7-18 [a4-d4]); thyroid gland (Table 7-18 [a5-d5]); colon and rectum (Table 7-18 [a7-d7]); ill-defined sites (Table 7-18 [a11-d11]); carcinoma in situ of penis (Table 7-18 [a12-d12]); and Hodgkin's disease (Table 7-18 [a14-d14]).

Under the minimal and maximal assumptions, only one Ranch Hand had a verified malignant systemic neoplasm of the bronchus and lung (Table 7-18 [a6-d6]); carcinoma in situ of other and unspecified sites (Table 7-18 [a13-d13]), and leukemia (Table 7-18 [a15-d15]).

Under the minimal assumption, four Ranch Hands had a verified malignant systemic neoplasm of the kidney and bladder. The relative risk was nonsignificant in the unadjusted analysis using initial dioxin (Table 7-18 [a8]:  $p=0.368$ ). Under the maximal assumption, five Ranch Hands had a verified malignant systemic neoplasm of the kidney and bladder. Again, the relative risk was nonsignificant (Table 7-18 [b8]:  $p=0.673$ ). An adjusted analysis under the minimal assumption was performed adjusting only for the covariate of age; the relative risk was not significant (Table 7-18 [c8]):  $p=0.583$ ). Age was not retained in the maximal adjusted analyses; therefore, the unadjusted and adjusted results were identical (Table 7-18 [b8] and [d8]).

Under the minimal and maximal assumptions, two Ranch Hands had a verified malignant systemic neoplasm of the prostate. In the unadjusted analyses, neither relative risk was significant (Table 7-18 [a9] and [b9]:  $p=0.522$  and  $p=0.933$ ). Adjusted analyses were not performed because of the sparse data.

Under the minimal and maximal assumptions, three Ranch Hands had a verified malignant systemic neoplasm of the testicles. In the unadjusted analyses, neither relative risk was significant (Table 7-18 [a10] and [b10]:  $p=0.363$  and  $p=0.999$ ). Due to the sparse frequency of Ranch Hands with these neoplasms, adjusted analyses were performed using only age as a candidate covariate. Under both assumptions, age was not retained in the model, hence the unadjusted and adjusted analyses were identical.

Under the minimal assumption, only one Ranch Hand had a verified malignant systemic neoplasm of lymphoid and histiocytic tissue (Table 7-18 [a16]). Under the maximal assumption, two Ranch Hands had verified malignant systemic neoplasms of lymphoid and histiocytic tissue. In the maximal analysis, the relative risk was nonsignificant (Table 7-18 [b16]:  $p=0.745$ ). No adjusted analyses were performed due to the sparse number of Ranch Hands with these neoplasms.

**TABLE 7-18.**
**Analysis of Malignant Systemic Neoplasms  
(Ear, Face, Head, and Neck)**
**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a1) Minimal (n=521)	Low	130	0.0	--	--
	Medium	260	0.0	--	--
	High	131	0.0	--	--
b1) Maximal (n=742)	Low	185	0.0	--	--
	Medium	371	0.0	--	--
	High	186	0.0	--	--

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	All Categories	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c1) Minimal (n=521)	--	--	0.184	--
d1) Maximal (n=742)	--	--	--	--

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

**TABLE 7-18. (Continued)**  
**Analysis of Malignant Systemic Neoplasms**  
**(Oral Cavity, Pharynx, and Larynx)**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a2) Minimal (n=521)	Low	130	0.0	--	--
	Medium	260	0.0	--	--
	High	131	0.0	--	--
b2) Maximal (n=742)	Low	185	0.0	--	--
	Medium	371	0.0	--	--
	High	186	0.0	--	--

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c2) Minimal (n=521)	--	--	--
d2) Maximal (n=742)	--	--	--

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.  
Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

**TABLE 7-18. (Continued)**  
**Analysis of Malignant Systemic Neoplasms**  
**(Brain)**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a3) Minimal (n=521)	Low	130	0.0	--	--
	Medium	260	0.0	--	--
	High	131	0.0	--	--
b3) Maximal (n=742)	Low	185	0.0	--	--
	Medium	371	0.0	--	--
	High	186	0.0	--	--

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c3) Minimal (n=521)	--	--	Minimal (n=521)
d3) Maximal (n=742)	--	--	Maximal (n=742)

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Thymus and Mediastinum)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a4) Minimal (n=521)	Low	130	0.0	--	--
	Medium	260	0.0	--	--
	High	131	0.0	--	--
b4) Maximal (n=742)	Low	185	0.0	--	--
	Medium	371	0.0	--	--
	High	186	0.0	--	--

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c4) Minimal (n=521)	--	--	--
d4) Maximal (n=742)	--	--	--

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Thyroid Gland)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a5) Minimal (n=521)	Low	130	0.0	--	--
	Medium	260	0.0	--	--
	High	131	0.0	--	--
b5) Maximal (n=742)	Low	185	0.0	--	--
	Medium	371	0.0	--	--
	High	186	0.0	--	--

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c5) Minimal (n=521)	--	--	--
d5) Maximal (n=742)	--	--	--

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

**TABLE 7-18. (Continued)**  
**Analysis of Malignant Systemic Neoplasms**  
**(Bronchus and Lung)**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a6) Minimal (n=521)	Low	130	0.0	0.64 (0.21, 1.83)	Insufficient data (n=0)
	Medium	260	0.4	0.86 (0.43, 1.73)	Insufficient data (n=0)
	High	131	0.0	0.64 (0.21, 1.83)	Insufficient data (n=0)
b6) Maximal (n=742)	Low	185	0.0	0.86 (0.43, 1.73)	Insufficient data (n=0)
	Medium	371	0.3	0.86 (0.43, 1.73)	Insufficient data (n=0)
	High	186	0.0	0.86 (0.43, 1.73)	Insufficient data (n=0)

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c6) Minimal (n=521)	0.75 (0.26, 2.21)	--	
d6) Maximal (n=742)	0.86 (0.43, 1.73)	--	Insufficient data (n=0)

--: Relative risk, confidence interval, and p-value not given due to the sparse number of abnormalities; adjusted analysis not performed due to the sparse number of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Colon and Rectum)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a7) Minimal (n=521)	Low	130	0.0	--	Minimal (n=521)
	Medium	260	0.0	--	Medium (n=521)
	High	131	0.0	--	High (n=521)
b7) Maximal (n=742)	Low	185	0.0	--	Minimal (n=742)
	Medium	371	0.0	--	Medium (n=742)
	High	186	0.0	--	High (n=742)

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c7) Minimal (n=521)	--	--	Minimal (n=521)
d7) Maximal (n=742)	--	--	Maximal (n=742)

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.  
Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Kidney and Bladder)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a8) Minimal (n=521)	Low	130	0.0	0.64 (0.23,1.83)	0.368
	Medium	260	1.5		
	High	131	0.0		
b8) Maximal (n=742)	Low	185	0.5	0.86 (0.43,1.73)	0.673
	Medium	371	1.1		
	High	186	0.0		

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c8) Minimal (n=521)	0.75 (0.26,2.21)	0.583	AGE (p=0.095)
d8) Maximal (n=742)	0.86 (0.43,1.73)	0.673	--

<sup>a</sup>Relative risk for a twofold increase in dioxin.Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Prostate)

## Ranch Hands - Log2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a9) Minimal (n=521)	Low	130	0.0	0.64 (0.15,2.82)	0.522
	Medium	260	0.8		
	High	131	0.0		
b9) Maximal (n=742)	Low	185	0.0	1.04 (0.39,2.81)	0.933
	Medium	371	0.5		
	High	186	0.0		

## Ranch Hands - Log2 (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c9) Minimal (n=521)	--	--	-- Minimal (83 (152=n)
d9) Maximal (n=742)	--	--	-- Maximal (83 (217=n)

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

--: Adjusted analysis not performed due to the sparse number of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Testicles)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.) <sup>a</sup>	p-Value
a10) Minimal (n=521)	Low	130	0.8	0.59 (0.17,2.09)	0.363
	Medium	260	0.8		
	High	131	0.0		
b10) Maximal (n=742)	Low	185	0.0	1.00 (0.44,2.30)	0.999
	Medium	371	0.8		
	High	186	0.0		

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c10) Minimal (n=521)	0.59 (0.17,2.09)	0.363	--
d10) Maximal (n=742)	1.00 (0.44,2.30)	0.999	--

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

Note: Minimal--Low: 52-93 ppt; Medium: &gt;93-292 ppt; High: &gt;292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: &gt;56.9-218 ppt; High: &gt;218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Ill-Defined Sites)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a11) Minimal (n=521)	Low	130	0.0	--	--
	Medium	260	0.0	--	--
	High	131	0.0	--	--
b11) Maximal (n=742)	Low	185	0.0	--	--
	Medium	371	0.0	--	--
	High	186	0.0	--	--

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c11) Minimal (n=521)	--	--	Minimal (012)
d11) Maximal (n=742)	--	--	Maximal (015)

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Carcinoma in Situ of Penis)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a12) Minimal (n=521)	Low	130	0.0	--	
	Medium	260	0.0	--	
	High	131	0.0	--	
b12) Maximal (n=742)	Low	185	0.0	--	
	Medium	371	0.0	--	
	High	186	0.0	--	

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c12) Minimal (n=521)	--	--	laminin-- (Elc (12c=n)
d12) Maximal (n=742)	--	--	laminin-- (Elb (24b=n)

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.  
Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

**Analysis of Malignant Systemic Neoplasms  
(Carcinoma in Situ of Other and Unspecified Sites)**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a13) Minimal (n=521)	Low	130	0.8	--	Minimal-- (521=n)
	Medium	260	0.0	--	Medium-- (521=n)
	High	131	0.0	--	High-- (521=n)
b13) Maximal (n=742)	Low	185	0.0	--	Minimal-- (742=n)
	Medium	371	0.3	--	Medium-- (742=n)
	High	186	0.0	--	High-- (742=n)

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c13) Minimal (n=521)	--	--	Minimal-- (521=n)
d13) Maximal (n=742)	--	--	Maximal-- (742=n)

--: Relative risk, confidence interval, and p-value not given due to the sparse number of abnormalities; adjusted analysis not performed due to the sparse number of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

**Analysis of Malignant Systemic Neoplasms  
(Other Malignant Neoplasms and Hematopoietic Tissue)**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted**

Assumption	Initial Dioxin (ppt)	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a14) Minimal (n=521)	Low	130	0.0	--	--
	Medium	260	0.0	--	--
	High	131	0.0	--	--
b14) Maximal (n=742)	Low	185	0.0	--	--
	Medium	371	0.0	--	--
	High	186	0.0	--	--

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted**

Assumption	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c14) Minimal (n=521)	--	--	--
d14) Maximal (n=742)	--	--	--

--: Relative risk, confidence interval, and p-value not given due to the absence of abnormalities; adjusted analysis not performed due to the absence of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.

TABLE 7-18. (Continued)

Analysis of Malignant Systemic Neoplasms  
(Carcinoma in Various Sites) (Leukemia)Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Percent Yes	Est. Relative Risk (95% C.I.)	p-Value
a15) Minimal (n=521)	Low	130	0.0	--	--
	Medium	260	0.4	--	--
	High	131	0.0	--	--
b15) Maximal (n=742)	Low	185	0.0	--	--
	Medium	371	0.3	--	--
	High	186	0.0	--	--

Ranch Hands - Log<sub>2</sub> (Initial Dioxin) - Adjusted

Assumption	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
c15) Minimal (n=521)	--	--	Minimal (n=521)
d15) Maximal (n=742)	--	--	Maximal (n=742)

--: Relative risk, confidence interval, and p-value not given due to the sparse number of abnormalities; adjusted analysis not performed due to the sparse number of abnormalities.

Note: Minimal--Low: 52-93 ppt; Medium: >93-292 ppt; High: >292 ppt.

Maximal--Low: 25-56.9 ppt; Medium: >56.9-218 ppt; High: >218 ppt.