

6. POST-SEA BIRTH DEFECTS

6.1 Post-SEA Exposure Analyses

The association between paternal dioxin and birth defects, grouped by CDC category, among children conceived during or after the father's duty in SEA were assessed with Models 1, 2 and 3. Each analysis was carried out twice, first with no restriction on sibship and again with the restriction to full siblings. The results are shown in Tables 6-1 through 6-78. When the data were not too sparse, analyses were carried out without and then with adjustment for covariates.

Listings of post-SEA children with anomalies in any of the 12 CDC categories are shown in Appendix Table D-1. Table D-1 also gives the father's current categorized dioxin level; children with multiple anomalies are listed for each anomaly.

Throughout this section, rates are computed as the number of occurrences of a birth defect per 1000 children.

Total Congenital Anomalies (All Children)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

Without adjustment for covariates (Table 6-1 [a] and [b]), there is no significant association between initial dioxin and total congenital anomalies among children of Ranch Hands with more than 10 ppt ($p=0.362$) or more than 5 ppt current dioxin ($p=0.861$).

After adjustment for covariates (Table 6-1 [c]), there is no significant association between total congenital anomalies and initial dioxin in the children of Ranch Hands with more than 10 ppt current dioxin ($p=0.261$).

After adjustment for covariates (Table 6-1 [d]), the association between initial dioxin level and total congenital anomalies in children of Ranch Hands with more than 5 ppt current dioxin varies significantly with the father's race ($p=0.020$). This changing association is displayed in Appendix Table D-2. The significance is caused by a low relative risk (OR=0.35 95% CI 0.11-1.15, $p=0.077$) among children of Black fathers. The relative risk among children of nonblack fathers was not significantly different from 1.0.

Table 6-1

Post-SEA Counts and Rates of Total Congenital Anomalies

Variable: Total Congenital Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	20	188.7	0.92(0.77,1.10)	0.362
	Medium	245	68	277.6		
	High	157	31	197.5		
b) D>5 ppt (n=690)	Low	155	35	225.8	0.99(0.87,1.12)	0.861
	Medium	308	72	233.8		
	High	227	49	215.9		

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted			
Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=458)	0.90(0.75,1.08)	0.261	RACE(p=0.028) OCC(p=0.062)
d) D>5 ppt (n=616)	0.93(0.80,1.08)***	0.358***	RACE*DIOXIN(p=0.020) OCC(p=0.003) F-AGE(p=0.033)

Total Congenital Anomalies (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-2 [a]), there is no significant variation in the association between total congenital anomalies and current dioxin and time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin (p=0.818). The relative risks among children of Ranch Hands with late (p=0.638) and early (p=0.389) tours are not significant.

Without adjustment for covariates (Table 6-2 [b]), there is no significant variation in the association between total congenital anomalies and current dioxin and time since duty in SEA among children of Ranch Hands with more than 5 ppt current dioxin ($p=0.274$). The relative risks among children of Ranch Hands with late ($p=0.604$) and early ($p=0.303$) tours were not statistically significant.

After adjustment for covariates (Table 6-2 [c]), there is significant variation in the association between total congenital anomalies and current dioxin and time since duty in SEA and the mother's drinking ($p=0.018$) among children of Ranch Hands having more than 10 ppt current dioxin. The basis for this variation is displayed in Appendix Table D-2. For the mothers who did not drink during pregnancy, there is no significant variation in the association between total congenital anomalies and current dioxin and time since duty in SEA ($p=0.857$). Furthermore the relative risks among children of Ranch Hands with late ($p=0.289$) or early ($p=0.155$) tours are not significantly different from 1. There was insufficient data to make similar comparisons in the other strata.

After adjustment for covariates (Table 6-2 [d]), there is significant variation in the association between total congenital anomalies and current dioxin with time since duty in SEA tour and the father's age at the time of conception ($p=0.033$) among children of Ranch Hands having more than 5 ppt current dioxin. The basis for this variation is displayed in Appendix Table D-2. For the fathers less than 30 years of age at time of conception, there is no significant variation in the association between the congenital anomalies and current dioxin and time since duty SEA ($p=0.720$). In that stratum, the relative risks among children of Ranch Hands with late ($p=0.294$) or early ($p=0.202$) tours are not significantly different from 1. For the fathers 30 years or older at the time of conception, there is a significant variation in the association between total congenital anomalies and current dioxin with time since duty in SEA ($p=0.046$). In that stratum, the negative relative risk among children of Ranch Hands with late tours was significantly less than 1 ($p=0.014$) while the risk for the early tours is not different from 1 ($p=0.739$).

If this variation in risk is ignored, there is no significant overall association between total congenital anomalies and current dioxin and time since duty in SEA ($p=0.241$). Furthermore, the association between total congenital anomalies and current dioxin is not significant among children whose father had a late ($p=0.194$) or early ($p=0.819$) tour.

Table 6-2

Post-SEA Counts and Rates of
Total Congenital Anomalies

Variable: Total Congenital Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)						0.818
	≤18.6	193.5 (12/62)	253.7 (34/134)	236.1 (17/72)	0.94(0.71,1.23)	0.638
	>18.6	275.0 (11/40)	250.0 (27/108)	204.3 (19/93)	0.90(0.70,1.15)	0.389
b) D>5 ppt (n=690)						0.274
	≤18.6	266.7 (24/90)	252.9 (44/174)	209.1 (23/110)	0.95(0.79,1.15)	0.604
	>18.6	95.2 (6/63)	279.4 (38/136)	179.5 (21/117)	1.10(0.92,1.32)	0.303

Table 6-2 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)			0.902***	RACE(p=0.012) SMOKE(p=0.110)
	≤18.6	0.90(0.67,1.20)***	0.465***	OCC(p=0.027) DRINK*TIME*
	>18.6	0.92(0.71,1.18)***	0.518***	DIOXIN(p=0.018)
d) D>5 ppt (n=616)			0.241***	OCC(p=0.001) F-AGE*TIME*
	≤18.6	0.87(0.70,1.08)***	0.194***	DIOXIN(p=0.033)
	>18.6	1.02(0.84,1.25)***	0.819***	

Total Congenital Anomalies (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-3 [a]), there is a borderline significant overall association between total congenital anomalies and categorized current dioxin (p=0.072). The total congenital anomaly rate in children of Ranch Hands in the Low category is significantly greater than that in children of Comparisons in the Background category (OR=1.58, 95% CI 1.10-2.27, p=0.013). The total congenital anomaly rates among children of Ranch Hands in the High (p=0.636), and Unknown (p=0.831) categories are not significantly different from the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-3 [b]), there is significant variation in the association between total congenital anomalies and categorized current dioxin with the father's military occupation (p=0.002). This changing association is displayed in Appendix Table D-2. The significance is primarily caused by the changes in the Low versus Background contrasts with occupation (officer OR=0.17, p=0.087; enlisted flyers OR=2.58, p=0.037, enlisted ground OR=1.72, p=0.022).

Table 6-3

Post-SEA Counts and Rates of
Total Congenital Anomalies

Variable: Total Congenital Anomalies
Restrictions: All Children of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Current Dioxin (Categorized Within Group) - Unadjusted

Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	204	208.0	All Exp Categ		0.072
Unknown	282	57	202.1	Unk vs Bkgd	0.96(0.69,1.34)	0.831
Low	174	51	293.1	Low vs Bkgd	1.58(1.10,2.27)	0.013
High	227	44	193.8	High vs Bkgd	0.92(0.64,1.32)	0.636
Total	1664					

b) Current Dioxin (Categorized Within Group) - Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	All Exp Categ	****	****	DIOXIN*OCC
Unknown	246	Unk vs Bkgd			(p=0.002)
Low	156	Low vs Bkgd			
High	203	High vs Bkgd			
Total	1448				

Total Congenital Anomalies (Full Siblings)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-4 [a] and [b]), there is no significant association between total congenital anomalies and initial dioxin among full sibling children of Ranch Hands with more than 10 ppt (p=0.259) or more than 5 ppt (p=0.684) current dioxin.

After adjustment for covariates (Table 6-4 [c]), there is no association between total congenital anomalies and initial dioxin among full sibling children of Ranch Hands with more than 10 ppt current dioxin (p=0.219).

After adjustment for covariates (Table 6-4 [d]), there is no significant association between total congenital anomalies and initial dioxin among full sibling children of Ranch Hands with more than 5 ppt current dioxin (p=0.494).

Table 6-4

Post-SEA Counts and Rates of
Total Congenital Anomalies

Variable: Total Congenital Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	16	205.1	0.89(0.74,1.09)	0.259
	Medium	206	57	276.7		
	High	136	27	198.5		
b) D>5 ppt (n=557)	Low	114	20	175.4	1.03(0.89,1.19)	0.684
	Medium	245	58	236.7		
	High	198	44	222.2		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=390)	0.88(0.72,1.08)		0.219		None	
d) D>5 ppt (n=513)	0.94(0.79,1.12)		0.494		M-AGE(p=0.072) OCC(p=0.033)	

Total Congenital Anomalies (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-5 [a]), there is no significant variation in the association between total congenital anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands with more than 10 ppt current dioxin ($p=0.786$). Furthermore, there is no significant association between total congenital anomalies and current dioxin among children of Ranch Hands with late ($p=0.529$) or early ($p=0.291$) tours.

Without adjustment for covariates (Table 6-5 [b]), there is no significant variation in the association between total congenital anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands with more than 5 ppt current dioxin ($p=0.532$). Furthermore, there is no significant association between total congenital anomalies and current dioxin among children of Ranch Hands late ($p=0.904$) or early ($p=0.312$) tours.

After adjustment for covariates (Table 6-5 [c]), there is no significant variation in the association between total congenital anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands with more than 10 ppt current dioxin ($p=0.643$) and there is no significant association between total congenital anomalies and the father's current dioxin among children of Ranch Hands with late ($p=0.561$) or early ($p=0.200$) tours.

After adjustment for covariates (Table 6-5 [d]), there is no significant variation in the association between total congenital anomalies and current dioxin level with time since duty in SEA ($p=0.618$) among full sibling children of Ranch Hands with more than 5 ppt current dioxin. Furthermore, there is no significant association between total congenital anomalies and the father's current dioxin among children of Ranch Hands with late ($p=0.541$) or early ($p=0.988$) tours.

Table 6-5

Post-SEA Counts and Rates of Total Congenital Anomalies

Variable: Total Congenital Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)						0.786
	≤18.6	234.0 (11/47)	234.8 (27/115)	265.6 (17/64)	0.91(0.68,1.22)	0.529
	>18.6	285.7 (8/28)	260.9 (24/92)	186.7 (14/75)	0.86(0.65,1.14)	0.291
b) D>5 ppt (n=557)						0.532
	≤18.6	203.4 (12/59)	263.9 (38/144)	214.3 (21/98)	1.01(0.82,1.25)	0.904
	>18.6	75.5 (4/53)	292.5 (31/106)	164.9 (16/97)	1.11(0.91,1.36)	0.312

Table 6-5 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)			0.643	None
	≤18.6	0.92(0.68,1.23)	0.561	
	>18.6	0.83(0.62,1.10)	0.200	
d) D>5 ppt (n=513)			0.618	M-AGE(p=0.059) OCC(p=0.038)
	≤18.6	0.93(0.72,1.19)	0.541	
	>18.6	1.00(0.80,1.25)	0.988	

Total Congenital Anomalies (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-6 [a]), there is a borderline significant association between total congenital anomalies and categorized dioxin level among full siblings (p=0.060). Children of Ranch Hands in the Low current dioxin category are at significantly greater risk of total congenital anomalies than children of Comparisons in the Background category (OR=1.55, 95% CI 1.05-2.29, p=0.028). The risks of congenital anomaly among children of Ranch Hands in the Unknown (p=0.351) and High (p=0.450) categories are not significantly different from that of children of Comparisons in the Background category.

After adjustment for covariates (Table 6-6 [b]), the overall association between total congenital anomalies and categorized current dioxin varies significantly with the father's military occupation among full siblings (p=0.012). This changing association is displayed in Appendix Table D-2. The children of the Ranch Hands in the Low dioxin category were at greater risk of congenital anomalies than children of Comparisons in the Background category in both the enlisted flyer (p=0.091) and enlisted ground (p=0.032) strata. In the officer stratum there is a borderline significantly lower risk of congenital anomalies among children of Ranch Hands in the Unknown category (p=0.103) relative to that in children of Comparisons in the Background category.

Table 6-6

Post-SEA Counts and Rates of
Total Congenital Anomalies

Variable: Total Congenital Anomalies
Restrictions: Full Siblings of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	174	214.3	All Exp Categ		0.060
Unknown	221	41	185.5	Unk vs Bkgd	0.84(0.57,1.22)	0.351
Low	148	44	297.3	Low vs Bkgd	1.55(1.05,2.29)	0.028
High	195	37	189.7	High vs Bkgd	0.86(0.58,1.28)	0.450
Total	1376					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	All Exp Categ	****	****	RACE(p=0.083)
Unknown	199	Unk vs Bkgd			OCC*DIOXIN
Low	137	Low vs Bkgd			(p=0.012)
High	180	High vs Bkgd			
Total	1231				

Nervous System Anomalies (All Children)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-7 [a] and [b]), there is no significant association between nervous system anomalies and initial dioxin among children of Ranch Hands with more than 10 ppt current dioxin (p=0.501) or more than 5 ppt (p=0.149) current dioxin.

There is insufficient data (Table 6-7 [c] and [d]) to assess the significance of the association between nervous system anomalies and initial dioxin with adjustment for covariates.

Table 6-7

Post-SEA Counts and Rates of Nervous System Anomalies

Variable: Nervous System Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	1	9.4	1.28(0.63,2.61)	0.501
	Medium	245	2	8.2		
	High	157	2	12.7		
b) D>5 ppt (n=690)	Low	155	0	0.0	1.55(0.85,2.82)	0.149
	Medium	308	2	6.5		
	High	227	3	13.2		

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted			
Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=458)	No adjusted analyses, only 5 defects total		
d) D>5 ppt (n=616)	No adjusted analyses, only 5 defects total		

Nervous System Anomalies (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

There is insufficient data (Table 6-8) to assess the significance of variation in the association between nervous system defects and current dioxin with time since duty in SEA among children of Ranch Hands with more than 10 ppt or more than 5 ppt current dioxin.

Table 6-8

Post-SEA Counts and Rates of
Nervous System Anomalies

Variable: Nervous System Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted

Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)	≤18.6	0.0 (0/62)	7.5 (1/134)	13.9 (1/72)	No analyses, only 5 defects total	
	>18.6	25.0 (1/40)	9.3 (1/108)	10.8 (1/93)		
b) D>5 ppt (n=690)	≤18.6	0.0 (0/90)	0.0 (0/174)	18.2 (2/110)	No analyses, only 5 defects total	
	>18.6	0.0 (0/63)	14.7 (2/136)	8.5 (1/117)		

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)		No adjusted analyses, only 5 defects total		
d) D>5 ppt (n=616)		No adjusted analyses, only 5 defects total		

Nervous System Anomalies (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-9 [a]), the overall association between nervous system anomalies and categorized current dioxin level is not significant (p=0.136). The nervous system anomaly rate among children of Ranch Hands in the High current dioxin category (13.2 per 1000) is borderline significantly greater than the rate among children of Comparisons in the Background current dioxin category (3.1 per 1000); OR=4.37, 95% CI 0.87-21.8, p=0.072. The nervous system anomaly rate among children of Ranch Hands in the Low category is not significantly different from that of children of Comparisons in the Background category.

There is insufficient data to assess the association between nervous system anomalies and categorized dioxin with adjustment for covariates (Table 13-9 [b]).

Table 6-9

Post-SEA Counts and Rates of Nervous System Anomalies

Variable: Nervous System Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	3	3.1	All Exp Categ		0.136
Unknown	282	0	0.0	Unk vs Bkgd	-- -- --	--
Low	174	1	5.7	Low vs Bkgd	1.88(0.20,18.3)	0.584
High	227	3	13.2	High vs Bkgd	4.37(0.87,21.8)	0.072
Total	1664					

Table 6-9 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843		No adjusted analyses, only 7 defects total		
Unknown	246				
Low	156				
High	203				
Total	1448				

Nervous System Anomalies (Full Siblings)

Model 1: Children of Ranch Hands - Log_2 (Initial Dioxin)

Without adjustment for covariates (Table 6-10 [a] and [b]), there is no significant association between nervous system anomalies and initial dioxin among full sibling children of Ranch Hands with more than 10 ppt ($p=0.214$) while there is a borderline significant association among children of Ranch Hands with more than 5 ppt ($p=0.073$) current dioxin.

There is insufficient data to assess the significance of the association between nervous system anomalies and initial dioxin among full sibling children of Ranch Hands with adjustment for covariates (Table 6-10 [c] and [d]).

Table 6-10

Post-SEA Counts and Rates of
Nervous System Anomalies

Variable: Nervous System Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	0	0.0	1.65(0.76,3.59)	0.214
	Medium	206	2	9.7		
	High	136	2	14.7		
b) D>5 ppt (n=557)	Low	114	0	0.0	1.85(0.93,3.69)	0.073
	Medium	245	1	4.1		
	High	198	3	15.2		

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted			
Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=390)	No adjusted analyses, only 4 defects total		
d) D>5 ppt (n=513)	No adjusted analyses, only 4 defects total		

Nervous System Anomalies (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

There is insufficient data (Table 6-11) to assess variation in the association between nervous system anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands.

Table 6-11

Post-SEA Counts and Rates of
Nervous System Anomalies

Variable: Nervous System Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)	≤18.6	0.0 (0/47)	8.7 (1/115)	15.6 (1/64)	No analyses, only 4 defects total	
	>18.6	0.0 (0/28)	10.9 (1/92)	13.3 (1/75)		
b) D>5 ppt (n=557)	≤18.6	0.0 (0/59)	0.0 (0/144)	20.4 (2/98)	No analyses, only 4 defects total	
	>18.6	0.0 (0/53)	9.4 (1/106)	10.3 (1/97)		
Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted						
Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)			p-Value	Covariate Remarks
c) D>10 ppt (n=391)		No adjusted analyses, only 4 defects total				
d) D>5 ppt (n=513)		No adjusted analyses, only 4 defects total				

Nervous System Anomalies (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-12 [a]), there is no overall association between nervous system anomalies and categorized current dioxin among full sibling children ($p=0.153$). However, the nervous system anomaly rate among children of Ranch Hands in the High current dioxin category (15.4 per 1000) is borderline significantly greater than that of children of Comparisons in the Background category (3.7 per 1000); $OR=4.21$, 95% CI 0.84-21.1, $p=0.080$. The low versus background ($p=0.600$) contrast is not statistically significant.

There is insufficient data (Table 6-12 [b]) to assess the significance of the association between nervous system anomalies and categorized current dioxin among full sibling children with adjustment for covariates.

Table 6-12

Post-SEA Counts and Rates of Nervous System Anomalies

Variable: Nervous System Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	3	3.7	All Exp Categ		0.153
Unknown	221	0	0.0	Unk vs Bkgd	-- -- --	--
Low	148	1	6.8	Low vs Bkgd	1.83(0.19,17.8)	0.600
High	195	3	15.4	High vs Bkgd	4.21(0.84,21.1)	0.080
Total	1376					

Table 6-12 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	No adjusted analyses, only 7 defects total			
Unknown	199				
Low	137				
High	180				
Total	1231				

Anomalies of the Eye (All Children)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

Without adjustment for covariates (Table 6-13 [a] and [b]), there is no significant association between eye anomalies and initial dioxin among children of Ranch Hands with more than 10 ppt ($p=0.534$) or more than 5 ppt ($p=0.872$) current dioxin.

There is insufficient data to assess the significance of the association between eye anomalies and initial dioxin among children of Ranch Hands with adjustment for covariates (Table 6-13 [c] and [d]).

Table 6-13

Post-SEA Counts and Rates of
Eye Anomalies

Variable: Eye Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted

Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	0	0.0	1.26(0.62,2.56)	0.534
	Medium	245	3	12.2		
	High	157	2	12.7		
b) D>5 ppt (n=690)	Low	155	2	12.9	1.04(0.62,1.76)	0.872
	Medium	308	2	6.5		
	High	227	3	13.2		

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted

Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=458)	No adjusted analyses, only 5 defects total		
d) D>5 ppt (n=616)	No adjusted analyses, only 7 defects total		

Anomalies of the Eye (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-14 [a]), there is no significant variation in the association between eye anomalies and current dioxin with time since duty in SEA among children of Ranch Hands with more than 10 ppt current dioxin ($p=0.428$). Furthermore there is no significant association between eye anomalies and current dioxin among children of Ranch Hands with late ($p=0.352$) or early ($p=0.819$) tours.

Without adjustment for covariates (Table 6-14 [b]), there is no significant variation in the association between eye anomalies and current dioxin with time since duty in SEA among children of Ranch Hands with more than 5 ppt current dioxin (p=0.868). Furthermore there is no significant association between eye anomalies and current dioxin among children of Ranch Hands with late (p=0.851) or early (p=0.730) tours.

There is insufficient data to assess the significance in variation in the association between eye anomalies and current dioxin with time since duty in SEA with adjustment for covariates (Table 6-14 [c] and [d]).

Table 6-14

Post-SEA Counts and Rates of Eye Anomalies

Variable: Eye Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)						0.428
	≤18.6	0.0 (0/62)	14.9 (2/134)	13.9 (1/72)	1.62(0.58,4.49)	0.352
	>18.6	25.0 (1/40)	0.0 (0/108)	10.8 (1/93)	0.87(0.26,2.83)	0.819
b) D>5 ppt (n=690)						0.868
	≤18.6	11.1 (1/90)	11.5 (2/174)	18.2 (2/110)	1.07(0.54,2.10)	0.851
	>18.6	0.0 (0/63)	7.4 (1/136)	8.5 (1/117)	1.18(0.47,2.95)	0.730

Table 6-14 (Continued)

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)		No adjusted analyses, only 5 defects total		
d) D>5 ppt (n=616)		No adjusted analyses, only 7 defects total		

Anomalies of the Eye (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-15 [a]), there is no significant overall association between eye anomalies and categorized current dioxin ($p=0.622$). Contrasts of children of Ranch Hands in the High ($p=0.370$), Low ($p=0.839$) and Unknown ($p=0.271$) categories with children of Comparisons in the Background category were not statistically significant.

There is insufficient data to assess the significance of the association between eye anomalies and categorized current dioxin with adjustment for covariates (Table 6-15 [b]).

Table 6-15

Post-SEA Counts and Rates of
Eye Anomalies

Variable: Eye Anomalies
Restrictions: All Children of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	7	7.1	All Exp Categ		0.622
Unknown	282	4	14.2	Unk vs Bkgd	2.00(0.58,6.89)	0.271
Low	174	1	5.7	Low vs Bkgd	0.80(0.10,6.59)	0.839
High	227	3	13.2	High vs Bkgd	1.86(0.48,7.27)	0.370
Total	1664					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	No adjusted analyses, only 15 defects total			
Unknown	246				
Low	156				
High	203				
Total	1448				

Anomalies of the Eye (Full Siblings)

Model 1: Children of Ranch Hands - Log_2 (Initial Dioxin)

Without adjustment for covariates (Table 6-16 [a] and [b]), there is no significant association between eye anomalies and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt ($p=0.597$) or more than 5 ppt ($p=0.518$) current dioxin.

There is insufficient data to assess the association between eye anomalies and initial dioxin among full sibling children of Ranch Hands with adjustment for covariates (Table 6-16 [c] and [d]).

Table 6-16

Post-SEA Counts and Rates of
Eye Anomalies

Variable: Eye Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	0	0.0	1.22(0.59,2.49)	0.597
	Medium	206	3	14.6		
	High	136	2	14.7		
b) D>5 ppt (n=557)	Low	114	1	8.8	1.20(0.69,2.09)	0.518
	Medium	245	2	8.2		
	High	198	3	15.2		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value		Covariate Remarks		
c) D>10 ppt (n=390)	No adjusted analyses, only 5 defects total					
d) D>5 ppt (n=513)	No adjusted analyses, only 6 defects total					

Anomalies of the Eye (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

There is insufficient data (Table 6-17) to assess the significance of variation in the association between eye anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands.

Table 6-17

Post-SEA Counts and Rates of
Eye Anomalies

Variable: Eye Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted

Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)	≤18.6	0.0 (0/47)	17.4 (2/115)	15.6 (1/64)	No analyses, only 5 defects total	
	>18.6	35.7 (1/28)	0.0 (0/92)	13.3 (1/75)		
b) D>5 ppt (n=557)	≤18.6	0.0 (0/59)	13.9 (2/144)	20.4 (2/98)	No analyses, only 6 defects total	
	>18.6	0.0 (0/53)	9.4 (1/106)	10.3 (1/97)		

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)		No adjusted analyses, only 5 defects total		
d) D>5 ppt (n=513)		No adjusted analyses, only 6 defects total		

Anomalies of the Eye (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-18 [a]) there is no significant overall association between eye anomalies and categorized current dioxin among full sibling children ($p=0.253$). However, the rate of eye anomalies among children of Ranch Hands in the High current dioxin category (15.4 per 1000) is borderline significantly greater than the corresponding rate among children of Comparisons in the Background category ($OR=4.21$, 95% CI 0.84-21.1, $p=0.080$). Contrasts of children of Ranch Hands in the Low (0.600) and Unknown ($p=0.110$) categories with children of Comparisons in the Background category were not statistically significant.

There is insufficient data to assess the significance of the association between anomalies of the eye and categorized dioxin with adjustment for covariates (Table 6-18 [b]).

Table 6-18

Post-SEA Counts and Rates of Eye Anomalies

Variable: Eye Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	821	3	3.7	All Exp Categ		0.253
Unknown	221	3	13.6	Unk vs Bkgd	3.71(0.74,18.5)	0.110
Low	148	1	6.8	Low vs Bkgd	0.83(0.19,17.8)	0.600
High	195	3	15.4	High vs Bkgd	4.21(0.84,21.1)	0.080
Total	1376					

Table 6-18 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	No adjusted analyses, only 10 defects total			
Unknown	199				
Low	137				
High	180				
Total	1231				

Anomalies of the Ear, Face and Neck (All Children)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

Without adjustment for covariates (Table 6-19 [a] and [b]), there is no significant association between ear, face and neck anomalies and initial dioxin among children of Ranch Hands having more than 10 ppt ($p=0.121$) or having more than 5 ppt ($p=0.781$) current dioxin.

There is insufficient data to assess the significance of the association between ear, face and neck anomalies and initial dioxin among children of Ranch Hands with more than 10 ppt or more than 5 ppt current dioxin with adjustment for covariates (Table 6-19 [c] and [d]).

Table 6-19

Post-SEA Counts and Rates of
Ear, Face and Neck Anomalies

Variable: Ear, Face and Neck Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	0	0.0	1.61(0.89,2.91)	0.121
	Medium	245	4	16.3		
	High	157	3	19.1		
b) D>5 ppt (n=690)	Low	155	4	25.8	1.06(0.70,1.61)	0.781
	Medium	308	3	9.7		
	High	227	4	17.6		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=458)	No adjusted analyses, only 7 defects total					
d) D>5 ppt (n=616)	No adjusted analyses, only 11 defects total					

Anomalies of the Ear, Face and Neck (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-20 [a]), there is no significant variation in the association between ear, face and neck anomalies and current dioxin with time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.534$). There is a no significant association between ear, face and neck anomalies and current dioxin among children of Ranch Hands with late ($p=0.820$) or early ($p=0.216$) tours.

Without adjustment for covariates (Table 6-20 [b]), there is significant variation in the association between anomalies of the ear, face and neck and current dioxin with time since duty in SEA among children of Ranch Hands with more than 5 ppt current dioxin (p=0.005). This significance was caused by a borderline significant increase of ear, face and neck anomalies among children of Ranch Hands with early tours (OR=1.72, 95% CI 0.98-3.01, p=0.059) and a borderline significant decrease among children of Ranch Hands with late tours (OR=0.39, 95% CI 0.13-1.15, p=0.087).

There is insufficient data to assess variation in the association between ear, face and neck anomalies and current dioxin with time since duty in SEA among children of Ranch Hands with adjustment for covariates (Table 13-20 [c] and [d]).

Table 6-20

**Post-SEA Counts and Rates of
Ear, Face and Neck Anomalies**

Variable: Ear, Face and Neck Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: Log₂(Current Dioxin), Time

Ranch Hands - Log ₂ (Current Dioxin), Time - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)						0.534
	≤18.6	0.0 (0/62)	7.5 (1/134)	0.0 (0/72)	0.79(0.11, 5.96)	0.820
	>18.6	25.0 (1/40)	18.5 (2/108)	32.3 (3/93)	1.50(0.79, 2.84)	0.216
b) D>5 ppt (n=690)						0.005
	≤18.6	33.3 (3/90)	11.5 (2/174)	0.0 (0/110)	0.39(0.13, 1.15)	0.087
	>18.6	0.0 (0/63)	14.7 (2/136)	34.2 (4/117)	1.72(0.98, 3.01)	0.059

Table 6-20 (Continued)

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)		No adjusted analyses, only 7 defects total		
d) D>5 ppt (n=616)		No adjusted analyses, only 11 defects total		

Anomalies of the Ear, Face and Neck (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-21 [a]), there is no significant overall association between ear, face and neck anomalies and categorized current dioxin ($p=0.786$). There is no significant difference between the rate of ear, face and neck anomalies among children of Ranch Hands in the High ($p=0.436$), Low ($p=0.974$) or Unknown ($p=0.393$) categories with that in children of Comparisons in the Background category.

After adjustment for covariates (Table 6-21 [b]), there is no significant overall overall association between ear, face and neck anomalies and categorized current dioxin among children ($p=0.720$). There is no significant difference between the rate of ear, face and neck anomalies among children of Ranch Hands in the High ($p=0.388$), Low ($p=0.920$) or Unknown ($p=0.322$) current dioxin category and the rate in children of Comparisons in the Background current dioxin category.

Table 6-21

Post-SEA Counts and Rates of
Ear, Face and Neck Anomalies

Variable: Ear, Face and Neck Anomalies
Restrictions: Full Siblings of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	11	11.2	All Exp Categ		0.786
Unknown	282	5	17.7	Unk vs Bkgd	1.59(0.55,4.62)	0.393
Low	174	2	11.5	Low vs Bkgd	1.03(0.22,4.67)	0.974
High	227	4	17.6	High vs Bkgd	1.58(0.50,5.02)	0.436
Total	1664					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	All Exp Categ		0.720	DRINK(p=0.077)
Unknown	246	Unk vs Bkgd	1.73(0.58,5.11)	0.322	
Low	156	Low vs Bkgd	1.08(0.23,4.99)	0.920	
High	203	High vs Bkgd	1.67(0.52,5.40)	0.388	
Total	1448				

Anomalies of the Ear, Face and Neck (Full Siblings)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-22 [a] and [b]), there is no significant association ear, face and neck anomalies and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt (p=0.150) or more than 5 ppt (p=0.540) current dioxin.

There is insufficient data to assess the significance of the association between ear, face and neck anomalies and initial dioxin among full sibling children of Ranch Hands with adjustment for covariates (Table 6-22 [c] and [d]).

Table 6-22

**Post-SEA Counts and Rates of
Ear, Face and Neck Anomalies**

Variable: Ear, Face and Neck Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	0	0.0	1.55(0.86,2.81)	0.150
	Medium	206	4	19.4		
	High	136	3	22.1		
b) D>5 ppt (n=557)	Low	114	3	26.3	1.15(0.74,1.76)	0.540
	Medium	245	3	12.2		
	High	198	4	20.2		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=390)	No adjusted analyses, only 7 defects total					
d) D>5 ppt (n=513)	No adjusted analyses, only 10 defects total					

Anomalies of the Ear, Face and Neck (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-23 [a]), there is no significant variation in the association between ear, face and neck anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.528$). Furthermore, there is no association between ear, face and neck anomalies and current dioxin among children of Ranch Hands with late ($p=0.789$) or early ($p=0.254$) tours.

Without adjustment for covariates (Table 6-23 [b]), there is significant variation in the association between ear, face and neck anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.014$). This finding is caused by increasing rates in children of Ranch Hands with early tours (OR=1.67, 95% CI 0.96-2.90, $p=0.069$) and decreasing rates in children of Ranch Hands with late tours (OR=0.43, 95% CI 0.14-1.31, $p=0.139$).

There is insufficient data to assess the significance of variation in the association between ear, face and neck anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands with adjustment for covariates (Table 6-23 [c] and [d]).

Table 6-23

Post-SEA Counts and Rates of
Ear, Face and Neck Anomalies

Variable: Ear, Face and Neck Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)						0.528
	≤18.6	0.0 (0/47)	8.7 (1/115)	0.0 (0/64)	0.76(0.10,5.79)	0.789
	>18.6	35.7 (1/28)	21.7 (2/92)	40.0 (3/75)	1.45(0.77,2.73)	0.254
b) D>5 ppt (n=557)						0.014
	≤18.6	33.9 (2/59)	13.9 (2/144)	0.0 (0/98)	0.43(0.14,1.31)	0.139
	>18.6	0.0 (0/53)	18.9 (2/106)	41.2 (4/97)	1.67(0.96,2.90)	0.069
Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted						
Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)			p-Value	Covariate Remarks
c) D>10 ppt (n=391)		No adjusted analyses, only 7 defects total				
d) D>5 ppt (n=513)		No adjusted analyses, only 10 defects total				

Anomalies of the Ear, Face and Neck (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-24 [a]), there is no significant overall association between ear, face and neck anomalies and categorized current dioxin among full siblings (p=0.889). Furthermore, there is no significant difference between the rates of ear, face and neck anomalies among children of Ranch Hands in the High (p=0.474), Low (p=0.997) and Unknown (p=0.617) categories and the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-24 [b]), there is no significant overall association between ear, face and neck anomalies and categorized current dioxin among full siblings (p=0.808). Furthermore, there is no significant difference between the rates of ear, face and neck anomalies among children of Ranch Hands in the High (p=0.430), Low (p=0.493) and Unknown (p=0.537) categories and the rate among children of Comparisons in the Background category.

Table 6-24

Post-SEA Counts and Rates of Ear, Face and Neck Anomalies

Variable: Ear, Face and Neck Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	11	13.5	All Exp Categ		0.889
Unknown	221	4	18.1	Unk vs Bkgd	1.34(0.42, 4.26)	0.617
Low	148	2	13.5	Low vs Bkgd	1.00(0.22, 4.55)	0.997
High	195	4	20.5	High vs Bkgd	1.52(0.48, 4.85)	0.474
Total	1376					

Table 6-24 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	All Exp Categ		0.808	OCC(p=0.090)
Unknown	199	Unk vs Bkgd	1.45(0.45,4.67)	0.537	DRINK(p=0.086)
Low	137	Low vs Bkgd	1.58(0.43,5.82)	0.493	
High	180	High vs Bkgd	1.60(0.50,5.17)	0.430	
Total	1231				

Anomalies of the Circulatory System and Heart (All Children)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-25 [a]), there is a significant negative association between anomalies of the circulatory system and heart and initial dioxin among children of Ranch Hands having more than 10 ppt current dioxin (OR=0.58, 95% CI 0.33-1.03, p=0.042).

Without adjustment for covariates (Table 6-25 [b]), there is no significant association between circulatory system and heart anomalies and initial dioxin among children of Ranch Hands with more than 5 ppt current dioxin (p=0.686).

There is insufficient data to assess the significance of the association between circulatory system and heart anomalies and fathers initial dioxin among children of Ranch Hands with adjustment for covariates (Table 13-25 [c] and [d]).

Table 6-25

Post-SEA Counts and Rates of
Circulatory System and Heart Anomalies

Variable: Circulatory System and Heart Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk(95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	3	28.3	0.58(0.33,1.03)	0.042
	Medium	245	9	36.7		
	High	157	1	6.4		
b) D>5 ppt (n=690)	Low	155	2	12.9	0.92(0.63,1.36)	0.686
	Medium	308	10	32.5		
	High	227	2	8.8		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=458)	No adjusted analyses, only 13 defects total					
d) D>5 ppt (n=616)	No adjusted analyses, only 14 defects total					

Anomalies of the Circulatory System and Heart (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-26 [a]), there is no significant variation in the association between anomalies of the circulatory system and heart and current dioxin with time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.589$). However, the negative association between anomalies of the circulatory system and heart and current dioxin among children of Ranch Hands with early tours is borderline significant (OR=0.45, 95% CI 0.19-1.05, $p=0.065$) and the association is not significant among children of Ranch Hands with late tours ($p=0.318$).

Without adjustment for covariates (Table 6-26 [b]), there is no significant variation in the association between anomalies of the circulatory system and heart and current dioxin with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin (p=0.730). Furthermore, the association between anomalies of the circulatory system and heart and current dioxin among children of Ranch Hands with early (p=0.543) and late (p=0.929) tours are not significant.

There is insufficient data to assess the variation in the association between anomalies of the circulatory system and heart and current dioxin with time since duty in SEA among children of Ranch Hands (Table 6-26 [c] and [d]).

Table 6-26

Post-SEA Counts and Rates of
Circulatory System and Heart Anomalies

Variable: Circulatory System and Heart Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: Log₂(Current Dioxin), Time

Ranch Hands - Log ₂ (Current Dioxin), Time - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)						0.589
	≤18.6	16.1 (1/62)	37.3 (5/134)	0.0 (0/72)	0.63(0.26,1.56)	0.318
	>18.6	50.0 (2/40)	37.0 (4/108)	10.8 (1/93)	0.45(0.19,1.05)	0.065
b) D>5 ppt (n=690)						0.730
	≤18.6	11.1 (1/90)	28.7 (5/174)	9.1 (1/110)	0.97(0.54,1.75)	0.929
	>18.6	0.0 (0/63)	44.1 (6/136)	8.5 (1/117)	0.85(0.49,1.45)	0.543

Table 6-26 (Continued)

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)		No adjusted analyses, only 13 defects total		
d) D>5 ppt (n=616)		No adjusted analyses, only 14 defects total		

Anomalies of the Circulatory System and Heart (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-27 [a]), there is a borderline significant overall association between anomalies of the circulatory system and heart and categorized current dioxin ($p=0.067$). The rate of circulatory system and heart anomalies among children of Ranch Hands in the Low current dioxin category (46.0 per 1000) is significantly greater than the rate among children of Comparisons in the Background category (16.3 per 1000), OR=2.91, 95% CI 1.22-6.90, $p=0.016$. Corresponding contrasts between children of Ranch Hands in the High ($p=0.408$) and Unknown ($p=0.801$) categories with children of Comparisons in the Background category are not significant.

After adjustment for covariates (Table 6-27 [b]), there is no significant overall association between anomalies of the circulatory system and heart and categorized current dioxin ($p=0.180$). Furthermore, the rates of circulatory system and heart anomalies among children of Ranch Hands in the High ($p=0.280$), Low ($p=0.124$) and Unknown ($p=0.785$) categories are not significantly different from the rate among children of Comparisons in the Background category.

Table 6-27

**Post-SEA Counts and Rates of
Circulatory System and Heart Anomalies**

Variable: Circulatory System and Heart Anomalies
Restrictions: All Children of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

Current Dioxin (Categorized Within Group) - Unadjusted						
Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	16	16.3	All Exp Categ		0.067
Unknown	282	4	14.2	Unk vs Bkgd	0.87(0.29,2.62)	0.801
Low	174	8	46.0	Low vs Bkgd	2.91(1.22,6.90)	0.016
High	227	2	8.8	High vs Bkgd	0.54(0.12,2.35)	0.408
Total	1664					

Current Dioxin (Categorized Within Group) - Adjusted						
Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks	
Background	843	All Exp Categ		0.180	RACE(p=0.081)	
Unknown	246	Unk vs Bkgd	0.85(0.27,2.69)	0.785	OCC(p=0.002)	
Low	156	Low vs Bkgd	2.16(0.81,5.74)	0.124	DRINK(p=0.019)	
High	203	High vs Bkgd	0.32(0.04,2.52)	0.280	C-TIME(p=0.001)	
Total	1448					

Anomalies of the Circulatory System and Heart (Full Siblings)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-28 [a] and [b]), there is a borderline significantly negative association between anomalies of the circulatory system and heart and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt (p=0.091), while the association is not significant in children of Ranch Hands having more than 5 ppt current dioxin (p=0.540).

There is insufficient data to assess the significance between circulatory system and heart anomalies and initial dioxin among full sibling children of Ranch Hands with adjustment for covariates (Table 6-28 [c] and [d]).

Table 6-28

Post-SEA Counts and Rates of
Circulatory System and Heart Anomalies

Variable: Circulatory System and Heart Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	1	12.8	0.56(0.27,1.17)	0.091
	Medium	206	7	34.0		
	High	136	0	0.0		
b) D>5 ppt (n=557)	Low	114	1	8.8	0.86(0.53,1.41)	0.540
	Medium	245	7	28.6		
	High	198	1	5.1		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=390)	No adjusted analyses, only 8 defects total					
d) D>5 ppt (n=513)	No adjusted analyses, only 9 defects total					

Anomalies of the Circulatory System and Heart (Full Siblings)

Model 2: Children of Ranch Hands - Log₂(Current Dioxin) and Time

There is insufficient data (Table 6-29) to assess the significance of variation in the association between anomalies of the circulatory system and heart and current dioxin level with time since duty in SEA among full sibling children of Ranch Hands.

Table 6-29

**Post-SEA Counts and Rates of
Circulatory System and Heart Anomalies**

Variable: Circulatory System and Heart Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: Log₂(Current Dioxin), Time

Ranch Hands - Log₂(Current Dioxin), Time - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)	≤18.6	0.0 (0/47)	26.1 (3/115)	0.0 (0/64)	No analyses, only 8 defects total	
	>18.6	35.7 (1/28)	43.5 (4/92)	0.0 (0/75)		
b) D>5 ppt (n=557)	≤18.6	16.9 (1/59)	20.8 (3/144)	0.0 (0/98)	No analyses, only 9 defects total	
	>18.6	0.0 (0/53)	47.2 (5/106)	0.0 (0/97)		

Table 6-29 (Continued)

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)		No adjusted analyses, only 8 defects total		
d) D>5 ppt (n=513)		No adjusted analyses, only 9 defects total		

Anomalies of the Circulatory System and Heart (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-30 [a]), there is an overall significant association between anomalies of the circulatory system and heart and categorized current dioxin among full siblings ($p=0.007$). Furthermore, the rate of circulatory system anomalies in children of Ranch Hands in the Low dioxin category is significantly greater than that among children of Comparisons in the Background category, $OR=2.83$ 95% Ci 1.12-7.14, $p=0.028$. The rate in children of Ranch Hands in the Unknown category is not significantly different from that among children of Comparisons in the Background category ($p=0.931$).

After adjustment for covariates (Table 6-30 [b]), there is a significant overall association between anomalies of the circulatory system and heart and categorized current dioxin among full siblings ($p=0.034$). However, the rate of circulatory system and heart anomalies among children of Ranch Hands in the Low current dioxin category is not significantly different from that of children of Comparisons in the Background current dioxin category ($p=0.136$). The corresponding contrast of children of Ranch Hands in the Unknown category with children of Comparisons in the Background category is not significant ($p=0.889$). Because there were no cardiovascular or heart anomalies in children of Ranch Hands in the High current dioxin category, an adjusted contrast with children of Comparisons in the Background category is not possible.

Table 6-30

Post-SEA Counts and Rates of
Circulatory System and Heart Anomalies

Variable: Circulatory System and Heart Anomalies
Restrictions: Full Siblings of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

Current Dioxin (Categorized Within Group) - Unadjusted						
Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	14	17.2	All Exp Categ		0.007
Unknown	221	4	18.1	Unk vs Bkgd	1.05(0.34,3.23)	0.931
Low	148	7	47.3	Low vs Bkgd	2.83(1.12,7.14)	0.028
High	195	0	0.0	High vs Bkgd	-- -- --	0.388
Total	1376					

Current Dioxin (Categorized Within Group) - Adjusted						
Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks	
Background	715	All Exp Categ		0.034	OCC(p=0.002)	
Unknown	199	Unk vs Bkgd	0.92(0.28,2.98)	0.889	DRINK(p=0.037)	
Low	137	Low vs Bkgd	2.13(0.78,5.80)	0.136	C-TIME (p=0.005)	
High	180	High vs Bkgd	-- -- --			
Total	1231					

Anomalies of the Respiratory System (All Children)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

There is insufficient data (Table 6-31) to assess the association between anomalies of the respiratory system and initial dioxin level among children of Ranch Hands without or with adjustment for covariates.

Table 6-31

Post-SEA Counts and Rates of
Respiratory System Anomalies

Variable: Respiratory System Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	0	0.0	No analyses, only 2 defects total	
	Medium	245	1	4.1		
	High	157	1	6.4		
b) D>5 ppt (n=690)	Low	155	1	6.5	No analyses, only 3 defects total	
	Medium	308	1	3.2		
	High	227	1	4.4		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value		Covariate Remarks		
c) D>10 ppt (n=458)	No adjusted analyses, only 2 defects total					
d) D>5 ppt (n=616)	No adjusted analyses, only 3 defects total					

Anomalies of the Respiratory System (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

There is insufficient data (Table 6-32) to assess the variation in the association between anomalies of the respiratory system and current dioxin with time since duty in SEA among children of Ranch Hands.

Table 6-32

Post-SEA Counts and Rates of
Respiratory System Anomalies

Variable: Respiratory System Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)	≤18.6	0.0 (0/62)	0.0 (0/134)	0.0 (0/72)	No analyses, only 2 defects total	
	>18.6	0.0 (0/40)	9.3 (1/108)	10.8 (1/93)		
b) D>5 ppt (n=690)	≤18.6	11.1 (1/90)	0.0 (0/174)	0.0 (0/110)	No analyses, only 3 defects total	
	>18.6	0.0 (0/63)	7.4 (1/136)	8.5 (1/117)		
Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted						
Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)		p-Value	Covariate Remarks	
c) D>10 ppt (n=459)		No adjusted analyses, only 2 defects total				
d) D>5 ppt (n=616)		No adjusted analyses, only 3 defects total				

Anomalies of the Respiratory System (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-33 [a]), there is no significant overall association between anomalies of the respiratory system and categorized current dioxin ($p=0.623$). Furthermore, the rates of anomalies of the respiratory system among children of Ranch Hands in the High ($p=0.529$), Low ($p=0.397$) and Unknown categories ($p=0.211$) are not significantly different from the rate among children of Comparisons in the Background category.

There is insufficient data to assess the significance of the association between anomalies of the respiratory system and categorized current dioxin with adjustment for covariates (Table 6-33 [b]).

Table 6-33

Post-SEA Counts and Rates of Respiratory System Anomalies

Variable: Respiratory System Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	2	2.0	All Exp Categ		0.623
Unknown	282	2	7.1	Unk vs Bkgd	3.50(0.49,25.0)	0.211
Low	174	1	5.7	Low vs Bkgd	2.83(0.26,31.4)	0.397
High	227	1	4.4	High vs Bkgd	2.17(0.20,24.0)	0.529
Total	1664					

Table 6-33 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	No adjusted analyses, only 6 defects total			
Unknown	246				
Low	156				
High	203				
Total	1448				

Anomalies of the Respiratory System (Full Siblings)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

There is insufficient data (Table 6-34) to assess the association between respiratory system anomalies and fathers initial dioxin body burden among full sibling children of Ranch Hands.

Table 6-34

Post-SEA Counts and Rates of Respiratory System Anomalies

Variable: Respiratory System Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	Abnormal Number	Rate	n	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	0	0.0	No analyses, only 2 defects total	
	Medium	206	1	4.9		
	High	136	1	7.4		
b) D>5 ppt (n=557)	Low	114	1	8.8	No analyses, only 3 defects total	
	Medium	245	1	4.1		
	High	198	1	5.1		

Table 6-34 (Continued)

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted

Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=390)	No adjusted analyses, only 2 defect total		
d) D>5 ppt (n=513)	No adjusted analyses, only 3 defects total		

Anomalies of the Respiratory System (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

There is insufficient data (Table 6-35) to assess variation in the association between anomalies of the respiratory system and current dioxin with time since duty in SEA among full sibling children of Ranch Hands.

Table 6-35

Post-SEA Counts and Rates of
Respiratory System Anomalies

Variable: Respiratory System Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)	≤18.6	0.0 (0/47)	0.0 (0/115)	0.0 (0/64)	No analyses, only 2 defects total	
	>18.6	0.0 (0/28)	10.9 (1/92)	13.3 (1/75)		
b) D>5 ppt (n=557)	≤18.6	16.9 (1/59)	0.0 (0/144)	0.0 (0/98)	No analyses, only 3 defects total	
	>18.6	0.0 (0/53)	9.4 (1/106)	10.3 (1/97)		
Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted						
Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)		p-Value	Covariate Remarks	
c) D>10 ppt (n=391)		No adjusted analyses, only 2 defect total				
d) D>5 ppt (n=513)		No adjusted analyses, only 3 defects total				

Anomalies of the Respiratory System (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-36 [a]), there is no significant overall association between anomalies of the respiratory system and categorized current dioxin among full siblings ($p=0.605$). Furthermore, the rates of respiratory system anomalies among children of Ranch Hands in the High ($p=0.549$), Low ($p=0.409$) and Unknown ($p=0.194$) categories are not significantly different from the rate among children of Comparisons in the background category.

There is insufficient data to assess the significance of the overall association between respiratory system anomalies and categorized dioxin among full siblings with adjustment for covariates (Table 6-36 [b]).

Table 6-36

Post-SEA Counts and Rates of Respiratory System Anomalies

Variable: Respiratory System Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	2	2.5	All Exp Categ		0.605
Unknown	221	2	9.0	Unk vs Bkgd	3.70(0.52,26.5)	0.194
Low	148	1	6.8	Low vs Bkgd	2.76(0.25,30.6)	0.409
High	195	1	5.1	High vs Bkgd	2.09(0.19,23.2)	0.549
Total	1376					

Table 6-36 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	No adjusted analyses, only 6 defects total			
Unknown	199				
Low	137				
High	180				
Total	1231				

Digestive System Anomalies (All Children)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

Without adjustment for covariates (Table 6-37 [a] and [b]), there is no significant association between digestive system anomalies and initial dioxin among children of Ranch Hands having more than 10 ppt ($p=0.744$) or more than 5 ppt ($p=0.977$) current dioxin.

After adjustment for covariates (Table 6-37 [c] and [d]), there is no significant association between digestive system anomalies and initial dioxin among children of Ranch Hands having more than 10 ppt ($p=0.799$) or more than 5 ppt ($p=0.884$) current dioxin.

Table 6-37

**Post-SEA Counts and Rates of
Digestive System Anomalies**

Variable: Digestive System Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	2	18.9	0.92(0.56,1.51)	0.744
	Medium	245	6	24.5		
	High	157	4	25.5		
b) D>5 ppt (n=690)	Low	155	3	19.4	1.01(0.71,1.43)	0.977
	Medium	308	8	26.0		
	High	227	5	22.0		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=458)	0.94(0.56,1.56)		0.799		None	
d) D>5 ppt (n=616)	1.03(0.71,1.49)		0.884		None	

Digestive System Anomalies (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-38 [a]), there is no significant variation in the association between anomalies of the digestive system and current dioxin level with time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.567$). Furthermore, there is no significant association between digestive system anomalies and current dioxin among children of Ranch Hands with late ($p=0.859$) or early ($p=0.482$) tours.

Without adjustment for covariates (Table 6-38 [b]), there is no significant variation in the association between anomalies of the digestive system and current dioxin with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin ($p=0.682$). Furthermore, there is no significant association between digestive system anomalies and current dioxin among children of Ranch Hands with late ($p=0.745$) or early ($p=0.802$) tours.

After adjustment for covariates (Table 6-38 [c]), there is no significant variation in the association between anomalies of the digestive system and current dioxin with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin ($p=0.678$). Furthermore, there is no significant association between digestive system anomalies and current dioxin among children of Ranch Hands with late ($p=0.898$) or early ($p=0.620$) tours.

After adjustment for covariates (Table 6-38 [d]), there is no significant variation in the association between anomalies of the digestive system and current dioxin with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin ($p=0.890$). Furthermore, there is no significant association between digestive system anomalies and current dioxin among children of Ranch Hands with late ($p=0.793$) or early ($p=0.933$) tours.

Table 6-38

Post-SEA Counts and Rates of
Digestive System Anomalies

Variable: Digestive System Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)						0.567
	≤18.6	16.1 (1/62)	14.9 (2/134)	27.8 (2/72)	1.08(0.47,2.48)	0.859
	>18.6	25.0 (1/40)	37.0 (4/108)	21.5 (2/93)	0.79(0.41,1.52)	0.482
b) D>5 ppt (n=690)						0.682
	≤18.6	11.1 (1/90)	23.0 (4/174)	18.2 (2/110)	1.10(0.62,1.94)	0.745
	>18.6	0.0 (0/63)	51.5 (7/136)	17.1 (2/117)	0.94(0.60,1.49)	0.802

Table 6-38 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)			0.678	None
	≤18.6	1.05(0.46,2.40)	0.898	
	>18.6	0.84(0.43,1.66)	0.620	
d) D>5 ppt (n=616)			0.890	None
	≤18.6	1.08(0.61,1.90)	0.793	
	>18.6	1.02(0.62,1.69)	0.933	

Digestive System Anomalies (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-39 [a]), there is no significant overall association between anomalies of the digestive system and categorized current dioxin (p=0.740). Furthermore, the rates of digestive system anomalies among children of Ranch Hands in the High (p=0.539), Low (p=0.446) and Unknown (p=0.757) categories are not significantly different from the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-39 [b]), there is no significant overall association between anomalies of the digestive system and categorized current dioxin (p=0.734). Furthermore, the rates of digestive system anomalies among children of Ranch Hands in the High (p=0.421), Low (p=0.609) and Unknown (p=0.709) categories are not significantly different from the rate among children of Comparisons in the Background category.

Table 6-39

Post-SEA Counts and Rates of
Digestive System Anomalies

Variable: Digestive System Anomalies
Restrictions: All Children of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted						
Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	24	24.5	All Exp Categ		0.740
Unknown	282	6	21.3	Unk vs Bkgd	0.87(0.35,2.14)	0.757
Low	174	6	34.5	Low vs Bkgd	1.42(0.57,3.54)	0.446
High	227	4	17.6	High vs Bkgd	0.72(0.25,2.08)	0.539
Total	1664					

b) Adjusted						
Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks	
Background	843	All Exp Categ		0.734	OCC(p=0.008)	
Unknown	246	Unk vs Bkgd	0.83(0.31,2.23)	0.709		
Low	156	Low vs Bkgd	1.30(0.48,3.51)	0.609		
High	203	High vs Bkgd	0.64(0.21,1.91)	0.421		
Total	1448					

Digestive System Anomalies (Full Siblings)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

Without adjustment for covariates (Table 6-40 [a] and [b]), there is no significant association between anomalies of the digestive system and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt (p=0.588) or more than 5 ppt (p=0.930) current dioxin.

After adjustment for covariates (Table 6-40 [c] and [d]), there is no significant association between anomalies of the digestive system and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt (p=0.620) or more than 5 ppt (p=0.984) current dioxin.

Table 6-40

Post-SEA Counts and Rates of Digestive System Anomalies

Variable: Digestive System Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	1	12.8	0.86(0.49,1.50)	0.588
	Medium	206	6	29.1		
	High	136	3	22.1		
b) D>5 ppt (n=557)	Low	114	2	17.5	1.02(0.68,1.53)	0.930
	Medium	245	6	24.5		
	High	198	4	20.2		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=390)	0.86(0.46,1.59)		0.620		M-AGE(p=0.024) F-AGE(p=0.034) C-TIME(p=0.103)	
d) D>5 ppt (n=513)	1.01(0.66,1.53)		0.984		None	

Digestive System Anomalies (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-41 [a]), there is no significant variation in the association between digestive system anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.532$). Furthermore, there is no significant association between digestive system anomalies and current dioxin among children of Ranch Hands with late ($p=0.937$) or early ($p=0.418$) tours.

Without adjustment for covariates (Table 6-41 [b]), there is no significant variation in the association between digestive system anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.616$). Furthermore, there is no significant association between digestive system anomalies and current dioxin among children of Ranch Hands with late ($p=0.623$) or early ($p=0.840$) tours.

After adjustment for covariates (Table 6-41 [c]), there is no significant variation in the association between digestive system anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.549$). Furthermore, there is no significant association between digestive system anomalies and current dioxin among children of Ranch Hands with late ($p=0.917$) or early ($p=0.505$) tours.

After adjustment for covariates (Table 6-41 [d]), there is no significant variation in the association between digestive system anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.649$). Furthermore, there is no significant association between digestive system anomalies and current dioxin among children of Ranch Hands with late ($p=0.666$) or early ($p=0.836$) tours.

Table 6-41

**Post-SEA Counts and Rates of
Digestive System Anomalies**

Variable: Digestive System Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)						0.532
	≤18.6	21.3 (1/47)	17.4 (2/115)	31.3 (2/64)	1.03(0.45,2.39)	0.937
	>18.6	0.0 (0/28)	43.5 (4/92)	13.3 (1/75)	0.71(0.31,1.62)	0.418
b) D>5 ppt (n=557)						0.616
	≤18.6	0.0 (0/59)	27.8 (4/144)	20.4 (2/98)	1.17(0.63,2.16)	0.623
	>18.6	0.0 (0/53)	47.2 (5/106)	10.3 (1/97)	0.94(0.54,1.64)	0.840

Table 6-41 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)			0.549	M-AGE(p=0.021) F-AGE(p=0.032) C-TIME(p=0.088)
	≤18.6	1.05(0.44,2.48)	0.917	
	>18.6	0.71(0.26,1.93)	0.505	
d) D>5 ppt (n=513)			0.649	None
	≤18.6	1.14(0.62,2.12)	0.666	
	>18.6	0.94(0.51,1.71)	0.836	

Digestive System Anomalies (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-42 [a]), there is no significant overall association between anomalies of the digestive system and categorized current dioxin among full siblings (p=0.447). Furthermore, there is no significant difference between the rates of digestive system anomalies among children of Ranch Hands in the High (p=0.691), Low (p=0.129) and Unknown (p=0.878) categories and the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-42 [b]), there is no significant overall association between anomalies of the digestive system and categorized current dioxin among full siblings (p=0.542). Furthermore, there is no significant difference between the rates of digestive system anomalies among children of Ranch Hands in the High (p=0.694), Low (p=0.171) and Unknown (p=0.890) categories and the rate among children of Comparisons in the Background category.

Table 6-42

Post-SEA Counts and Rates of
Digestive System Anomalies

Variable: Digestive System Anomalies
Restrictions: Full Siblings of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted						
Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	16	19.7	All Exp Categ		0.447
Unknown	221	4	18.1	Unk vs Bkgd	0.92(0.30,2.77)	0.878
Low	148	6	40.5	Low vs Bkgd	2.10(0.81,5.47)	0.129
High	195	3	15.4	High vs Bkgd	0.78(0.22,2.70)	0.691
Total	1376					

b) Adjusted						
Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks	
Background	715	All Exp Categ		0.542	RACE(p=0.060)	
Unknown	199	Unk vs Bkgd	1.08(0.35,3.39)	0.890	OCC(p=0.041)	
Low	137	Low vs Bkgd	2.08(0.73,5.97)	0.171		
High	180	High vs Bkgd	0.77(0.21,2.81)	0.694		
Total	1231					

Genital Anomalies (All Children)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-43 [a] and [b]), there is no significant association between genital anomalies and initial dioxin among children of Ranch Hands having more than 10 ppt (p=0.346) or more than 5 ppt (p=0.971) current dioxin.

After adjustment for covariates (Table 6-43 [c] and [d]), the association between genital anomalies and initial dioxin is not significant among children of Ranch Hands having more than 10 ppt (p=0.215) or having more than 5 ppt (p=1.000).

Table 6-43

Post-SEA Counts and Rates of
Genital Anomalies

Variable: Genital Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	1	9.4	0.79(0.48,1.31)	0.346
	Medium	245	10	40.8		
	High	157	2	12.7		
b) D>5 ppt (n=690)	Low	155	2	12.9	1.01(0.70,1.45)	0.971
	Medium	308	11	35.7		
	High	227	2	8.8		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=458)	0.72(0.42,1.23)		0.215		OCC(p=0.028)	
d) D>5 ppt (n=616)	1.00(0.70,1.43)		1.000		None	

Genital Anomalies (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-44 [a]), there is no significant variation in the association between genital anomalies and current dioxin with time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.883$). Furthermore, there is no association between genital anomalies and current dioxin among children of Ranch Hands with late ($p=0.498$) or early ($p=0.739$) tours.

Without adjustment for covariates (Table 6-44 [b]), there is no significant variation in the association between genital anomalies and current dioxin with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin ($p=0.916$). Furthermore, there is no association between genital anomalies and current dioxin among children of Ranch Hands with late ($p=0.613$) or early ($p=0.630$) tours.

After adjustment for covariates (Table 6-44 [c]), there is no significant variation in the association between genital anomalies and current dioxin with time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.822$). Furthermore, there is no association between genital anomalies and current dioxin among children of Ranch Hands with late ($p=0.465$) or early ($p=0.777$) tours.

After adjustment for covariates (Table 6-44 [d]), there is no significant variation in the association between genital anomalies and current dioxin with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin ($p=0.881$). Furthermore, there is no association between genital anomalies and current dioxin among children of Ranch Hands with late ($p=0.669$) or early ($p=0.632$) tours.

Table 6-44

Post-SEA Counts and Rates of
Genital Anomalies

Variable: Genital Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)						0.883
	≤18.6	16.1 (1/62)	59.7 (8/134)	13.9 (1/72)	0.80(0.42,1.53)	0.498
	>18.6	0.0 (0/40)	27.8 (3/108)	10.8 (1/93)	0.87(0.38,2.00)	0.739
b) D>5 ppt (n=690)						0.916
	≤18.6	11.1 (1/90)	46.0 (8/174)	18.2 (2/110)	1.12(0.71,1.77)	0.613
	>18.6	0.0 (0/63)	22.1 (3/136)	8.5 (1/117)	1.17(0.61,2.25)	0.630

Table 6-44 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)			0.822	None
	≤18.6	0.79(0.42,1.49)	0.465	
	>18.6	0.89(0.39,2.01)	0.777	
d) D>5 ppt (n=616)			0.881	None
	≤18.6	1.10(0.70,1.73)	0.669	
	>18.6	1.17(0.61,2.24)	0.632	

Genital Anomalies (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-45 [a]), there is a significant overall association between genital anomalies and categorized dioxin (p=0.005). Additionally, the genital anomaly rate among children of Ranch Hands in the Low current dioxin category is significantly greater than the rate among children of Comparisons in the Background category (OR=2.92, 95% CI 1.29-6.61, p=0.010). Corresponding contrasts between children of Ranch Hands in the High (p=0.595) and Unknown categories (p=0.107) with children of Comparisons in the Background category are not significant.

After adjustment for covariates (Table 6-45 [b]), there is a significant overall association between genital anomalies and categorized dioxin (p=0.007). Additionally, the genital anomaly rate among children of Ranch Hands in the Low current dioxin category is significantly greater than the rate among children of Comparisons in the Background category (OR=2.89, 95% CI 1.26-6.64, p=0.012). Corresponding contrasts between children of Ranch Hands in the High (p=0.724) and Unknown categories (p=0.112) with children of Comparisons in the Background category are not significant.

Table 6-45

Post-SEA Counts and Rates of
Genital Anomalies

Variable: Genital Anomalies
Restrictions: All Children of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	18	18.3	All Exp Categ		0.005
Unknown	282	1	3.5	Unk vs Bkgd	0.19(0.03,1.43)	0.107
Low	174	9	51.7	Low vs Bkgd	2.92(1.29,6.61)	0.010
High	227	3	13.2	High vs Bkgd	0.72(0.21,2.46)	0.595
Total	1664					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	All Exp Categ		0.007	SMOKE(p=0.046)
Unknown	246	Unk vs Bkgd	0.19(0.03,1.46)	0.112	
Low	156	Low vs Bkgd	2.89(1.26,6.64)	0.012	
High	203	High vs Bkgd	0.80(0.23,2.77)	0.724	
Total	1448				

Genital Anomalies (Full Siblings)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-46 [a] and [b]), there is no significant association between genital anomalies and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt (p=0.427) or more than 5 ppt (p=0.757) current dioxin.

After adjustment for covariates (Table 6-46 [c] and [d]), there is no significant association between genital anomalies and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt (p=0.422) or more than 5 ppt (p=0.938).

Table 6-46

Post-SEA Counts and Rates of Genital Anomalies

Variable: Genital Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	1	12.8	0.79(0.43,1.44)	0.427
	Medium	206	6	29.1		
	High	136	2	14.7		
b) D>5 ppt (n=557)	Low	114	2	17.5	0.93(0.61,1.44)	0.757
	Medium	245	7	28.6		
	High	198	2	10.1		

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted			
Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=390)	0.79(0.43,1.44)	0.422	None
d) D>5 ppt (n=513)	0.98(0.64,1.52)	0.938	None

Genital Anomalies (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-47 [a]), there is no significant variation in the association between genital anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.372$). Furthermore, there is no significant association between genital anomalies and current dioxin among children of Ranch Hands with late ($p=0.308$) or early ($p=0.695$) tours.

Without adjustment for covariates (Table 6-47 [b]), there is no significant variation in the association between genital anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.420$). Furthermore, there is no significant association between genital anomalies and current dioxin among children of Ranch Hands with late ($p=0.900$) or early ($p=0.397$) tours.

After adjustment for covariates (Table 6-47 [c]), there is significant variation in the association between genital anomalies and current dioxin with time since duty in SEA and the father's age at the time of conception among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.030$). The basis for this variation in risk is displayed in Appendix D-2. For neither the younger fathers (less than 30 years) or the older fathers (30 or older) is there a significant association between the genital anomalies and current dioxin in the children of Ranch Hands with late tours ($p=0.934$ and $p=0.349$, respectively). There is insufficient data for similar comparisons among children of Ranch Hands with early tours. When this variation in risk is ignored, there is no significant variation association between genital anomalies and current dioxin with time since duty in SEA ($p=0.359$). Furthermore, the association between genital anomalies and current dioxin is not significant among children whose father had a late ($p=0.289$) or early ($p=0.699$) tour.

After adjustment for covariates (Table 6-47 [d]), there is no significant variation in the association between genital anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.409$). Furthermore, there is no significant association between genital anomalies and current dioxin among children of Ranch Hands with late ($p=0.844$) or early ($p=0.404$) tours.

Table 6-47

Post-SEA Counts and Rates of
Genital Anomalies

Variable: Genital Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)						0.372
	≤18.6	21.3 (1/47)	52.2 (6/115)	15.6 (1/64)	0.68(0.32,1.44)	0.308
	>18.6	0.0 (0/28)	10.9 (1/92)	13.3 (1/75)	1.24(0.42,3.71)	0.695
b) D>5 ppt (n=557)						0.420
	≤18.6	16.9 (1/59)	48.6 (7/144)	10.2 (1/98)	0.97(0.57,1.63)	0.900
	>18.6	0.0 (0/53)	9.4 (1/106)	10.3 (1/97)	1.49(0.59,3.73)	0.397

Table 6-47 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)			0.359***	F-AGE*TIME* DIOXIN(p=0.030)
	≤18.6	0.66(0.31,1.42)***	0.289***	
	>18.6	1.23(0.42,3.59)***	0.699***	
d) D>5 ppt (n=513)			0.409	None
	≤18.6	0.95(0.56,1.60)	0.844	
	>18.6	1.47(0.59,3.63)	0.404	

Genital Anomalies (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-48 [a]), there is a significant overall association between genital anomalies and categorized dioxin among full siblings (p=0.028). The genital anomaly rate among children of Ranch Hands in the Low category is significantly greater than the rate among children of Comparisons in the Background category (p=0.050). However, the same contrast was not significant for the High (p=0.380) and Unknown (p=0.150) categories.

After adjustment for covariates (Table 6-48 [b]), there is a significant overall association between genital anomalies and categorized dioxin among full siblings (p=0.027). The genital anomaly rate among children of Ranch Hands in the Low category is borderline significantly greater than the rate among children of Comparisons in the Background category (p=0.075). However, the rates among children of Ranch Hands in the High (p=0.298) and Unknown (p=0.136) categories are not significantly different from the rate among children of Comparisons in the Background category.

Table 6-48

Post-SEA Counts and Rates of
Genital Anomalies

Variable: Genital Anomalies
Restrictions: Full Siblings of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted						
Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	16	19.7	All Exp Categ		0.028
Unknown	221	1	4.5	Unk vs Bkgd	0.23(0.03,1.72)	0.150
Low	148	7	47.3	Low vs Bkgd	2.47(1.00,6.12)	0.050
High	195	2	10.3	High vs Bkgd	0.52(0.12,2.26)	0.380
Total	1376					

b) Adjusted						
Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks	
Background	715	All Exp Categ		0.027	DRINK(p=0.044)	
Unknown	199	Unk vs Bkgd	0.22(0.03,1.63)	0.136		
Low	137	Low vs Bkgd	2.28(0.92,5.67)	0.075		
High	180	High vs Bkgd	0.46(0.10,2.01)	0.298		
Total	1231					

Urinary System Anomalies (All Children)

Model 1: Children of Ranch Hands - \log_2 (Initial Dioxin)

Without adjustment for covariates (Table 6-49 [a] and [b]), there is no significant association between urinary system anomalies and initial dioxin among children of Ranch Hands having more than 10 ppt (p=0.944) or more than 5 ppt (p=0.444) current dioxin.

There is insufficient data with which to assess the significance of the association between urinary system anomalies and initial dioxin with adjustment for covariates (Table 6-49 [c] and [d]).

Table 6-49

Post-SEA Counts and Rates of
Urinary System Anomalies

Variable: Urinary System Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Fathers Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	3	28.3	0.98(0.62,1.57)	0.944
	Medium	245	6	24.5		
	High	157	4	25.5		
b) D>5 ppt (n=690)	Low	155	2	12.9	1.15(0.81,1.63)	0.444
	Medium	308	7	22.7		
	High	227	6	26.4		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=458)	No adjusted analyses, only 13 defects total					
d) D>5 ppt (n=616)	No adjusted analyses, only 15 defects total					

Urinary System Anomalies (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-50 [a]), there is no significant variation in the association between urinary system anomalies and current dioxin with time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.957$). Furthermore, there is no significant association between urinary system anomalies and current dioxin level among children of Ranch Hands with late ($p=0.913$) or early ($p=0.798$) tours.

Without adjustment for covariates (Table 6-50 [b]), there is no significant variation in the association between urinary system anomalies and current dioxin with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin ($p=0.623$). Furthermore, there is no significant association between urinary system anomalies and current dioxin among children of Ranch Hands with late ($p=0.946$) or early ($p=0.387$) tours.

There is insufficient data to assess the significance of variation in the association between urinary system anomalies and current dioxin with time since duty in SEA with adjustment for covariates (Table 6-50 [c] and [d]).

Table 6-50

Post-SEA Counts and Rates of
Urinary System Anomalies

Variable: Urinary System Anomalies
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)						0.957
	≤18.6	16.1 (1/62)	22.4 (3/134)	13.9 (1/72)	0.95(0.40,2.25)	0.913
	>18.6	25.0 (1/40)	37.0 (4/108)	32.3 (3/93)	0.93(0.52,1.66)	0.798
b) D>5 ppt (n=690)						0.623
	≤18.6	22.2 (2/90)	17.2 (3/174)	18.2 (2/110)	1.02(0.57,1.82)	0.946
	>18.6	0.0 (0/63)	36.8 (5/136)	25.6 (3/117)	1.23(0.77,1.95)	0.387
Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted						
Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)			p-Value	Covariate Remarks
c) D>10 ppt (n=459)		No adjusted analyses, only 13 defects total				
d) D>5 ppt (n=616)		No adjusted analyses, only 15 defects total				

Urinary System Anomalies (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-51 [a]), there is no significant overall association between urinary system anomalies and categorized dioxin ($p=0.228$). However, the rate of urinary system anomalies among children of Ranch Hands in the Low category is significantly greater than the rate among children of Comparisons in the Background category ($p=0.037$). The rates of urinary system anomalies among children of Ranch Hands in the High ($p=0.267$) and Unknown ($p=0.796$) categories are not significantly different from the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-51 [b]), there is no significant overall association between urinary system anomalies and categorized dioxin ($p=0.170$). However, the rate of urinary system anomalies among children of Ranch Hands in the Low ($p=0.021$) category is significantly greater than the rate among children of Comparisons in the Background category. The rates of urinary system anomalies among children of Ranch Hands in the High ($p=0.388$) and Unknown ($p=0.966$) categories do not differ significantly from the rate among children of Comparisons in the Background category.

Table 6-51

Post-SEA Counts and Rates of Urinary System Anomalies

Variable: Urinary System Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted						
Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	12	12.2	All Exp Categ		0.228
Unknown	282	4	14.2	Unk vs Bkgd	1.16(0.37,3.63)	0.796
Low	174	6	34.5	Low vs Bkgd	2.88(1.07,7.79)	0.037
High	227	5	22.0	High vs Bkgd	1.82(0.63,5.22)	0.267
Total	1664					

Table 6-51 (Continued)

b) Adjusted

Exposure Category		Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	All Exp Categ		0.170	DRINK(p=0.065)
Unknown	246	Unk vs Bkgd	1.03(0.28,3.77)	0.966	
Low	156	Low vs Bkgd	3.33(1.19,9.31)	0.021	
High	203	High vs Bkgd	1.67(0.52,5.40)	0.388	
Total	1448				

Urinary System Anomalies (Full Siblings)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-52 [a] and [b]), there is no significant association between urinary system anomalies and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt (p=0.877) or more than 5 ppt (p=0.668) current dioxin.

There is insufficient data with which to assess the association between urinary system anomalies and initial dioxin among full sibling children of Ranch Hands with adjustment for covariates (Table 6-52 [c] and [d]).

Table 6-52

Post-SEA Counts and Rates of
Urinary System Anomalies

Variable: Urinary System Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	2	25.6	0.96(0.57,1.61)	0.877
	Medium	206	6	29.1		
	High	136	3	22.1		
b) D>5 ppt (n=557)	Low	114	2	17.5	1.09(0.74,1.60)	0.668
	Medium	245	6	24.5		
	High	198	5	25.3		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value		Covariate Remarks		
c) D>10 ppt (n=390)	No adjusted analyses, only 11 defects total					
d) D>5 ppt (n=513)	No adjusted analyses, only 13 defects total					

Urinary System Anomalies (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-53 [a]), there is no significant variation in the association between urinary system anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.607$). Furthermore, there is no significant association between urinary system anomalies and current dioxin among children of Ranch Hands with late ($p=0.852$) or early ($p=0.530$) tours.

Without adjustment for covariates (Table 6-53 [b]), there is no significant variation in the association between urinary system anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 5 ppt current dioxin (p=0.712). Furthermore, there is no significant association between urinary system anomalies and current dioxin among children of Ranch Hands with late (p=0.949) or early (p=0.606) tours.

There is insufficient data with which to assess the significance of the variation in the association between urinary system anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands with adjustment for covariates (Table 6-53 [c] and [d]).

Table 6-53

Post-SEA Counts and Rates of
Urinary System Anomalies

Variable: Urinary System Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: Log₂(Current Dioxin), Time

Ranch Hands - Log ₂ (Current Dioxin), Time - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)						0.607
	≤18.6	21.3 (1/47)	17.4 (2/115)	15.6 (1/64)	1.09(0.43,2.75)	0.852
	>18.6	35.7 (1/28)	43.5 (4/92)	26.7 (2/75)	0.81(0.42,1.57)	0.530
b) D>5 ppt (n=557)						0.712
	≤18.6	33.9 (2/59)	13.9 (2/144)	20.4 (2/98)	0.98(0.52,1.85)	0.949
	>18.6	0.0 (0/53)	47.2 (5/106)	20.6 (2/97)	1.14(0.69,1.87)	0.606

Table 6-53 (Continued)

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)		No adjusted analyses, only 11 defects total		
d) D>5 ppt (n=513)		No adjusted analyses, only 13 defects total		

Urinary System Anomalies (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-54 [a]), there is no significant overall association between urinary system anomalies and categorized dioxin among full siblings ($p=0.440$). However, the rate of urinary system anomalies among children of Ranch Hands in the Low category is borderline significantly greater than the rate among children of Comparisons in the Background category ($p=0.087$). The rates of urinary system anomalies among children of Ranch Hands in the High ($p=0.474$) and Unknown ($p=0.617$) categories do not differ significantly from the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-54 [b]), there is no significant overall association between urinary system anomalies and categorized dioxin among full siblings ($p=0.352$). However, the rate of urinary system anomalies among children of Ranch Hands in the Low category is significantly greater than the rate among children of Comparisons in the Background category ($p=0.055$). The rates of urinary system anomalies among the children of Ranch Hands in the High ($p=0.672$) and Unknown ($p=0.786$) categories are not significantly different from the rate among children of Comparisons in the Background category.

Table 6-54

Post-SEA Counts and Rates of
Urinary System Anomalies

Variable: Urinary System Anomalies
Restrictions: Full Siblings of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	11	13.5	All Exp Categ		0.440
Unknown	221	4	18.1	Unk vs Bkgd	1.34(0.42,4.26)	0.617
Low	148	5	33.8	Low vs Bkgd	2.55(0.87,7.44)	0.087
High	195	4	20.5	High vs Bkgd	1.52(0.48,4.85)	0.474
Total	1376					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	All Exp Categ		0.352	DRINK(p=0.093)
Unknown	199	Unk vs Bkgd	1.20(0.32,4.48)	0.786	
Low	137	Low vs Bkgd	2.97(0.98,9.02)	0.055	
High	180	High vs Bkgd	1.33(0.36,4.97)	0.672	
Total	1231				

Musculoskeletal Deformities (All Children)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-55 [a] and [b]), there is no association between musculoskeletal deformities and initial dioxin among children of Ranch Hands having more than 10 ppt (p=0.154) or more than 5 ppt (p=0.365) current dioxin.

After adjustment for covariates (Table 6-55 [c]), the association between musculoskeletal deformities and initial dioxin varies significantly with the father's race (p=0.022) among children of Ranch Hands having more than 10 ppt current dioxin. The basis for this variation is displayed in Appendix Table D-2. The variation in risk is due to a lack of musculoskeletal deformities among children of Black Ranch Hands. If this variation in risk is ignored, there remains a borderline significant negative association between musculoskeletal deformities and initial dioxin (p=0.062).

After adjustment for covariates (Table 6-55 [d]), the association between musculoskeletal deformities and initial dioxin varies significantly with the father's race (p=0.003) among children of Ranch Hands having more than 5 ppt current dioxin. The basis for this variation is displayed in Appendix Table D-2. There is a significantly decreased risk of musculoskeletal deformities among children of Black Ranch Hands (OR=0.03, 95% CI 0.001-0.68, p=0.024) and a nonsignificant decreased risk among children of nonblack Ranch Hands (OR=0.85, 95% CI 0.70-1.04, p=0.107).

Table 6-55

Post-SEA Counts and Rates of
Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	11	103.8	0.85(0.67,1.07)	0.154
	Medium	245	40	163.3		
	High	157	14	89.2		
b) D>5 ppt (n=690)	Low	155	20	129.0	0.93(0.79,1.09)	0.365
	Medium	308	39	126.6		
	High	227	29	127.8		

Table 6-55 (Continued)

Ranch Hands - Log₂(Initial Dioxin) - Adjusted

Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=458)	0.79(0.61,1.02)***	0.062***	RACE*DIOXIN(p=0.022) OCC(p=0.068)
d) D>5 ppt (n=616)	****	****	RACE*DIOXIN(p=0.003) OCC(p=0.002) F-AGE(p=0.088)

Musculoskeletal Deformities (All Children)

Model 2: Children of Ranch Hands - Log₂(Current Dioxin) and Time

Without adjustment for covariates (Table 6-56 [a]), there is a borderline significant variation in the association between musculoskeletal deformities and current dioxin level with time since duty in SEA (p=0.068) among children of Ranch Hands having more than 10 ppt current dioxin. Among children of Ranch Hands with early tours, the risk is significantly decreased (OR=0.68, 95% CI 0.48-0.96, p=0.030) and among children of Ranch Hands with late tours the risk is nonsignificant (OR=1.06, 95% CI 0.76-1.49, p=0.729).

Without adjustment for covariates (Table 6-56 [b]), there is no significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA tour among children of Ranch Hands having more than 5 ppt current dioxin (p=0.476). Furthermore, there is no significant association between musculoskeletal deformities and current dioxin among children of Ranch Hands with late (p=0.980) or early (p=0.342) tours.

After adjustment for covariates (Table 6-56 [c]), there is borderline significant variation in the association between musculoskeletal deformities and current dioxin (p=0.072) with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin. The risk is significantly decreased among children whose father had an early tour (OR=0.68, 95% CI 0.48-0.97, p=0.033) and the risk is not statistically significant among children whose father had a late tour (OR=1.08, 95% CI 0.75-1.53, p=0.688).

After adjustment for covariates (Table 6-56 [d]), the association between musculoskeletal deformities and current dioxin varies significantly with time since the father's duty in SEA and the father's age at conception (p=0.041) among children of Ranch Hands having more than 5 ppt current dioxin. The basis for this variation in risk is displayed in Appendix Table D-2. The risk among children of younger fathers is higher than the risk among children of older fathers. The risk among children of older fathers with early tours is borderline significantly decreased (OR=0.74, 95% CI 0.53-1.04, p=0.080) and among children of older fathers with late tours the risk is significantly decreased (OR=0.56, 95% CI 0.34-0.92, p=0.21). All other within-stratum relative risks were not significant.

Table 6-56

Post-SEA Counts and Rates of
Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: Log₂(Current Dioxin), Time

Ranch Hands - Log ₂ (Current Dioxin), Time - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)	≤18.6	129.0 (8/62)	104.5 (14/134)	180.6 (13/72)	1.06(0.76,1.49)	0.068 0.729
	>18.6	175.0 (7/40)	157.4 (17/108)	64.5 (6/93)	0.68(0.48,0.96)	0.030
b) D>5 ppt (n=690)	≤18.6	155.6 (14/90)	126.4 (22/174)	145.5 (16/110)	1.00(0.80,1.26)	0.476 0.980
	>18.6	79.4 (5/63)	169.1 (23/136)	68.4 (8/117)	0.89(0.70,1.13)	0.342

Table 6-56 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)			0.072	OCC(p=0.010) RACE(p=0.032)
	≤18.6	1.08(0.75,1.53)	0.688	
	>18.6	0.68(0.48,0.97)	0.033	
d) D>5 ppt (n=616)			0.872	OCC(p=0.001) F-AGE*DIOXIN*TIME (p=0.041)
	≤18.6	0.83(0.63,1.08)***	0.171	
	>18.6	0.81(0.62,1.05)***	0.107	

Musculoskeletal Deformities (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-57 [a]), there is no significant overall association between musculoskeletal deformities and categorized current dioxin (p=0.588). Furthermore, there is no significant difference between the rates of musculoskeletal deformities among children of Ranch Hands in the High (p=0.246), Low (p=0.747) and Unknown (p=0.541) categories and the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-57 [b]), the association between musculoskeletal deformities and categorized current dioxin varies significantly with the father's military occupation (p=0.001). This variation in risk is displayed in Appendix Table D-2. There is a significant overall association between musculoskeletal deformity and categorized current dioxin among children whose fathers were officers (p=0.001). The deformity rate among children of Ranch Hand officers in the Unknown current dioxin category is significantly lower than that of children of Comparisons in the Background current dioxin category (OR=0.30, 95% CI 0.12-0.74, p=0.009). The rate in children of Ranch Hand officers in the Low current dioxin category is zero and hence no adjusted contrast with children of Comparisons in the Background category is possible. A contrast between children of Ranch Hand officers in the High category with children of Comparisons in the Background category was not carried out because there were no children of Ranch Hand officers in the High dioxin category. All other category contrasts with the Background category are not significant within each of the other occupations.

Table 6-57

Post-SEA Counts and Rates of
Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
Restrictions: All Children of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	132	134.6	All Exp Categ		0.588
Unknown	282	34	120.6	Unk vs Bkgd	0.88(0.59,1.32)	0.541
Low	174	25	143.7	Low vs Bkgd	1.08(0.68,1.71)	0.747
High	227	24	105.7	High vs Bkgd	0.76(0.48,1.21)	0.246
Total	1664					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	All Exp Categ	****	****	DIOXIN*OCC(p=0.001)
Unknown	246	Unk vs Bkgd			
Low	156	Low vs Bkgd			
High	203	High vs Bkgd			
Total	1448				

Musculoskeletal Deformities (Full Siblings)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

Without adjustment for covariates (Table 6-58 [a] and [b]), there is no significant association between musculoskeletal deformities and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt ($p=0.136$) or more than 5 ppt ($p=0.897$) current dioxin.

After adjustment for covariates (Table 6-58 [c]), the association between musculoskeletal deformities and initial dioxin varies significantly with the father's race ($p=0.008$) among full sibling children of Ranch Hands having more than 10 ppt current dioxin. The basis for this variation in risk is displayed in Appendix Table D-2. The association between musculoskeletal deformities and initial dioxin is not significant in children of nonblack fathers. There is insufficient data to assess this association in children of Black fathers.

After adjustment for covariates (Table 6-58 [d]), the association between musculoskeletal deformities and initial dioxin varies significantly with the father's race ($p=0.008$) among full siblings of Ranch Hands having more than 5 ppt current dioxin. The basis for this variation in risk is displayed in Appendix Table D-2. The association between musculoskeletal deformities and initial dioxin is not significant in children of nonblack fathers. There is insufficient data to assess this association in children of Black fathers.

Table 6-58

**Post-SEA Counts and Rates of
Musculoskeletal Deformities**

Variable: Musculoskeletal Deformities
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	10	128.2	0.83(0.64,1.07)	0.136
	Medium	206	32	155.3		
	High	136	13	95.6		
b) D>5 ppt (n=557)	Low	114	10	87.7	0.99(0.82,1.18)	0.897
	Medium	245	30	122.4		
	High	198	27	136.4		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=390)	****		****		RACE*DIOXIN(p=0.008)	
d) D>5 ppt (n=513)	****		****		RACE*DIOXIN(p=0.008) OCC(p=0.006) M-AGE(p=0.074) F-AGE(p=0.087)	

Musculoskeletal Deformities (Full Siblings)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-59 [a]), there is no significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.128$). The risk among children of Ranch Hands with early tours is borderline significantly decreased (OR=0.667, 95% 0.45-1.01, $p=0.053$) and the risk among children of Ranch Hands with late tours is not significant ($p=0.944$).

Without adjustment for covariates (Table 6-59 [b]), there is no significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA among full siblings of Ranch Hands having more than 5 ppt current dioxin ($p=0.429$). Furthermore, there is no significant association between musculoskeletal deformities and current dioxin among children whose father had a late ($p=0.524$) or early ($p=0.627$) tour.

After adjustment for covariates (Table 6-59 [c]), there is borderline significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA among full siblings of Ranch Hands having more than 10 ppt current dioxin ($p=0.096$). The risk among children of Ranch Hands with early tours is significantly decreased (OR=0.66, 95% CI 0.43-0.99, $p=0.46$) and the risk among children of Ranch Hands with late tours is not significant ($p=0.819$).

After adjustment for covariates (Table 6-59 [d]), there is no significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.560$). Furthermore, there is no significant association between musculoskeletal deformities and current dioxin among whose father had late ($p=0.605$) or early ($p=0.189$) tours.

Table 6-59

Post-SEA Counts and Rates of
Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)						0.128
	≤18.6	170.2 (8/47)	95.7 (11/115)	203.1 (13/64)	1.01(0.71,1.44)	0.944
	>18.6	178.6 (5/28)	152.2 (14/92)	53.3 (4/75)	0.67(0.45,1.01)	0.053
b) D>5 ppt (n=557)						0.429
	≤18.6	101.7 (6/59)	138.9 (20/144)	153.1 (15/98)	1.09(0.84,1.40)	0.524
	>18.6	56.6 (3/53)	160.4 (17/106)	61.9 (6/97)	0.93(0.71,1.23)	0.627

Table 6-59 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)			0.096	OCC(p=0.061)
	≤18.6	1.04(0.72,1.51)	0.819	
	>18.6	0.66(0.43,0.99)	0.046	
d) D>5 ppt (n=513)			0.560	OCC(p=0.017) M-AGE(p=0.064)
	≤18.6	0.92(0.68,1.25)	0.605	
	>18.6	0.82(0.60,1.10)	0.189	

Musculoskeletal Deformities (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-60 [a]), there is no overall significant association between musculoskeletal deformities and categorized dioxin among full siblings (p=0.331). There is no significant difference between the rates of musculoskeletal deformities among children of Ranch Hands in the High (p=0.215), Low (p=0.993) and Unknown (p=.0.147) dioxin categories and the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-60 [b]), the overall association between musculoskeletal deformity and categorized dioxin varies significantly with the father's military occupation in SEA (p=0.010) among full siblings. This variation in risk is displayed in Appendix Table D-2. The rates of musculoskeletal deformity among children whose fathers were Ranch Hand officers are lower than the rates in the other strata. Among children of officers, there was an overall significant association between musculoskeletal deformity and categorized current dioxin (p=0.002). The rate among children of Ranch Hand officers in the Unknown current dioxin category (49.0 per 1000) is significantly lower than that in children of Comparisons officers in the Background current dioxin category (153.5 per 1000) (p=0.010); there were no Ranch Hand children whose fathers were in the High current dioxin category. All other contrasts with the Background category are not significant within each of the other occupations.

Table 6-60

Post-SEA Counts and Rates of
Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
Restrictions: Full Siblings of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	115	141.6	All Exp Categ		0.331
Unknown	221	23	104.1	Unk vs Bkgd	0.70(0.44,1.13)	0.147
Low	148	21	141.9	Low vs Bkgd	1.00(0.61,1.66)	0.993
High	195	21	107.7	High vs Bkgd	0.73(0.45,1.20)	0.215
Total	1376					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	All Exp Categ	****	****	DIOXIN*OCC(p=0.010)
Unknown	199	Unk vs Bkgd			RACE(p=0.062)
Low	137	Low vs Bkgd			
High	180	High vs Bkgd			
Total	1231				

Anomalies of the Skin (All Children)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

Without adjustment for covariates (Table 6-61 [a] and [b]), there is no significant association between anomalies of the skin and initial dioxin among children of Ranch Hands having more than 10 ppt ($p=0.428$) or more than 5 ppt ($p=0.768$) current dioxin.

After adjustment for covariates (Table 6-61 [c]), there is no association between anomalies of the skin and initial dioxin among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.718$).

After adjustment for covariates (Table 6-61 [d]), the association between anomalies of the skin and initial dioxin varies significantly with the father's race ($p=0.012$) among children of Ranch Hands having more than 5 ppt current dioxin. This variation in risk is displayed in Appendix Table D-2. The association between anomalies of the skin and initial dioxin is not significant among children of nonblack fathers. There is insufficient data to assess this association in children of Black fathers.

Table 6-61

Post-SEA Counts and Rates of
Anomalies of the Skin

Variable: Anomalies of the Skin
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	2	18.9	0.80(0.45,1.41)	0.428
	Medium	245	6	24.5		
	High	157	2	12.7		
b) D>5 ppt (n=690)	Low	155	2	12.9	0.94(0.62,1.42)	0.768
	Medium	308	8	26.0		
	High	227	2	8.8		

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted			
Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=458)	0.90(0.51,1.59)	0.718	None
d) D>5 ppt (n=616)	1.09(0.71,1.67)***	0.703***	RACE*DIOXIN(p=0.012)

Anomalies of the Skin (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

Without adjustment for covariates (Table 6-62 [a]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin (p=0.338). Furthermore, the association between anomalies of the skin and current dioxin is not significant among children of Ranch Hands with late (p=0.303) or early (p=0.799) tours.

Without adjustment for covariates (Table 6-62 [b]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA among children of Ranch Hands having more than 5 ppt current dioxin ($p=0.202$). Furthermore, the association between anomalies of the skin and current dioxin is not significant among children of Ranch Hands with late ($p=0.414$) and early ($p=0.339$) tours.

After adjustment for covariates (Table 6-62 [c]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.483$). Furthermore, the association between anomalies of the skin and current dioxin is not significant among children whose father had a late ($p=0.509$) or early ($p=0.770$) tour.

After adjustment for covariates (Table 6-62 [d]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA among children of Ranch Hands with more than 5 ppt current dioxin ($p=0.412$). Furthermore, the association between anomalies of the skin and current dioxin is not significant among children whose father had a late ($p=0.850$) or early ($p=0.341$) tour.

Table 6-62

Post-SEA Counts and Rates of
Anomalies of the Skin

Variable: Anomalies of the Skin
Restrictions: All Children of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)						0.338
	≤18.6	16.1 (1/62)	29.9 (4/134)	13.9 (1/72)	0.62(0.25,1.54)	0.303
	>18.6	0.0 (0/40)	27.8 (3/108)	10.8 (1/93)	1.11(0.50,2.44)	0.799
b) D>5 ppt (n=690)						0.202
	≤18.6	22.2 (2/90)	28.7 (5/174)	9.1 (1/110)	0.78(0.43,1.41)	0.414
	>18.6	0.0 (0/63)	22.1 (3/136)	8.5 (1/117)	1.38(0.72,2.64)	0.339

Table 6-62 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=459)			0.483	None
	≤18.6	0.74(0.29,1.84)	0.509	
	>18.6	1.12(0.52,2.42)	0.770	
d) D>5 ppt (n=616)			0.412	OCC(p=0.070)
	≤18.6	0.94(0.50,1.77)	0.850	
	>18.6	1.37(0.72,2.61)	0.341	

Anomalies of the Skin (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-63 [a]), there is no significant overall association between anomalies of the skin and categorized current dioxin (p=0.318). Furthermore, the rate of anomalies of the skin among children of Ranch Hands in the High (p=0.226), Low (p=0.298) and Unknown (p=0.702) categories are not significantly different than that of children of Comparisons in the Background category.

After adjustment for covariates (Table 6-63 [b]), there is significant variation in association between anomalies of the skin and categorized current dioxin with the father's race (p=0.023). This variation in risk is displayed in Appendix Table D-2. There is no significant overall association between anomalies of the skin and categorized current dioxin among children of non-black fathers (p=0.115). Furthermore among children of nonblack fathers, there is no significant difference between the rates of the anomalies of the skin among the children of Ranch Hands in the High (p=0.285), Low (p=0.197) and Unknown (p=0.190) categories and the rate among children of Comparisons in the Background category. There is insufficient data to assess the significance of this association among children of Black fathers.

If this variation in risk is ignored, there is no significant overall association between the anomalies of the skin and categorized dioxin ($p=0.298$). Furthermore, there is no significant difference between the rates of skin anomalies among children of Ranch Hands in the High ($p=0.289$), Low ($p=0.208$) and Unknown ($p=0.618$) categories and the rate among children of Comparisons in the Background category.

Table 6-63

Post-SEA Counts and Rates of Anomalies of the Skin

Variable: Anomalies of the Skin
 Restrictions: All Children of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	21	21.4	All Exp Categ		0.318
Unknown	282	5	17.7	Unk vs Bkgd	0.82(0.31,2.21)	0.702
Low	174	6	34.5	Low vs Bkgd	1.63(0.65,4.11)	0.298
High	227	2	8.8	High vs Bkgd	0.41(0.09,1.75)	0.226
Total	1664					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	All Exp Categ		0.298***	RACE*DIOXIN ($p=0.023$)
Unknown	246	Unk vs Bkgd	0.76(0.25,2.26)***	0.618***	
Low	156	Low vs Bkgd	1.83(0.72,4.70)***	0.208***	
High	203	High vs Bkgd	0.46(0.11,1.95)***	0.289***	
Total	1448				

Anomalies of the Skin (Full Siblings)

Model 1: Children of Ranch Hands - Log₂(Initial Dioxin)

Without adjustment for covariates (Table 6-64 [a]), there is a borderline significant negative association between anomalies of the skin and initial dioxin among full sibling children of Ranch Hands having more than 10 ppt (p=0.066) current dioxin.

Without adjustment for covariates (Table 6-64 [b]), there is no significant association between anomalies of the skin and initial dioxin among full sibling children of Ranch Hands having more than 5 ppt (p=0.366) current dioxin.

After adjustment for covariates (Table 6-64 [c] and [d]), there is no significant association between anomalies of the skin and initial dioxin among full sibling children of Ranch Hands with more than 10 ppt (0.171) or with more than 5 ppt (p=0.925) current dioxin.

Table 6-64

Post-SEA Counts and Rates of Anomalies of the Skin

Variable: Anomalies of the Skin
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 1: Log₂(Initial Dioxin)

Ranch Hands - Log₂(Initial Dioxin) - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	2	25.6	0.52(0.24,1.12)	0.066
	Medium	206	5	24.3		
	High	136	1	7.4		
b) D>5 ppt (n=557)	Low	114	1	8.8	0.80(0.48,1.32)	0.366
	Medium	245	7	28.6		
	High	198	1	5.1		

Table 6-64 (Continued)

Ranch Hands - Log₂(Initial Dioxin) - Adjusted

Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=390)	0.61(0.29,1.30)	0.171	None
d) D>5 ppt (n=513)	0.98(0.57,1.66)	0.925	OCC(p=0.102)

Anomalies of the Skin (Full Siblings)

Model 2: Children of Ranch Hands - Log₂(Current Dioxin) and Time

Without adjustment for covariates (Table 6-65 [a]), there is no significant variation in association between anomalies of the skin and current dioxin with time since duty in SEA among full sibling children of Ranch Hands having more than 10 ppt current dioxin (p=0.974). Furthermore, there is no significant association between anomalies of the skin and current dioxin among children of Ranch Hands with late (p=0.258) or early (p=0.479) tours.

Without adjustment for covariates (Table 6-65 [b]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA among full sibling children of Ranch Hands with more than 5 ppt current dioxin (p=0.790). Furthermore, there is no significant association between anomalies of the skin and current dioxin among children of Ranch Hands with late (p=0.571) or early (p=0.961) tours.

After adjustment for covariates (Table 6-65 [c]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA among full sibling children of Ranch Hands with more than 10 ppt current dioxin (p=0.889). Furthermore, there is no significant association between anomalies of the skin and current dioxin among children of Ranch Hands with late (p=0.453) or early (p=0.491) tours.

After adjustment for covariates (Table 6-65 [d]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA among full sibling children of Ranch Hands with more than 5 ppt current dioxin (p=0.850). Furthermore, there is no significant association between anomalies of the skin and current dioxin among children of Ranch Hands with late (p=0.804) or early (p=0.957) tours.

Table 6-65

Post-SEA Counts and Rates of
Anomalies of the Skin

Variable: Anomalies of the Skin
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)						0.974
	≤18.6	21.3 (1/47)	34.8 (4/115)	15.6 (1/64)	0.59(0.23,1.48)	0.258
	>18.6	0.0 (0/28)	21.7 (2/92)	0.0 (0/75)	0.61(0.15,2.43)	0.479
b) D>5 ppt (n=557)						0.790
	≤18.6	16.9 (1/59)	34.7 (5/144)	10.2 (1/98)	0.84(0.45,1.55)	0.571
	>18.6	0.0 (0/53)	18.9 (2/106)	0.0 (0/97)	0.98(0.38,2.51)	0.961

Table 6-65 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)			0.889	None
	≤18.6	0.70(0.27,1.78)	0.453	
	>18.6	0.62(0.16,2.40)	0.491	
d) D>5 ppt (n=513)			0.850	None
	≤18.6	1.09(0.55,2.14)	0.804	
	>18.6	0.97(0.38,2.48)	0.957	

Anomalies of the Skin (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-66 [a]), there is no significant overall association between anomalies of the skin and categorized current dioxin among full siblings (p=0.216). Furthermore, the rates of anomalies of the skin among children of Ranch Hands in the High (p=0.211), Low (p=0.238) and Unknown (p=0.623) categories are not significantly different from the rate among children of Comparisons in the Background category.

After adjustment for covariates (Table 6-66 [b]), there is no significant variation in overall association between anomalies of the skin and categorized current dioxin (p=0.180) among full siblings. Furthermore, the rates of anomalies of the skin among children of Ranch Hands in the High (p=0.285), Low (p=0.142) and Unknown (p=0.498) categories are not significantly different from the rate among children of Comparisons in the Background category.

Table 6-66

Post-SEA Counts and Rates of
Anomalies of the Skin

Variable: Anomalies of the Skin
Restrictions: Full Siblings of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	15	18.5	All Exp Categ		0.216
Unknown	221	3	13.6	Unk vs Bkgd	0.73(0.21,2.55)	0.623
Low	148	5	33.8	Low vs Bkgd	1.86(0.66,5.20)	0.238
High	195	1	5.1	High vs Bkgd	0.27(0.04,2.09)	0.211
Total	1376					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	All Exp Categ		0.180	None
Unknown	199	Unk vs Bkgd	0.60(0.13,2.68)	0.498	
Low	137	Low vs Bkgd	2.22(0.77,6.41)	0.142	
High	180	High vs Bkgd	0.33(0.04,2.53)	0.285	
Total	1231				

Chromosomal Anomalies (All Children)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

There is insufficient data (Table 6-67) to assess the significance of the association between chromosomal anomalies and initial dioxin among children of Ranch Hands.

Table 6-67

Post-SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	0	0.0	No analyses, only 1 defect total	
	Medium	245	0	0.0		
	High	157	1	6.4		
b) D>5 ppt (n=690)	Low	155	1	6.5	No analyses, only 2 defects total	
	Medium	308	0	0.0		
	High	227	1	4.4		

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted			
Exposure Assumptions	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=458)	No Adjusted Analyses, only 1 defect total		
d) D>5 ppt (n=616)	No Adjusted Analyses, only 2 defects total		

Chromosomal Anomalies (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

There is insufficient data (Table 6-68) to assess the significance of variation in the association between chromosomal anomalies and current dioxin with time since duty in SEA among children of Ranch Hands.

Table 6-68

Post-SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)	≤18.6	0.0 (0/62)	0.0 (0/134)	0.0 (0/72)	No analyses, only 1 defect total	
	>18.6	0.0 (0/40)	0.0 (0/108)	10.8 (1/93)		
b) D>5 ppt (n=690)	≤18.6	11.1 (1/90)	0.0 (0/174)	0.0 (0/110)	No analyses, only 2 defects total	
	>18.6	0.0 (0/63)	0.0 (0/136)	8.5 (1/117)		
Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted						
Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)			p-Value	Covariate Remarks
c) D>10 ppt (n=459)		No adjusted analyses, only 1 defect total				
d) D>5 ppt (n=616)		No adjusted analyses, only 2 defects total				

Chromosomal Anomalies (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-69 [a]), there is no significant overall association between chromosomal anomalies and categorized current dioxin ($p=0.292$). Furthermore, there is no significant difference between the rates of chromosomal anomalies among children of Ranch Hands in the High ($p=0.751$), Low ($p=0.560$) and Unknown ($p=0.126$) categories and the rate among children of Comparisons in the Background category.

There is insufficient data (Table 6-69 [b]) to assess the association between chromosomal anomalies and categorized current dioxin with adjustment for covariates.

Table 6-69

Post-SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	3	3.1	All Exp Categ		0.292
Unknown	282	3	10.6	Unk vs Bkgd	3.51(0.70,17.5)	0.126
Low	174	0	0.0	Low vs Bkgd	-- -- --	0.560
High	227	1	4.4	High vs Bkgd	1.44(0.15,14.0)	0.751
Total	1664					

Table 6-69 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843	No adjusted analyses, only 7 defects total			
Unknown	246				
Low	156				
High	203				
Total	1448				

Chromosomal Anomalies (Full Siblings)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

There is insufficient data (Table 6-70) to assess the significance of the association between chromosomal anomalies and initial dioxin among full siblings of Ranch Hands.

Table 6-70

Post-SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted

Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	0	0.0	No analyses, only 1 defect total	
	Medium	206	0	0.0		
	High	136	1	7.4		
b) D>5 ppt (n=557)	Low	114	1	8.8	No analyses, only 2 defects total	
	Medium	245	0	0.0		
	High	198	1	5.1		

Table 6-70 (Continued)

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=390)	No Adjusted Analyses, only 1 defect total		
d) D>5 ppt (n=513)	No Adjusted Analyses, only 2 defects total		

Chromosomal Anomalies (Full Siblings)

Model 2: Children of Ranch Hands - Log_2 (Current Dioxin) and Time

There is insufficient data (Table 6-71) to assess the significance of variation in the association between chromosomal anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands.

Table 6-71

Post-SEA Counts and Rates of
Chromosomal Anomalies

Variable: Chromosomal Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted

Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)	≤18.6	0.0 (0/47)	0.0 (0/115)	0.0 (0/64)	No analyses, only 1 defect total	
	>18.6	0.0 (0/28)	0.0 (0/92)	13.3 (1/75)		
b) D>5 ppt (n=557)	≤18.6	16.9 (1/59)	0.0 (0/144)	0.0 (0/98)	No analyses, only 2 defects total	
	>18.6	0.0 (0/53)	0.0 (0/106)	10.3 (1/97)		

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)		No adjusted analyses, only 1 defect total		
d) D>5 ppt (n=513)		No adjusted analyses, only 2 defects total		

Chromosomal Anomalies (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

Without adjustment for covariates (Table 6-72 [a]), there is no significant overall association between chromosomal anomalies and categorized current dioxin among full siblings ($p=0.264$). Furthermore, the rates among children of Ranch Hands in the High ($p=0.776$), Low ($p=0.575$) and Unknown ($p=0.110$) dioxin categories are not significantly different than that of children of Comparisons in the Background category.

There is insufficient data (Table 6-72 [b]) to assess the significance of the association between chromosomal anomalies and categorized dioxin among full sibling children with adjustment for covariates.

Table 6-72

Post-SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Children Conceived during or after the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	3	3.7	All Exp Categ		0.264
Unknown	221	3	13.6	Unk vs Bkgd	3.71(0.74,18.5)	0.110
Low	148	0	0.0	Low vs Bkgd	-- -- --	0.575
High	195	1	5.1	High vs Bkgd	1.39(0.14,13.5)	0.776
Total	1376					

Table 6-72 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	No adjusted analyses, only 7 defects total			
Unknown	199				
Low	137				
High	180				
Total	1231				

Other and Unspecified Anomalies (All Children)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

There is insufficient data (Table 6-73) to assess the significance of the association between other and unspecified anomalies and initial dioxin among children of Ranch Hands.

Table 6-73

Post-SEA Counts and Rates of Other and Unspecified Anomalies

Variable: Other and Unspecified Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted

Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=508)	Low	106	1	9.4	No analyses, only 3 defects total	
	Medium	245	2	8.2		
	High	157	0	0.0		
b) D>5 ppt (n=690)	Low	155	1	6.5	No analyses, only 4 defects total	
	Medium	308	3	9.7		
	High	227	0	0.0		

Table 6-73 (Continued)

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted

Exposure Restriction	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=458)	No adjusted analyses, only 3 defects total		
d) D>5 ppt (n=616)	No adjusted analysis, only 4 defects total		

Other and Unspecified Anomalies (All Children)

Model 2: Children of Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$ and Time

There is insufficient data (Table 6-74) to assess the significance of variation in the association between other and unspecified anomalies and current dioxin with time since duty in SEA among children of Ranch Hands.

Table 6-74

**Post-SEA Counts and Rates of
Other and Unspecified Anomalies**

Variable: Other and Unspecified Anomalies
 Restrictions: All Children of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=509)	≤18.6	0.0 (0/62)	7.5 (1/134)	0.0 (0/72)	No analyses, only 3 defects total	
	>18.6	25.0 (1/40)	9.3 (1/108)	0.0 (0/93)		
b) D>5 ppt (n=690)	≤18.6	0.0 (0/90)	5.7 (1/174)	0.0 (0/110)	No analyses, only 4 defects total	
	>18.6	15.9 (1/63)	14.7 (2/136)	0.0 (0/117)		
Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Adjusted						
Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)			p-Value	Covariate Remarks
c) D>10 ppt (n=459)		No adjusted analyses, only 3 defects total				
d) D>5 ppt (n=616)		No adjusted analyses, only 4 defects total				

Other and Unspecified Anomalies (All Children)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

There is insufficient data (Table 6-75) to assess the significance of the association between other and unspecified anomalies and categorized current dioxin.

Table 6-75

Post-SEA Counts and Rates of
Other and Unspecified Anomalies

Variable: Other and Unspecified Anomalies
Restrictions: All Children of Ranch Hands and Comparisons
Children Conceived during or after the
Father's Duty in SEA
Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	981	2	2.0	All Exp Categ	No analyses, only 5 defects total	
Unknown	282	1	3.5	Unk vs Bkgd		
Low	174	2	11.5	Low vs Bkgd		
High	227	0	0.0	High vs Bkgd		
Total	1664					

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	843		No adjusted analyses, only 5 defects total		
Unknown	246				
Low	156				
High	203				
Total	1448				

Other and Unspecified Anomalies (Full Siblings)

Model 1: Children of Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$

There is insufficient data (Table 6-76) to assess the significance of the association between other and unspecified anomalies and initial dioxin among full sibling children of Ranch Hands.

Table 6-76

Post-SEA Counts and Rates of
Other and Unspecified Anomalies

Variable: Other and Unspecified Anomalies
Restrictions: Full Siblings of Ranch Hands
Children Conceived during or after the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Unadjusted						
Exposure Restriction	Initial Dioxin	n	Abnormal Number	Abnormal Rate	Est. Relative Risk (95% C.I.)	p-Value
a) D>10 ppt (n=420)	Low	78	0	0.0	No analyses, only 1 defect total	
	Medium	206	1	4.9		
	High	136	0	0.0		
b) D>5 ppt (n=557)	Low	114	1	8.8	No analyses, only 2 defects total	
	Medium	245	1	4.1		
	High	198	0	0.0		
Ranch Hands - $\text{Log}_2(\text{Initial Dioxin})$ - Adjusted						
Exposure Restriction	Adj. Relative Risk (95% C.I.)		p-Value		Covariate Remarks	
c) D>10 ppt (n=390)	No adjusted analyses,		1 defects total			
d) D>5 ppt (n=513)	No adjusted analysis,		2 defects total			

Other and Unspecified Anomalies (Full Siblings)

Model 2: Children of Ranch Hands - Log₂(Current Dioxin) and Time

There is insufficient data (Table 6-77) to assess the significance of variation in the association between other and unspecified anomalies and current dioxin with time since duty in SEA among full sibling children of Ranch Hands.

Table 6-77

**Post-SEA Counts and Rates of
Other and Unspecified Anomalies**

Variable: Other and Unspecified Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Children Conceived during or after the
 Father's Duty in SEA
 Model 2: Log₂(Current Dioxin), Time

Ranch Hands - Log₂(Current Dioxin), Time - Unadjusted						
Exposure Restriction	Time Since SEA (years)	Anomaly Rate (No./n)			Est. Relative Risk (95% C.I.)	p-Value
		Low	Medium	High		
a) D>10 ppt (n=421)	≤18.6	0.0 (0/47)	0.0 (0/115)	0.0 (0/64)	No analyses, only 1 defect total	
	>18.6	0.0 (0/28)	10.9 (1/92)	0.0 (0/75)		
b) D>5 ppt (n=557)	≤18.6	0.0 (0/59)	0.0 (0/144)	0.0 (0/98)	No analyses, only 2 defects total	
	>18.6	18.9 (1/53)	9.4 (1/106)	0.0 (0/97)		

Table 6-77 (Continued)

Ranch Hands - Log₂(Current Dioxin), Time - Adjusted

Exposure Restriction	Time Since SEA (years)	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
c) D>10 ppt (n=391)		No adjusted analyses, 1 defects total		
d) D>5 ppt (n=513)		No adjusted analyses, 2 defects total		

Other and Unspecified Anomalies (Full Siblings)

Model 3: Children of Ranch Hands and Comparisons - Categorized Current Dioxin

There is insufficient data (Table 6-78) to assess the significance of the association between other and unspecified anomalies and categorized current dioxin among full sibling children.

Table 6-78

Post-SEA Counts and Rates of Other and Unspecified Anomalies

Variable: Other and Unspecified Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Children Conceived during or after the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

a) Unadjusted

Exposure Category	n	Abnormal Number	Abnormal Rate	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value
Background	812	2	2.5	All Exp Categ	No analyses, only 4 defects total	
Unknown	221	1	4.5	Unk vs Bkgd		
Low	148	1	6.8	Low vs Bkgd		
High	195	0	0.0	High vs Bkgd		
Total	1376					

Table 6-78 (Continued)

b) Adjusted

Exposure Category	n	Category Contrast	Est. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	715	No adjusted analyses, only 4 defect total			
Unknown	199				
Low	137				
High	180				
Total	1231				

6.2 Conclusion

The statistical significance of the association between post-SEA birth defects and the father's dioxin level was assessed within each of the 13 birth defect categories in four separate series of analyses. Analyses were first conducted on all children and then with restriction to full sibling children. Within each of these two series, each analysis was carried out first without and then with adjustment for covariates. The results are summarized in Tables 6-79 through 6-81.

Throughout this section, nonsignificant results are indicated by NS, borderline significant results are indicated by NS* and the presence of interactions with the p-value greater than or equal to 0.01 and less than 0.05 are indicated with a preceding double asterisk (**). Four asterisks (****) represent the presence of an interaction between a covariate and dioxin with a p-value less than 0.01. The p-value is replaced by a double hyphen (--) when the analysis was not carried out due to sparse data.

Table 6-79

P-Value Summary of Post-SEA Initial Dioxin (Model 1) Analyses
of Birth Defects (Children of Ranch Hands)

a) All Children

Variable	Unadjusted		Adjusted	
	D>10 ppt	D>5 ppt	D>10 ppt	D>5 ppt
Total Congenital Anomalies	NS	NS	NS	**NS
Nervous System Anomalies	NS	NS	--	--
Eye Anomalies	NS	NS	--	--
Ear, Face and Neck Anomalies	NS	NS	--	--
Circulatory System and Heart Anomalies	0.042	NS	--	--
Respiratory System Anomalies	--	--	--	--
Digestive System Anomalies	NS	NS	NS	NS
Genital Anomalies	NS	NS	NS	NS
Urinary System Anomalies	NS	NS	--	--
Musculoskeletal Deformities	NS	NS	**NS*	****
Anomalies of the Skin	NS	NS	NS	**NS
Chromosomal Anomalies	--	--	--	--
Other and Unspecified Anomalies	--	--	--	--

b) Full Siblings

Variable	Unadjusted		Adjusted	
	D>10 ppt	D>5 ppt	D>10 ppt	D>5 ppt
Total Congenital Anomalies	NS	NS	NS	NS
Nervous System Anomalies	NS	NS	--	--
Eye Anomalies	NS	NS	--	--
Ear, Face and Neck Anomalies	NS	NS	--	--
Circulatory System and Heart Anomalies	NS*	NS	--	--
Respiratory System Anomalies	--	--	--	--
Digestive System Anomalies	NS	NS	NS	NS
Genital Anomalies	NS	NS	NS	NS
Urinary System Anomalies	NS	NS	--	--
Musculoskeletal Deformities	NS	NS	****	****
Anomalies of the Skin	NS*	NS	NS	NS
Chromosomal Anomalies	--	--	--	--
Other and Unspecified Anomalies	--	--	--	--

Table 6-80

P-Value Summary of Current Dioxin and Time (Model 2) Analyses
Post-SEA Birth Defects (Children of Ranch Hands)

Variable	Unadjusted					
	Dioxin by Time	D>10 ppt Time Since SEA (years)		Dioxin by Time	D>5 ppt Time Since SEA (years)	
		≤18.6	>18.6		≤18.6	>18.6
Total Congenital Anomalies	NS	NS	NS	NS	NS	NS
Nervous System Anomalies	--	--	--	--	--	--
Eye Anomalies	NS	NS	NS	NS	NS	NS
Ear, Face and Neck Anomalies	NS	NS	NS	0.005	NS*	NS*
Circulatory System and Heart Anomalies	NS	NS	NS*	NS	NS	NS
Respiratory System Anomalies	--	--	--	--	--	--
Digestive System Anomalies	NS	NS	NS	NS	NS	NS
Genital Anomalies	NS	NS	NS	NS	NS	NS
Urinary System Anomalies	NS	NS	NS	NS	NS	NS
Musculoskeletal Deformities	NS*	NS	0.030	NS	NS	NS
Anomalies of the Skin	NS	NS	NS	NS	NS	NS
Chromosomal Anomalies	--	--	--	--	--	--
Other and Unspecified Anomalies	--	--	--	--	--	--

Table 6-80 (Continued)

b) Full Siblings

Variable	Unadjusted					
	D>10 ppt Time Since Dioxin SEA (years)			D>5 ppt Time Since Dioxin SEA (years)		
	by Time	≤18.6	>18.6	by Time	≤18.6	>18.6
Total Congenital Anomalies	NS	NS	NS	NS	NS	NS
Nervous System Anomalies	--	--	--	--	--	--
Eye Anomalies	--	--	--	--	--	--
Ear, Face and Neck Anomalies	NS	NS	NS	0.014	NS	NS*
Circulatory System and Heart Anomalies	--	--	--	--	--	--
Respiratory System Anomalies	--	--	--	--	--	--
Digestive System Anomalies	NS	NS	NS	NS	NS	NS
Genital Anomalies	NS	NS	NS	NS	NS	NS
Urinary System Anomalies	NS	NS	NS	NS	NS	NS
Musculoskeletal Deformities	NS	NS	0.053	NS	NS	NS
Anomalies of the Skin	NS	NS	NS	NS	NS	NS
Chromosomal Anomalies	--	--	--	--	--	--
Other and Unspecified Anomalies	--	--	--	--	--	--

Table 6-80 (Continued)

c) All Children

Variable	Adjusted					
	D>10 ppt			D>5 ppt		
	Dioxin by Time	Time Since SEA (years)		Dioxin by Time	Time Since SEA (years)	
	<18.6	>18.6		<18.6	>18.6	
Total Congenital Anomalies	**NS	**NS	**NS	**NS	**NS	**NS
Nervous System Anomalies	--	--	--	--	--	--
Eye Anomalies	--	--	--	--	--	--
Ear, Face and Neck Anomalies	--	--	--	--	--	--
Circulatory System and Heart Anomalies	--	--	--	--	--	--
Respiratory System Anomalies	--	--	--	--	--	--
Digestive System Anomalies	NS	NS	NS	NS	NS	NS
Genital Anomalies	NS	NS	NS	NS	NS	NS
Urinary System Anomalies	--	--	--	--	--	--
Musculoskeletal Deformities	NS*	NS	0.033	**NS	**NS	**NS
Anomalies of the Skin	NS	NS	NS	NS	NS	NS
Chromosomal Anomalies	--	--	--	--	--	--
Other and Unspecified Anomalies	--	--	--	--	--	--

Table 6-80 (Continued)

d) Full Siblings

Variable	Adjusted					
	D>10 ppt Dioxin Tour by Time <18.6 >18.6			D>5 ppt Dioxin Tour by Time <18.6 >18.6		
Total Congenital Anomalies	NS	NS	NS	NS	NS	NS
Nervous System Anomalies	--	--	--	--	--	--
Eye Anomalies	--	--	--	--	--	--
Ear, Face and Neck Anomalies	--	--	--	--	--	--
Circulatory System and Heart Anomalies	--	--	--	--	--	--
Respiratory System Anomalies	--	--	--	--	--	--
Digestive System Anomalies	NS	NS	NS	NS	NS	NS
Genital Anomalies	**NS	**NS	**NS	NS	NS	NS
Urinary System Anomalies	--	--	--	--	--	--
Musculoskeletal Deformities	NS*	NS	0.046	NS	NS	NS
Anomalies of the Skin	NS	NS	NS	NS	NS	NS
Chromosomal Anomalies	--	--	--	--	--	--
Other and Unspecified Anomalies	--	--	--	--	--	--

Table 6-81

P-Value Summary of Categorized Current Dioxin (Model 3) Analyses of
Post-SEA Birth Defects (Children of Ranch Hands and Comparisons)

Variable	Unadjusted			
	All	Contrasts with Background		
		Unknown	Low	High
Total Congenital Anomalies	NS*	NS	0.013	NS
Nervous System Anomalies	NS	--	NS	NS*
Eye Anomalies	NS	NS	NS	NS
Ear, Face and Neck Anomalies	NS	NS	NS	NS
Circulatory System and Heart Anomalies	NS*	NS	0.016	NS
Respiratory System Anomalies	NS	NS	NS	NS
Digestive System Anomalies	NS	NS	NS	NS
Genital Anomalies	0.005	NS	0.010	NS
Urinary System Anomalies	NS	NS	0.037	NS
Musculoskeletal Deformities	NS	NS	NS	NS
Anomalies of the Skin	NS	NS	NS	NS
Chromosomal Anomalies	NS	NS	NS	NS
Other and Unspecified Anomalies	--	--	--	--

Table 6-81 (Continued)

b) Full Siblings

Variable	Unadjusted			
	All	Contrasts with Background		
		Unknown	Low	High
Total Congenital Anomalies	NS*	NS	0.028	NS
Nervous System Anomalies	NS	--	NS	NS*
Eye Anomalies	NS	NS	NS	NS*
Ear, Face and Neck Anomalies	NS	NS	NS	NS
Circulatory System and Heart Anomalies	0.007	NS	0.028	NS
Respiratory System Anomalies	NS	NS	NS	NS
Digestive System Anomalies	NS	NS	NS	NS
Genital Anomalies	0.028	NS	0.050	NS
Urinary System Anomalies	NS	NS	NS*	NS
Musculoskeletal Deformities	NS	NS	NS	NS
Anomalies of the Skin	NS	NS	NS	NS
Chromosomal Anomalies	NS	NS	NS	NS
Other and Unspecified Anomalies	--	--	--	--

Table 6-81 (Continued)

c) All Children

Variable	Adjusted			
	All	Contrasts with Background		
		Unknown	Low	High
Total Congenital Anomalies	****	****	****	****
Nervous System Anomalies	--	--	--	--
Eye Anomalies	--	--	--	--
Ear, Face and Neck Anomalies	NS	NS	NS	NS
Circulatory System and Heart Anomalies	NS	NS	NS	NS
Respiratory System Anomalies	--	--	--	--
Digestive System Anomalies	NS	NS	NS	NS
Genital Anomalies	0.007	NS	0.012	NS
Urinary System Anomalies	NS	NS	0.021	NS
Musculoskeletal Deformities	****	****	****	****
Anomalies of the Skin	**NS	**NS	**NS	**NS
Chromosomal Anomalies	--	--	--	--
Other and Unspecified Anomalies	--	--	--	--

Table 6-81 (Continued)

d) Full Siblings

Variable	Adjusted			
	All	Contrasts with Background		
		Unknown	Low	High
Total Congenital Anomalies	****	****	****	****
Nervous System Anomalies	--	--	--	--
Eye Anomalies	--	--	--	--
Ear, Face and Neck Anomalies	NS	NS	NS	NS
Circulatory System and Heart Anomalies	0.034	NS	NS	--
Respiratory System Anomalies	--	--	--	--
Digestive System Anomalies	NS	NS	NS	NS
Genital Anomalies	0.027	NS	NS*	NS
Urinary System Anomalies	NS	NS	0.055	NS
Musculoskeletal Deformities	****	****	****	****
Anomalies of the Skin	NS	NS	NS	NS
Chromosomal Anomalies	--	--	--	--
Other and Unspecified Anomalies	--	--	--	--

In the assessments of dioxin versus post-SEA birth defects, few significant associations were found. Those that were found did not appear consistently across analyses and most were not suggestive of a plausible dioxin effect. For example, a significant association was found between initial dioxin and circulatory system and heart anomalies, but the rate (6.4 per 1000) among children of Ranch Hands having the highest initial dioxin levels was less than that among children of Ranch Hands at the lowest dioxin levels (28.3 per 1000). In a Model 3 analysis restricted to full sibling children, a significant association was found between categorized dioxin and circulatory system and heart anomalies, but this was caused by a high rate (47.3 per 1000) among children of Ranch Hands in the Low category relative to children of Comparisons in the Background category (17.2 per 1000) and a low rate among children of Ranch Hands in the High category (0 per 1000). In a Model 2 analysis, a significant association was found between current dioxin and anomalies of the ear, face and neck, but this was caused by an increase in

anomalies with dioxin among children of Ranch Hands having early tours and a decrease in anomalies among children of Ranch Hands having late tours, a pattern that does not make biologic sense. A significant association was found in a Model 3 analysis of genital anomalies, but the pattern was not consistent with the expected dose-response. The rate among children of Ranch Hands in the Low dioxin category (51.7 per 1000) was greater than that among children of Ranch Hands in the High category (13.2 per 1000).

Several analyses of post-SEA total congenital anomalies and musculoskeletal deformities were complicated by significant interactions with covariates. Examination of these did not reveal meaningful patterns. For example, Model 3 analyses of total congenital anomalies (Table 6-3) found a significant interaction with the father's military occupation in SEA. Among children of officers, children of Ranch Hands in the Low dioxin category had a lower rate (45.5 per 1000) than children of Comparisons in the Background category (217.9 per 1000). Among children of flying enlisted and enlisted ground personnel, children of Ranch Hands in the Low dioxin category had higher rates (433.3 per 1000 and 317.3 per 1000) than children of Comparisons in the Background category (228.9 per 1000 and 212.7 per 1000) but the rates in children of enlisted ground personnel in the High category were not significantly elevated. A Model 3 analysis of musculoskeletal deformities (Table 6-57) also found a significant interaction with the father's military occupation in SEA. Children of Ranch Hand officers in the Low category had a low rate (0 per 1000) relative to children of Comparisons in the Background category (155.6 per 1000) and the rates in children of enlisted flyers and enlisted ground personnel were not significantly different from the rates in corresponding children of Comparisons in the Background category.

In summary, analyses of total congenital anomalies and musculoskeletal deformities found significant variation in relative risk, but taken together, no consistent pattern emerged. This suggests that these results are chance occurrences and that there is most likely no underlying association with dioxin. In conclusion, there is no evidence of an association between dioxin and birth defects among post-SEA children.