

5. PRE-POST SEA BIRTH DEFECTS

5.1 Introduction

Four issues are addressed here: (1) Can the baseline analysis be reproduced with the current database? (2) Does the baseline result hold for verified data? (3) If the baseline result holds for verified data, is the effect related to dioxin body burden? and (4) If the baseline result holds for verified data, is the effect more predominant in one or more of the 12 CDC categories of birth defects?

5.2 The Baseline Birth Defect Definition

At baseline, we used ICD-9-CM birth defect categories [14] which included 12 additional categories of anomalies not included in the CDC definition (Table 1-11). These 12 categories are summarized in Table 5-1. Table 5-1 also shows the numbers of children in each category by group and time of conception of the child relative to the father's duty in SEA and the corresponding rate per 1000 live births. The denominators for the rate calculations are shown in each column heading. These denominators are the total number of post-SEA live births of Ranch Hands and Comparisons who are included, according to their dioxin level, in any of the three statistical analyses. These denominators can be referenced to Table 1-6. For example, the 1772 post-SEA live births for all live births in Table 1-6 is the sum of the 791 Ranch Hands and 981 Comparisons in Table 5-1.

Table 5-1

Counts and Rates Of Live Births by Category
of Anomaly Included in the Baseline Definition but not
Included in the CDC Definition of Birth Defect

Restriction: All Live Births in Models 1, 2 or 3
Categories: Time of Conception the
Father's Group Membership

Category	Time of Conception Relative to the Father's Duty in SEA			
	Pre-SEA		Post-SEA	
	RH n=1283	Comparisons n=1459	RH n=791	Comparisons n=981
1. All 12 categories	88(68.6)	95(65.1)	101(127.7)	129(131.5)
2. Benign neoplasm of skin 216	36(28.1)	34(24.7)	35(44.2)	43(43.8)
3. Hemangioma and Lymphangioma any site 228	12(9.4)	16(11.0)	14(17.7)	25(25.5)
4. Neoplasms of unspecified nature of bone, skin etc 239.2	0(0.0)	0(0.0)	0(0.0)	0(0.0)
5. Chorioretinitis 363.2	0(0.0)	0(0.0)	0(0.0)	0(0.0)
6. Wolff-Parkinson-White syndrome 426.7	2(1.6)	1(0.7)	2(2.5)	0(0.0)
7. Major anomalies of jaw size 524.0	1(0.8)	3(2.1)	2(2.5)	2(2.0)
8. Inguinal hernia 550	24(18.7)	30(20.6)	17(21.5)	29(29.6)
9. Umbilical hernia 553.1	14(10.9)	7(4.8)	23(29.1)	21(21.4)
10. Epigastric hernia 553.29	0(0.0)	0(0.0)	0(0.0)	0(0.0)
11. Amniotic bands 658.8	0(0.0)	0(0.0)	0(0.0)	0(0.0)
12. Pilonidal sinus or dimple 685.1	0(0.0)	1(0.7)	2(2.5)	1(1.0)
13. Hydrocele 778.6	14(10.9)	12(8.2)	22(27.8)	23(23.4)

If a child was verified as having multiple birth defects, the child was counted in each category for which a birth defect was verified (see Section 1.6), but only once within a given category. For example, if a child had a verified nervous system defect and a verified circulatory defect, that child was counted in both categories. However, if a child had two verified nervous system defects, that child was counted only once in the nervous system category.

The corresponding cross classification of children according to the 12 additional baseline birth defect categories without the restriction to children whose fathers dioxin level included him in Model 1, 2 or 3 analyses is shown in Appendix Table C-1. The live births shown in Table C-1 are fathered by participants whose dioxin assay result was quantifiable, not quantifiable or missing.

5.3 The Baseline Analysis using Mother's Report, the Baseline Birth Defect Definition and Current Data

The current database is improved relative to the baseline database. At baseline, none of the information regarding children was verified. Therefore, the file contained errors in childrens birth dates, parentage, and birth defect status. Additionally, some children were not accounted for at all. In the interim, all of these errors have been corrected. Using the current database, all live births occurring at or before the participants baseline examination were considered and only the spouses reported assessment was used to categorize children. These inclusion criteria are identical to those used in the initial baseline birth defect analysis. The results were cross classified by reported defect (yes,no), group (Ranch Hand, Comparison) and time of conception relative to the father's duty in SEA. The results are shown in Table 5-2.

Table 5-2

Reported Birth Defects in Children Born At or Prior to Baseline by Time of Conception Relative to the Father's Duty in SEA Using Current Data and the Baseline Definition of Birth Defect

Time of Conception	Group	Any Reported Birth Defect		Total	Odds Ratio	p-Value
		Yes (Rate)	No			
Pre-SEA	Ranch Hand	93(58.8)	1489	1582	0.752	0.001
	Comparison	136(76.7)	1637	1773		
Post-SEA	Ranch Hand	105(128.0)	715	820	1.558	
	Comparison	89(86.2)	944	1033		

An analysis of Table 5-2 reveals that the change in the odds ratio from 0.752 to 1.558 is statistically significant ($p=0.001$).

These data were further analyzed to determine whether the significant effect is explained by group differences in the mother's age at the time of conception. An analysis adjusted for the mother's age found that the change in the odds ratio for reported defect with time of conception relative to father's service in SEA was not significantly influenced by the mother's age ($p=0.835$).

5.4 The Baseline Analysis using Mother's Report, the Baseline Birth Defect Definition, Restricted to Children Born During or Prior to the Father's Baseline Physical Examination, Adjusted for Dioxin Level

These data were further analyzed to assess the relationship between the change in relative risk (Table 5-3) and levels of dioxin body burden of the father. The change in the odds ratios is significantly associated with categorized dioxin ($p=0.038$). The association between reported birth defect and time of conception among children of Ranch Hands in the High category (OR=2.82) is significantly greater than that in children of Comparisons in the Background category (OR=1.14), $p=0.040$. The corresponding odds ratio in children of Ranch Hands in the Low category is also significantly increased relative to that in children of Comparisons in the Background category ($p=0.024$). The odds ratio in children of Ranch Hands in the Unknown category is not significantly different from that in the Background category ($p=0.163$). Thus, the baseline finding appears to be dose-related.

Table 5-3

Odds Ratios for Mothers Reported Birth Defect by the Father's Categorized Current Dioxin by Time of Conception Relative to the Father's Duty in SEA Tour Among Children Born At or Prior to the Baseline Physical Examination

Categorized Dioxin	Time of Conception	Reported Birth Defect Yes (Rate)	Total	Odds Ratio	p-value for Comparison with Background OR
Background	Pre-SEA	109 (79.3)	1374	1.14	0.038
	Post-SEA	72 (89.2)	807		
Unknown	Pre-SEA	36 (61.9)	582	1.76	0.163
	Post-SEA	25 (104.2)	240		
Low	Pre-SEA	20 (70.9)	282	2.50	0.024
	Post-SEA	26 (160.5)	162		
High	Pre-SEA	8 (48.8)	164	2.82	0.040
	Post-SEA	25 (126.3)	198		

5.5 The Baseline Analysis using Mother's Report and Subsequently Verified using the Baseline Birth Defect Definition, Restricted to Children Born During or Prior to the Father's Baseline Physical Examination

These data were reanalyzed by restricting birth defects to only those that were both reported by the mother and subsequently verified by review of medical records of the child. These data are summarized in Table 5-4 by the fathers group (Ranch Hand, Comparison) and time of conception (pre-SEA, post-SEA).

The change in the odds ratio with time of conception relative to fathers duty in SEA (Table 5-4) is significant for birth defects reported by the mother and subsequently verified (p=0.032). Analyses with adjustment for mothers age did not alter this finding.

Table 5-4

**Reported and Subsequently Verified Birth Defects in Children Born at
or Prior to Baseline by Time of Conception Relative
to the Father's Duty in SEA**

Time of Conception	Group	Reported and Verified Birth Defect			Total	Odds Ratio	p-Value
		Yes	(Rate)	No			
Pre-SEA	Ranch Hand	58	(36.7)	1524	1582	0.850	0.032
	Comparison	76	(42.9)	1697			
Post-SEA	Ranch Hand	75	(91.5)	745	820	1.451	
	Comparison	67	(64.9)	966			1033

**5.6 The Baseline Analysis using Mother's Report and Subsequently Verified
using the Baseline Definition of Birth Defect, Restricted to Children
Born During or Prior to the Father's Baseline Physical Examination,
Adjusted for Dioxin Level**

Reanalysis of the data in Table 5-5 to assess the significance of variation in the association between reported birth defects and time of conception with categorized dioxin were carried out. The results are shown in Table 5-5.

There is no variation in the overall association between reported and subsequently verified birth defects and categorized dioxin with time of birth relative to the fathers SEA duty ($p=0.549$). The association between reported and subsequently verified birth defect and time of birth in children of Ranch Hands in the High ($p=0.528$), Low ($p=0.382$) and Unknown ($p=0.196$) categories does not differ significantly from that in children of Comparisons in the Background category.

Table 5-5

Odds Ratios for Mothers Reported Birth Defect and Subsequently Verified, By Father's Categorized Current Dioxin by Time of Birth Relative to Father's Duty in SEA Tour Among Children Born At or Prior to Baseline Physical Examination

Categorized Dioxin	Time of Birth	Reported & Verified Birth Defect		Total	Odds Ratio	p-Value for Comparison with Background OR
		yes	(Rate)			
Background	Pre-SEA	59	(42.9)	1374	1.66	0.549
	Post-SEA	56	(69.4)	807		
Unknown	Pre-SEA	20	(34.4)	582	2.69	0.196
	Post-SEA	21	(87.5)	240		
Low	Pre-SEA	14	(49.6)	282	2.39	0.382
	Post-SEA	18	(111.1)	162		
High	Pre-SEA	6	(36.6)	164	2.32	0.528
	Post-SEA	16	(80.8)	198		

5.7 The Baseline Analysis using Verified Data, the CDC Definition of Birth Defect, Restricted to Children Born During or Prior to the Father's Baseline Physical Examination

Live births occurring at or before the participant's baseline examination were categorized by verified birth defect (yes,no), group (Ranch Hand, Comparison) and time of conception relative to father's service in SEA. The results are shown in Table 5-6.

Table 5-6

Verified Birth Defects in Children Born at or Prior to Baseline by
Time of Conception Relative to the Father's Duty in SEA
Using Current Data and the CDC Definition of Birth Defect

Time of Conception	Group	Verified Birth Defect		No	Total	Odds Ratio	p-Value
		Yes	(Rate)				
Pre-SEA	Ranch Hand	162	(102.4)	1420	1582	0.934	0.164
	Comparison	193	(108.9)	1580	1773		
Post-SEA	Ranch Hand	162	(197.6)	658	820	1.175	
	Comparison	179	(173.3)	854	1033		

The change in the odds ratio (Table 5-6) from 0.934 to 1.175 is not significant (p=0.164).

A cross tabulation of all live births according to the 13 CDC birth defect categories by group and time of conception relative to the father's duty in SEA among all children whose father had a dioxin level that included him in Models 1, 2 or 3 analyses is shown in Table 5-7.

Table 5-7

Counts and Rates Of Live Births by CDC Category of Anomaly

Restriction: All Live Births in Models 1, 2 or 3
 Categories: Time of Conception Relative to the
 Father's Duty in SEA

Category	Time of Conception Relative to the Father's Duty in SEA			
	Pre-SEA		Post-SEA	
	RH n=1283	Comparisons n=1459	RH n=791	Comparisons n=981
1. Total congenital anomalies	140(109.1)	158(108.3)	177(223.8)	204(208.0)
2. Nervous system anomalies	4(3.1)	7(4.8)	5(6.3)	3(3.1)
3. Eye anomalies	6(4.7)	6(4.1)	9(11.4)	7(7.1)
4. Ear, face, neck anomalies	7(5.5)	8(5.5)	13(16.4)	11(11.2)
5. Circulatory system and heart anomalies	15(11.7)	15(10.3)	17(21.5)	16(16.3)
6. Respiratory system anomalies	0(0.0)	1(0.7)	4(5.1)	2(2.0)
7. Digestive system anomalies	18(14.0)	15(10.3)	18(22.8)	24(24.5)
8. Genital anomalies	15(11.7)	15(10.3)	15(19.0)	18(18.3)
9. Urinary system anomalies	18(14.0)	21(14.4)	17(21.5)	12(12.2)
10. Musculoskeletal deformities	68(53.0)	81(55.5)	99(125.2)	132(134.6)
11. Anomalies of the skin	13(10.1)	11(7.5)	15(19.0)	21(21.4)
12. Chromosomal anomalies	2(1.6)	2(1.4)	4(5.1)	3(3.1)
13. Other and Unspecified	6(4.7)	3(2.1)	4(5.1)	2(2.0)

Analyses of the same type used at baseline were carried out for each of the 13 CDC categories of birth defects on children born at or before the father's baseline physical examination using verified birth defect data. Data in only 7 of the 13 categories were analyzable (total congenital, circulatory and heart, digestive system, genital, urinary, musculoskeletal and skin) due to sparse data in the other categories. The results are shown in Table 5-8.

Table 5-8

Verified Birth Defects in Children Born at or Prior to Baseline by
Time of Conception Relative to the Father's Duty in SEA Current Data
Within each of 7 CDC Birth Defect Categories

Defect Category	Time of Conception	Group	Verified Birth Defect		Rate	Odds Ratio	p-value
			Yes	Total			
Total Congenital	Pre-SEA	RH	162	1582	102.4	0.93	
		C	193	1773	108.9		
	Post-SEA	RH	162	820	197.6	1.17	
		C	179	1033	173.3		
Circulatory and Heart	Pre-SEA	RH	16	1582	10.1	0.90	
		C	20	1773	11.3		
	Post-SEA	RH	13	820	15.9	1.37	
		C	12	1033	11.6		
Digestive System	Pre-SEA	RH	21	1582	13.3	1.31	
		C	18	1773	10.2		
	Post-SEA	RH	16	820	19.5	1.12	
		C	18	1033	17.4		
Genital	Pre-SEA	RH	16	1582	10.1	0.90	
		C	20	1773	11.3		
	Post-SEA	RH	12	820	14.6	0.94	
		C	16	1033	15.5		
Urinary	Pre-SEA	RH	18	1582	11.4	0.96	
		C	21	1773	11.8		
	Post-SEA	RH	15	820	18.3	2.39	
		C	8	1033	7.7		

Table 5-8 (Continued)

Defect Category	Time of Conception	Group	Verified Birth Defect		Rate	Odds Ratio	p-value
			Yes	Total			
Musculo-skeletal	Pre-SEA	RH	82	1582	51.8	0.89	
		C	103	1773	58.1		
	Post-SEA	RH	91	820	111.0	1.04	
		C	111	1033	107.5		
Skin	Pre-SEA	RH	13	1582	8.2	1.22	
		C	12	1773	6.8		
	Post-SEA	RH	18	820	22.0	1.08	
		C	21	1033	20.3		

Without adjustment for covariates (Table 5-8) there is borderline significant variation in the association between urinary anomaly ($p=0.092$) and the father's group membership with time of conception. This significance is due to a change in the odds ratio from 0.96 to 2.39 from pre-SEA to post-SEA. There is no significant variation in the association between total congenital anomalies ($p=0.164$), circulatory and heart anomalies ($p=0.417$), digestive system anomalies ($p=0.742$), genital anomalies ($p=0.918$), musculoskeletal deformities ($p=0.463$) or anomalies of the skin ($p=0.821$) and fathers group membership with time of conception.

5.8 The Baseline Analysis using Verified Data and the CDC Definition of Birth Defects

These analyses were also carried out without the restriction that the children be born prior to the father's baseline physical examination. In this unrestricted approach, all 13 categories of defects are analyzable. The results are shown in Table 5-9.

Table 5-9

**Verified Birth Defects in All Children by Time of Conception
Relative to the Father's Duty in SEA Using Current Data
Within each of 13 CDC Birth Defect Categories (n=6792)**

Defect Category	Time of Conception	Group	Verified Birth Defect		Rate	Odds Ratio	p-value
			Yes	Total			
Total Congenital	Pre-SEA	RH	184	1805	101.9	0.93	
		C	254	2340	108.5		
	Post-SEA	RH	229	1045	219.1	1.28	
		C	289	1602	180.4		
Nervous System	Pre-SEA	RH	4	1805	2.2	0.47	
		C	11	2340	4.7		
	Post-SEA	RH	5	1045	4.8	1.92	
		C	4	1602	2.5		
Eye	Pre-SEA	RH	7	1805	3.9	1.01	
		C	9	2340	3.8		
	Post-SEA	RH	9	1045	8.6	1.26	
		C	11	1602	6.9		
Ear, Face and Neck	Pre-SEA	RH	8	1805	4.4	1.04	
		C	10	2340	4.3		
	Post-SEA	RH	15	1045	14.4	1.78	
		C	13	1602	8.1		
Circulatory and Heart	Pre-SEA	RH	20	1805	11.1	0.93	
		C	28	2340	12.0		
	Post-SEA	RH	19	1045	18.2	1.39	
		C	21	1602	13.1		
Respiratory System	Pre-SEA	RH	0	1805	0.0	----	
		C	4	2340	1.7		
	Post-SEA	RH	5	1045	4.8	2.56	
		C	3	1602	1.9		

Table 5-9 (Continued)

Defect Category	Time of Conception	Group	Verified Birth Defect		Rate	Odds Ratio	p-value
			Yes	Total			
Digestive System	Pre-SEA	RH	22	1805	12.2	1.36	
		C	21	2340	9.0		
	Post-SEA	RH	22	1045	21.1	1.13	0.649
		C	30	1602	18.7		
Genital	Pre-SEA	RH	19	1805	10.5	0.95	
		C	26	2340	11.1		
	Post-SEA	RH	21	1045	20.1	1.04	0.823
		C	31	1602	19.4		
Urinary	Pre-SEA	RH	20	1805	11.1	0.96	
		C	27	2340	11.5		
	Post-SEA	RH	21	1045	20.1	2.51	0.036
		C	13	1602	8.1		
Musculo-skeletal	Pre-SEA	RH	94	1805	52.1	0.92	
		C	132	2340	56.4		
	Post-SEA	RH	132	1045	126.3	1.14	0.239
		C	180	1602	112.4		
Skin	Pre-SEA	RH	16	1805	8.9	0.94	
		C	22	2340	9.4		
	Post-SEA	RH	26	1045	24.9	1.11	0.697
		C	36	1602	22.5		
Chromosomal Abnormality	Pre-SEA	RH	3	1805	1.7	1.30	
		C	3	2340	1.3		
	Post-SEA	RH	6	1045	5.7	1.84	0.729
		C	5	1602	3.1		
Other	Pre-SEA	RH	6	1805	3.3	2.60	
		C	3	2340	1.3		
	Post-SEA	RH	5	1045	4.8	2.56	0.989
		C	3	1602	1.9		

Without adjustment for covariates (Table 5-9), there is significant variation in the association between total congenital (p=0.028), respiratory system (p=0.028), and urinary system (p=0.036) anomalies and the father's group membership with time of conception. There is borderline significant variation in the association between nervous system anomalies (p=0.105) and the father's group membership with time of conception. All of these significant and borderline significant findings are caused by the Ranch Hands rate being less than the Comparison rate in pre-SEA children and greater than the Comparison rate in post-SEA children.

Without adjustment for covariates (Table 5-9), there is no significant variation in the association between eye anomalies (p=0.745), ear, face and neck anomalies (p=0.374), circulatory system and heart anomalies (p=0.344), digestive system anomalies (p=0.649), genital anomalies (p=0.823), musculoskeletal deformities (p=0.239), anomalies of the skin (p=0.697), chromosomal abnormalities (p=0.729) and other anomalies (p=0.989) and the father's group membership with time of conception.

5.9 Pre-Post SEA Exposure Analyses

Further analyses using Models 1, 2 and 3 were carried out to determine whether any of the pre-post SEA changes in verified birth defect odds ratio were related to the father's dioxin body burden. These analyses are not adjusted for covariates.

Total Congenital Anomalies (All Children)

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

Without adjustment for covariates (Table 5-10 [a] and [b]), there is no significant variation in the association between total congenital anomalies and initial dioxin with time of conception among children of Ranch Hands having more than 10 ppt (p=0.859) or more than 5 ppt (p=0.875) current dioxin.

Table 5-10

Pre-post SEA Counts and Rates Of
Total Congenital Anomalies

Variable: Total Congenital Anomalies
Restrictions: All Children of Ranch Hands
Categories: Time of Conception Relative to the
Father's Duty in SEA
Model 1: $\text{Log}_2(\text{Initial Dioxin})$

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

Time of Conception Relative
to the Father's Duty in SEA

Exposure Restriction	Initial Dioxin	Pre-SEA			Post-SEA			p-Value
		n	Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1208)	Low	249	32	128.5	106	20	188.7	0.859
	Medium	338	35	103.6	245	68	277.6	
	High	113	13	115.0	157	31	197.5	
b) D>5 ppt (n=1748)	Low	286	31	108.4	155	35	225.8	0.875
	Medium	616	66	107.1	308	72	233.8	
	High	156	19	121.8	227	49	215.9	

Total Congenital Anomalies (All Children)

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

Without adjustment for covariates (Table 5-11 [a]), there is no significant variation in the association between total congenital anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 10 ppt (p=0.162) or more than 5 ppt (p=0.573) current dioxin.

Table 5-11

Pre-post SEA Counts and Rates Of
Total Congenital Anomalies

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted								
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value		
			Low	Medium	High			
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	138.7 (19/137)	158.5 (29/183)	135.1 (5/37)	0.162		
		>18.6	73.7 (7/95)	70.2 (12/171)	115.4 (9/78)			
	Post-SEA	≤18.6	193.5 (12/62)	253.7 (34/134)	236.1 (17/72)			
		18.6	275.0 (11/40)	250.0 (27/108)	204.3 (19/93)			
	b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	95.5 (15/157)	156.5 (49/313)		106.1 (7/66)	0.573
			>18.6	80.0 (12/150)	85.2 (23/270)		98.0 (10/102)	
Post-SEA		≤18.6	266.7 (24/90)	252.9 (44/174)	209.1 (23/110)			
		>18.6	95.2 (6/63)	279.4 (38/136)	179.5 (21/117)			

Total Congenital Anomalies (All Children)

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

Without adjustment for covariates (Table 5-12), there is no significant variation in the overall association between total congenital anomalies and categorized current dioxin with time of conception (p=0.726). Furthermore, the associations between total congenital anomalies and time of conception in children of Ranch Hands in the High (p=0.970), Low (p=0.263) and Unknown (p=0.871) categories do not differ from that in children of Comparisons in the Background category.

Table 5-12

Pre-post SEA Counts and Rates of Total Congenital Anomalies

Variable: Total Congenital Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1459	158	108.3	981	204	208.0	2.16	All Exp Categ	0.726
Unknown	582	59	101.4	282	57	202.1	2.25	Unk vs Bkgd	0.871
Low	290	36	124.1	174	51	293.1	2.93	Low vs Bkgd	0.263
High	168	17	101.2	227	44	193.8	2.14	High vs Bkgd	0.970
Total	2499			1664					

Total Congenital Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-13 [a] and [b]), there is no significant variation in the association between total congenital anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands having more than 10 ppt (p=0.570) or more than 5 ppt (p=0.772) current dioxin.

Table 5-13

**Pre-post SEA Counts and Rates of
Total Congenital Anomalies**

Variable: Total Congenital Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

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

Time of Conception Relative
to the Father's Duty in SEA

Exposure Restriction	Initial Dioxin	Pre-SEA			Post-SEA			p-Value
		n	Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1030)	Low	231	30	129.9	78	16	205.1	0.570
	Medium	276	26	94.2	206	57	276.7	
	High	103	13	126.2	136	27	198.5	
b) D>5 ppt (n=1489)	Low	252	29	115.1	114	20	175.4	0.772
	Medium	545	59	108.3	245	58	236.7	
	High	135	16	118.5	198	44	222.2	

Total Congenital Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-14 [a]), there is no significant change in the association between total congenital anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.116$).

Without adjustment for covariates (Table 5-14 [b]), there is no significant variation in the association between total congenital anomalies and current dioxin with time since duty in SEA and the time of conception among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.932$).

Table 5-14

Pre-post SEA Counts and Rates of Total Congenital Anomalies

Variable: Total Congenital Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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 of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	145.2 (18/124)	141.9 (22/155)	142.9 (5/35)	0.116
		>18.6	82.4 (7/85)	62.9 (9/143)	130.4 (9/69)	
	Post-SEA	≤18.6	234.0 (11/47)	234.8 (27/115)	265.6 (17/64)	
		>18.6	285.7 (8/28)	260.9 (24/92)	186.7 (14/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	111.1 (14/126)	152.2 (42/276)	100.0 (6/60)	0.932
		>18.6	82.8 (12/145)	84.4 (20/237)	113.6 (10/88)	
	Post-SEA	≤18.6	203.4 (12/59)	263.9 (38/144)	214.3 (21/98)	
		>18.6	75.5 (4/53)	292.5 (31/106)	164.9 (16/97)	

Total Congenital Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-15), there is no significant variation in the overall association between total congenital anomalies and categorized current dioxin with time of conception ($p=0.336$) among full siblings. The association between total congenital anomalies and time of conception among children of Ranch Hands in the Low current dioxin category is borderline significantly increased relative to that among children of Comparisons in the Background category ($p=0.089$). The association between total congenital anomalies and time of conception among children of Ranch Hands in the High ($p=0.867$) and Unknown ($p=0.835$) categories are not significantly different from that among children of Comparisons in the Background category.

Table 5-15

Pre-post SEA Counts and Rates of Total Congenital Anomalies

Variable: Total Congenital Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1250	147	117.6	812	174	214.3	2.05	All Exp Categ	0.336
Unknown	514	54	105.1	221	41	185.5	1.94	Unk vs Bkgd	0.835
Low	244	27	110.7	148	44	297.3	3.40	Low vs Bkgd	0.089
High	148	16	108.1	195	37	189.7	1.93	High vs Bkgd	0.867
Total	2156			1376					

Nervous System Anomalies (All Live Births)

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

There is insufficient data (Table 5-16) to assess the significance of variation in the association between nervous system anomalies and initial dioxin with time of conception among children of Ranch Hands.

Table 5-16

Pre-post SEA Counts and Rates of Nervous System Anomalies

Variable: Nervous System Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 1: Log₂(Initial Dioxin)

Ranch Hands - Log₂(Initial Dioxin) - Unadjusted

Exposure Restriction	Initial Dioxin	n	Time of Conception Relative to the Father's Duty in SEA					
			Pre-SEA		Post-SEA			p-Value
			Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1208)	Low	249	1	4.0	106	1	9.4	
	Medium	338	0	0.0	245	2	8.2	
	High	113	0	0.0	157	2	12.7	
b) D>5 ppt (n=1748)	Low	286	1	3.5	155	0	0.0	
	Medium	616	2	3.2	308	2	6.5	
	High	156	0	0.0	227	3	13.2	

Nervous System Anomalies (All Children)

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

There is insufficient data (Table 5-17) to assess the significance of variation in the association between nervous system anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands.

Table 5-17

Pre-post SEA Counts and Rates of Nervous System Anomalies

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	0.0 (0/137)	0.0 (0/183)	0.0 (0/37)	
		>18.6	10.5 (1/95)	0.0 (0/171)	0.0 (0/78)	
	Post-SEA	≤18.6	0.0 (0/62)	7.5 (1/134)	13.9 (1/72)	
		>18.6	25.0 (1/40)	9.3 (1/108)	10.8 (1/93)	
b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	0.0 (0/157)	3.2 (1/313)	0.0 (0/66)	
		>18.6	6.7 (1/150)	3.7 (1/270)	0.0 (0/102)	
	Post-SEA	≤18.6	0.0 (0/90)	0.0 (0/174)	18.2 (2/110)	
		>18.6	0.0 (0/63)	14.7 (2/136)	8.5 (1/117)	

Nervous System Anomalies (All Children)

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

There is insufficient data (Table 5-18) to assess the significance of variation in the association between nervous system anomalies and categorized current dioxin with time of conception.

Table 5-18

Pre-post SEA Counts and Rates of Nervous System Anomalies

Variable: Nervous System Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
 to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1459	7	4.8	981	3	3.1	0.64	All Exp Categ	
Unknown	582	3	5.2	282	0	0.0	----	Unk vs Bkgd	
Low	290	0	0.0	174	1	5.7	----	Low vs Bkgd	
High	168	0	0.0	227	3	13.2	----	High vs Bkgd	
Total	2499			1664					

Nervous System Anomalies (Full Siblings)

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

There is insufficient data (Table 5-19) to assess the significance of variation in the association between nervous system anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands.

Table 5-19

**Pre-post SEA Counts and Rates of
Nervous System Anomalies**

Variable: Nervous System Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

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

Time of Conception Relative
to the Father's Duty in SEA

Exposure Restriction	Initial Dioxin	n	Pre-SEA		Post-SEA			p-Value
			Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1030)	Low	231	1	4.3	78	0	0.0	
	Medium	276	0	0.0	206	2	9.7	
	High	103	0	0.0	136	2	14.7	
b) D>5 ppt (n=1489)	Low	252	1	4.0	114	0	0.0	
	Medium	545	2	3.7	245	1	4.1	
	High	135	0	0.0	198	3	15.2	

Nervous System Anomalies (Full Siblings)

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

There is insufficient data (Table 5-20) to assess the significance of variation in the association between nervous system anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands.

Table 5-20

Pre-post SEA Counts and Rates of
Nervous System Anomalies

Variable: Nervous System Anomalies
Restrictions: Full Siblings of Ranch Hands
Categories: Time of Conception Relative to the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	0.0 (0/124)	0.0 (0/155)	0.0 (0/35)	
		>18.6	11.8 (1/85)	0.0 (0/143)	0.0 (0/69)	
	Post-SEA	≤18.6	0.0 (0/47)	8.7 (1/115)	15.6 (1/64)	
		>18.6	0.0 (0/28)	10.9 (1/92)	13.3 (1/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	0.0 (0/126)	3.6 (1/276)	0.0 (0/60)	
		>18.6	6.9 (1/145)	4.2 (1/237)	0.0 (0/88)	
	Post-SEA	≤18.6	0.0 (0/59)	0.0 (0/144)	20.4 (2/98)	
		>18.6	0.0 (0/53)	9.4 (1/106)	10.3 (1/97)	

Nervous System Anomalies (Full Siblings)

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

There is insufficient data (Table 5-21) to assess variation in the association between nervous system anomalies and categorized current dioxin with time of conception among full siblings.

Table 5-21

Pre-post SEA Counts and Rates of Nervous System Anomalies

Variable: Nervous System Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1250	6	4.8	812	3	3.7	0.77	All Exp Categ	
Unknown	514	3	5.8	221	0	0.0	----	Unk vs Bkgd	
Low	244	0	0.0	148	1	6.8	----	Low vs Bkgd	
High	148	0	0.0	195	3	15.4	----	High vs Bkgd	
Total	2156			1376					

Eye Anomalies (All Children)

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

There is insufficient data (Table 5-22) to assess the significance of variation in the association between eye anomalies and initial dioxin with time of conception among children of Ranch Hands.

Table 5-22

Pre-post SEA Counts and Rates of Eye Anomalies

Variable: Eye Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

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

Time of Conception Relative
to the Father's Duty in SEA

Exposure Restriction	Initial Dioxin	n	Pre-SEA		Post-SEA			p-Value
			Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1208)	Low	249	1	4.0	106	0	0.0	
	Medium	338	1	3.0	245	3	12.2	
	High	113	0	0.0	157	2	12.7	
b) D>5 ppt (n=1748)	Low	286	2	7.0	155	2	12.9	
	Medium	616	2	3.2	308	2	6.5	
	High	156	0	0.0	227	3	13.2	

Eye Anomalies (All Children)

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

There is insufficient data (Table 5-23) to assess the significance of variation in the association between eye anomalies and current dioxin with time since duty in SEA and time of conception.

Table 5-23

Pre-post SEA Counts and Rates of Eye Anomalies

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted							
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value	
			Low	Medium	High		
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	7.3 (1/137)	5.5 (1/183)	0.0 (0/37)		
		>18.6	0.0 (0/95)	0.0 (0/171)	0.0 (0/78)		
	Post-SEA	≤18.6	0.0 (0/62)	14.9 (2/134)	13.9 (1/72)		
		>18.6	25.0 (1/40)	0.0 (0/108)	10.8 (1/93)		
	b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	6.4 (1/157)	6.4 (2/313)	0.0 (0/66)	
			>18.6	6.7 (1/150)	0.0 (0/270)	0.0 (0/102)	
Post-SEA		≤18.6	11.1 (1/90)	11.5 (2/174)	18.2 (2/110)		
		>18.6	0.0 (0/63)	7.4 (1/136)	8.5 (1/117)		

Eye Anomalies (All Children)

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

There is insufficient data (Table 5-24) to assess the significance of variation in the association between eye anomalies and categorized current dioxin with time of conception.

Table 5-24

Pre-post SEA Counts and Rates of Eye Anomalies

Variable: Eye Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
 to the Father's Duty in SEA

Exposure Category	n	Pre-SEA Abn	Pre-SEA Rate	n	Post-SEA Abn	Post-SEA Rate	Odds Ratio	Category Contrast	p-Value
Background	1459	6	4.1	981	7	7.1		All Exp Categ	
Unknown	582	4	6.9	282	4	14.2		Unk vs Bkgd	
Low	290	1	3.4	174	1	5.7		Low vs Bkgd	
High	168	0	0.0	227	3	13.2		High vs Bkgd	
Total	2499			1664					

Eye Anomalies (Full Siblings)

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

There is insufficient data (Table 5-25) to assess the significance of variation in the association between eye anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands.

Table 5-25

Pre-post SEA Counts and Rates of Eye Anomalies

Variable: Eye Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA						p-Value
		Pre-SEA			Post-SEA			
		n	Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1030)	Low	231	1	4.3	78	0	0.0	
	Medium	276	0	0.0	206	3	14.6	
	High	103	0	0.0	136	2	14.7	
b) D>5 ppt (n=1489)	Low	252	2	7.9	114	1	8.8	
	Medium	545	1	1.8	245	2	8.2	
	High	135	0	0.0	198	3	15.2	

Eye Anomalies (Full Siblings)

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

There is insufficient data with which to assess the significance of variation in the association between eye anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands (Table 5-26 [a] and [b]).

Table 5-26

Pre-post SEA Counts and Rates of Eye Anomalies

Variable: Eye Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

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

Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value	
			Low	Medium	High		
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	8.1 (1/124)	0.0 (0/155)	0.0 (0/35)		
		>18.6	0.0 (0/85)	0.0 (0/143)	0.0 (0/69)		
	Post-SEA	≤18.6	0.0 (0/47)	17.4 (2/115)	15.6 (1/64)		
		>18.6	35.7 (1/28)	0.0 (0/92)	13.3 (1/75)		
	b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	7.9 (1/126)	3.6 (1/276)	0.0 (0/60)	
			>18.6	6.9 (1/145)	0.0 (0/237)	0.0 (0/88)	
Post-SEA		≤18.6	0.0 (0/59)	13.9 (2/144)	20.4 (2/98)		
		>18.6	0.0 (0/53)	9.4 (1/106)	10.3 (1/97)		

Eye Anomalies (Full Siblings)

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

There is insufficient data (Table 5-27) to assess the significance of the variation in the association between eye anomalies and categorized current dioxin with time of conception among full siblings.

Table 5-27

Pre-post SEA Counts and Rates of Eye Anomalies

Variable: Eye Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
 to the Father's Duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1250	6	4.8	812	3	3.7		All Exp Categ	
Unknown	514	4	7.8	221	3	13.6		Unk vs Bkgd	
Low	244	0	0.0	148	1	6.8		Low vs Bkgd	
High	148	0	0.0	195	3	15.4		High vs Bkgd	
Total	2156			1376					

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

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

There is insufficient data (Table 5-28) to assess the significance of variation in the association between anomalies of the ear, face and neck and initial dioxin with time of conception among full sibling children of Ranch Hands.

Table 5-28

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

Variable: Ear, Face and Neck Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA					p-Value
			Pre-SEA		Post-SEA			
			Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1208)	Low	249	1	4.0	106	0	0.0	
	Medium	338	1	3.0	245	4	16.3	
	High	113	0	0.0	157	3	19.1	
b) D>5 ppt (n=1748)	Low	286	3	10.5	155	4	25.8	
	Medium	616	1	1.6	308	3	9.7	
	High	156	1	6.4	227	4	17.6	

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

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

There is insufficient data (Table 5-29) to assess the significance of variation in the association between anomalies of the ear, face and neck and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands.

Table 5-29

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

Variable: Ear, Face and Neck Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	0.0 (0/137)	5.5 (1/183)	0.0 (0/37)	
		>18.6	0.0 (0/95)	5.8 (1/171)	0.0 (0/78)	
	Post-SEA	≤18.6	0.0 (0/62)	7.5 (1/134)	0.0 (0/72)	
		>18.6	25.0 (1/40)	18.5 (2/108)	32.3 (3/93)	
b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	6.4 (1/157)	6.4 (2/313)	0.0 (0/66)	
		>18.6	6.7 (1/150)	3.7 (1/270)	0.0 (0/102)	
	Post-SEA	≤18.6	33.3 (3/90)	11.5 (2/174)	0.0 (0/110)	
		>18.6	0.0 (0/63)	14.7 (2/136)	34.2 (4/117)	

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

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

There is insufficient data (Table 5-30) to assess the significance of variation in the association between anomalies of the ear, face and neck and categorized current dioxin with time of conception.

Table 5-30

Pre-post SEA Counts and Rates of Ear, Face and Neck Anomalies

Variable: Ear, Face and Neck Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1459	8	5.5	981	11	11.2	2.06	All Exp Categ	
Unknown	582	5	8.6	282	5	17.7	2.08	Unk vs Bkgd	
Low	290	2	6.9	174	2	11.5	1.67	Low vs Bkgd	
High	168	0	0.0	227	4	17.6	----	High vs Bkgd	
Total	2499			1664					

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

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

There is insufficient data (Table 5-31) to assess the significance of variation in the association between anomalies of the ear, face and neck and initial dioxin with time of conception among full sibling children of Ranch Hands.

Table 5-31

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

Variable: Ear, Face and Neck Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA					p-Value
			Pre-SEA		Post-SEA			
			Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1030)	Low	231	1	4.3	78	0	0.0	
	Medium	276	0	0.0	206	4	19.4	
	High	103	0	0.0	136	3	22.1	
b) D>5 ppt (n=1489)	Low	252	2	7.9	114	3	26.3	
	Medium	545	1	1.8	245	3	12.2	
	High	135	0	0.0	198	4	20.2	

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

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

There is insufficient data (Table 5-32) to assess the significance of variation in the association between ear, face and neck anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands.

Table 5-32

Pre-post SEA Counts and Rates of
Ear, Face and Neck Anomalies

Variable: Ear, Face and Neck Anomalies
Restrictions: Full Siblings of Ranch Hands
Categories: Time of Conception Relative to the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	0.0 (0/124)	6.5 (1/155)	0.0 (0/35)	
		>18.6	0.0 (0/85)	0.0 (0/143)	0.0 (0/69)	
	Post-SEA	≤18.6	0.0 (0/47)	8.7 (1/115)	0.0 (0/64)	
		>18.6	35.7 (1/28)	21.7 (2/92)	40.0 (3/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	0.0 (0/126)	7.2 (2/276)	0.0 (0/60)	
		>18.6	6.9 (1/145)	0.0 (0/237)	0.0 (0/88)	
	Post-SEA	≤18.6	33.9 (2/59)	13.9 (2/144)	0.0 (0/98)	
		>18.6	0.0 (0/53)	18.9 (2/106)	41.2 (4/97)	

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

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

There is insufficient data (Table 5-33) to assess the significance of variation in the association between ear, face and neck anomalies and categorized current dioxin with time of conception among full siblings.

Table 5-33

Pre-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
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1250	8	6.4	812	11	13.5	2.13	All Exp Categ	
Unknown	514	4	7.8	221	4	18.1	2.35	Unk vs Bkgd	
Low	244	1	4.1	148	2	13.5	5.03	Low vs Bkgd	
High	148	0	0.0	195	4	20.5	--	High vs Bkgd	
Total	2156			1376					

Circulatory System and Heart Anomalies (All Children)

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

Without adjustment for covariates (Table 5-34 [a]), there is borderline significant variation in the association between circulatory system and heart anomalies and initial dioxin with time of conception among children of Ranch Hands having more than 10 ppt current dioxin (p=0.071). This borderline significance is due to the relatively high anomaly rate among post-SEA children of Ranch Hands with low initial dioxin (28.3 per 1000) compared to the corresponding rate among pre-SEA children (4.0 per 1000) and a reversed pattern among children of Ranch Hands with high levels of initial dioxin.

Without adjustment for covariates (Table 5-34 [b]), there is no significant variation in the association between circulatory system and heart anomalies and initial dioxin with time of conception among children of Ranch Hands having more than 5 ppt current dioxin (p=0.500).

Table 5-34

**Pre-post SEA Counts and Rates of
Circulatory System and Heart Anomalies**

Variable: Circulatory System and Heart Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA					
			Pre-SEA		Post-SEA		p-Value	
			Abn	Rate	n	Abn		Rate
a) D>10 ppt (n=1208)	Low	249	1	4.0	106	3	28.3	0.071
	Medium	338	6	17.8	245	9	36.7	
	High	113	2	17.7	157	1	6.4	
b) D>5 ppt (n=1748)	Low	286	4	14.0	155	2	12.9	0.500
	Medium	616	5	8.1	308	10	32.5	
	High	156	4	25.6	227	2	8.8	

Circulatory System and Heart Anomalies (All Children)

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

Without adjustment for covariates (Table 5-35 [a] and [b]), there is no significant variation in the association between circulatory system and heart anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 10 ppt (p=0.739) or more than 5 ppt (p=0.778) current dioxin.

Table 5-35

**Pre-post SEA Counts and Rates of
Circulatory System and Heart Anomalies**

Variable: Circulatory System and Heart Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted								
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value		
			Low	Medium	High			
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	7.3 (1/137)	10.9 (2/183)	27.0 (1/37)	0.739		
		>18.6	0.0 (0/95)	23.4 (4/171)	12.8 (1/78)			
	Post-SEA	≤18.6	16.1 (1/62)	37.3 (5/134)	0.0 (0/72)			
		>18.6	50.0 (2/40)	37.0 (4/108)	10.8 (1/93)			
	b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	12.7 (2/157)	9.6 (3/313)		15.2 (1/66)	0.778
			>18.6	13.3 (2/150)	14.8 (4/270)		9.8 (1/102)	
Post-SEA		≤18.6	11.1 (1/90)	28.7 (5/174)	9.1 (1/110)			
		>18.6	0.0 (0/63)	44.1 (6/136)	8.5 (1/117)			

Circulatory System and Heart Anomalies (All Children)

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

Without adjustment for covariates (Table 5-36), there is no significant variation in the overall association between circulatory system and heart anomalies and categorized current dioxin with time of conception ($p=0.788$). The corresponding contrasts of children of Ranch Hands in the High ($p=0.470$), Low ($p=0.587$) and Unknown ($p=0.846$) categories versus children of Comparisons in the Background category are not significant.

Table 5-36

**Pre-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
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1459	15	10.3	981	16	16.3	1.60	All Exp Categ	0.788
Unknown	582	6	10.3	282	4	14.2	1.38	Unk vs Bkgd	0.846
Low	290	6	20.7	174	8	46.0	2.28	Low vs Bkgd	0.587
High	168	2	11.9	227	2	8.8	0.74	High vs Bkgd	0.470
Total	2499			1664					

Circulatory System and Heart Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-37 [a] and [b]), there is no significant variation in the association between circulatory system and heart anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands having more than 10 ppt ($p=0.154$) or more than 5 ppt ($p=0.727$) current dioxin.

Table 5-37

**Pre-post SEA Counts and Rates of
Circulatory System and Heart Anomalies**

Variable: Circulatory System and Heart Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA			n	Abn	Rate	p-Value
			Pre-SEA Abn	Rate	Post-SEA Abn				
a) D>10 ppt (n=1030)	Low	231	1	4.3	78	1	12.8	0.154	
	Medium	276	3	10.9	206	7	34.0		
	High	103	2	19.4	136	0	0.0		
b) D>5 ppt (n=1489)	Low	252	4	15.9	114	1	8.8	0.727	
	Medium	545	4	7.3	245	7	28.6		
	High	135	2	14.8	198	1	5.1		

Circulatory System and Heart Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-38 [a] and [b]), there is no significant variation in the association between circulatory system and heart anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands having more than 10 ppt (p=0.621) or more than 5 ppt (p=0.892) current dioxin.

Table 5-38

Pre-post SEA Counts and Rates of
Circulatory System and Heart Anomalies

Variable: Circulatory System and Heart Anomalies
Restrictions: Full Siblings of Ranch Hands
Categories: Time of Conception Relative to 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 of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value		
			Low	Medium	High			
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	8.1 (1/124)	6.5 (1/155)	28.6 (1/35)	0.621		
		>18.6	0.0 (0/85)	14.0 (2/143)	14.5 (1/69)			
	Post-SEA	≤18.6	0.0 (0/47)	26.1 (3/115)	0.0 (0/64)			
		>18.6	35.7 (1/28)	43.5 (4/92)	0.0 (0/75)			
	b) c>5 ppt (n=1489)	Pre-SEA	≤18.6	15.9 (2/126)	7.2 (2/276)		16.7 (1/60)	0.892
			>18.6	13.8 (2/145)	8.4 (2/237)		11.4 (1/88)	
Post-SEA		≤18.6	16.9 (1/59)	20.8 (3/144)	0.0 (0/98)			
		>18.6	0.0 (0/53)	47.2 (5/106)	0.0 (0/97)			

Circulatory System and Heart Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-39), there is borderline significant variation in the overall association between circulatory system and heart anomalies and categorized current dioxin with time of conception among full siblings (p=0.095). However, the association between circulatory system and heart anomalies and time of conception among children of Ranch Hands in the Unknown (p=0.992), Low (p=0.234) and High (p=0.377) categories do not differ significantly from the corresponding association among children of Comparisons in the Background category.

Table 5-39

Pre-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
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA		Odds Ratio	Category Contrast	p-Value	
		Abn	Rate	n	Abn Rate				
Background	1250	14	11.2	812	14	17.2	1.55	All Exp Categ	0.095
Unknown	514	6	11.7	221	4	18.1	1.56	Unk vs Bkgd	0.992
Low	244	3	12.3	148	7	47.3	3.99	Low vs Bkgd	0.234
High	148	2	13.5	195	0	0.0	----	High vs Bkgd	0.377
Total	2156			1376					

Respiratory System Anomalies (All Children)

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

There is insufficient data (Table 5-40) to assess the significance of variation in the association between respiratory system anomalies and initial dioxin with time of conception among children of Ranch Hands.

Table 5-40

**Pre-post SEA Counts and Rates of
Respiratory System Anomalies**

Variable: Respiratory System Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA						p-Value
		n	Pre-SEA Abn	Rate	n	Post-SEA Abn	Rate	
a) c>10 ppt (n=1208)	Low	249	0	0.0	106	0	0.0	
	Medium	338	0	0.0	245	1	4.1	
	High	113	0	0.0	157	1	6.4	
b) c>5 ppt (n=1748)	Low	286	0	0.0	155	1	6.5	
	Medium	616	0	0.0	308	1	3.2	
	High	156	0	0.0	227	1	4.4	

Respiratory System Anomalies (All Children)

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

There is insufficient data (Table 5-41) to assess the significance of variation in the association between respiratory system anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands.

Table 5-41

Pre-post SEA Counts and Rates of
Respiratory System Anomalies

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n)			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	0.0 (0/137)	0.0 (0/183)	0.0 (0/37)	
		>18.6	0.0 (0/95)	0.0 (0/171)	0.0 (0/78)	
	Post-SEA	≤18.6	0.0 (0/62)	0.0 (0/134)	0.0 (0/72)	
		>18.6	0.0 (0/40)	9.3 (1/108)	10.8 (1/93)	
b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	0.0 (0/157)	0.0 (0/313)	0.0 (0/66)	
		>18.6	0.0 (0/150)	0.0 (0/270)	0.0 (0/102)	
	Post-SEA	≤18.6	11.1 (1/90)	0.0 (0/174)	0.0 (0/110)	
		>18.6	0.0 (0/63)	7.4 (1/136)	8.5 (1/117)	

Respiratory System Anomalies (All Children)

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

There is insufficient data (Table 5-42) to assess the significance of variation in the association between respiratory system anomalies and categorized current dioxin with time of conception.

Table 5-42

Pre-post SEA Counts and Rates of Respiratory System Anomalies

Variable: Respiratory System Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1459	1	0.7	981	2	2.0	All Exp Categ Unk vs Bkgd Low vs Bkgd High vs Bkgd		
Unknown	582	0	0.0	282	2	7.1			
Low	290	0	0.0	174	1	5.7			
High	168	0	0.0	227	1	4.4			
Total	2499			1664					

Respiratory System Anomalies (Full Siblings)

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

There is insufficient data (Table 5-43) to assess the significance of variation in the association between respiratory system anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands.

Table 5-43

**Pre-post SEA Counts and Rates of
Respiratory System Anomalies**

Variable: Respiratory System Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

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

Exposure Assumption	Initial Dioxin	n	Time of Conception Relative to the Father's Duty in SEA			n	Abn	Rate	p-Value
			Pre-SEA Abn	Rate	Post-SEA				
a) D>10 ppt (n=1030)	Low	231	0	0.0	78	0	0.0		
	Medium	276	0	0.0	206	1	4.9		
	High	103	0	0.0	136	1	7.4		
b) D>5 ppt (n=1489)	Low	252	0	0.0	114	1	8.8		
	Medium	545	0	0.0	245	1	4.1		
	High	135	0	0.0	198	1	5.1		

Respiratory System Anomalies (Full Siblings)

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

There is insufficient data (Table 5-44) to assess the significance of variation in the association between respiratory system anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands.

Table 5-44

**Pre-post SEA Counts and Rates of
Respiratory System Anomalies**

Variable: Respiratory System Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	0.0 (0/124)	0.0 (0/155)	0.0 (0/35)	
		>18.6	0.0 (0/85)	0.0 (0/143)	0.0 (0/69)	
	Post-SEA	≤18.6	0.0 (0/47)	0.0 (0/115)	0.0 (0/64)	
		>18.6	0.0 (0/28)	10.9 (1/92)	13.3 (1/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	0.0 (0/126)	0.0 (0/276)	0.0 (0/60)	
		>18.6	0.0 (0/145)	0.0 (0/237)	0.0 (0/88)	
	Post-SEA	≤18.6	16.9 (1/59)	0.0 (0/144)	0.0 (0/98)	
		>18.6	0.0 (0/53)	9.4 (1/106)	10.3 (1/97)	

Respiratory System Anomalies (Full Siblings)

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

There is insufficient data (Table 5-45) to assess the significance of variation in the association between respiratory system anomalies and categorized current dioxin with time of conception among full siblings.

Table 5-45

Pre-post SEA Counts and Rates of Respiratory System Anomalies

Variable: Respiratory System Anomalies
 Restrictions: Full Siblings of Ranch Hands of Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA Abn	Pre-SEA Rate	Post-SEA n	Post-SEA Abn	Post-SEA Rate	Odds Ratio	Category Contrast	p-Value
Background	1250	1	0.8	812	2	2.5		All Exp Categ	
Unknown	514	0	0.0	221	2	9.0		Unk vs Bkgd	
Low	244	0	0.0	148	1	6.8		Low vs Bkgd	
High	148	0	0.0	195	1	5.1		High vs Bkgd	
Total	2156			1376					

Digestive System Anomalies (All Children)

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

Without adjustment for covariates (Table 5-46 [a] and [b]), there is no significant variation in the association between digestive system anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 10 ppt (p=0.704) or more than 5 ppt (p=0.926) current dioxin.

Table 5-46

Pre-post SEA Counts and Rates of Digestive System Anomalies

Variable: Digestive System Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA						p-Value
		Pre-SEA			Post-SEA			
		n	Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1208)	Low	249	7	28.1	106	2	18.9	0.704
	Medium	338	3	8.9	245	6	24.5	
	High	113	2	17.7	157	4	25.5	
b) D>5 ppt (n=1748)	Low	286	3	10.5	155	3	19.4	0.926
	Medium	616	8	13.0	308	8	26.0	
	High	156	3	19.2	227	5	22.0	

Digestive System Anomalies (All Children)

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

Without adjustment for covariates (Table 5-47 [a]), there is significant variation in the association between digestive system anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 10 ppt current dioxin ($p=0.030$). This significance is caused by high rates of digestive anomalies in post-SEA children of Ranch Hands with late tours and high dioxin levels (27.8 per 1000) in post-SEA children of Ranch Hands with early tours and intermediate dioxin levels (37.0 per 1000), as compared with the corresponding pre-SEA rates (0.0 per 1000 and 5.8 per 1000).

Without adjustment for covariates (Table 5-47 [b]), there is borderline significant variation in the association between digestive system anomalies and current dioxin with time of conception among children of Ranch Hands having more than 5 ppt current dioxin ($p=0.071$). This borderline significance is caused by high rates of digestive anomalies in post-SEA children of Ranch

Hands with late tours and high dioxin levels (18.2 per 1000) and in post-SEA children of Ranch Hands with early tours and intermediate dioxin levels (51.5 per 1000), as compared with the corresponding pre-SEA rates (0.0 per 1000 and 3.7 per 1000).

Table 5-47

Pre-post SEA Counts and Rates of Digestive System Anomalies

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted								
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value		
			Low	Medium	High			
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	36.5 (5/137)	16.4 (3/183)	0.0 (0/37)	0.030		
		>18.6	10.5 (1/95)	5.8 (1/171)	25.6 (2/78)			
	Post-SEA	≤18.6	16.1 (1/62)	14.9 (2/134)	27.8 (2/72)			
		>18.6	25.0 (1/40)	37.0 (4/108)	21.5 (2/93)			
	b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	12.7 (2/157)	25.6 (8/313)		0.0 (0/66)	0.071
			>18.6	0.0 (0/150)	3.7 (1/270)		29.4 (3/102)	
Post-SEA		≤18.6	11.1 (1/90)	23.0 (4/174)	18.2 (2/110)			
		>18.6	0.0 (0/63)	51.5 (7/136)	17.1 (2/117)			

Digestive System Anomalies (All Children)

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

Without adjustment for covariates (Table 5-48), there is no significant variation in the overall association between digestive system anomalies and categorized current dioxin with time of conception (p=0.523). The association between time of conception and digestive system anomalies among children of Ranch Hands in the High (p=0.285), Low (p=0.394) and Unknown (p=0.828) categories are not significantly different from that among children of Comparisons in the Background category.

Table 5-48

Pre-post SEA Counts and Rates of Digestive System Anomalies

Variable: Digestive System Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted									
Time of Conception Relative to the Father's Duty in SEA									
Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1459	15	10.3	981	24	24.5	2.41	All Exp Categ	0.523
Unknown	582	6	10.3	282	6	21.3	2.09	Unk vs Bkgd	0.828
Low	290	2	6.9	174	6	34.5	5.14	Low vs Bkgd	0.394
High	168	3	17.9	227	4	17.6	0.99	High vs Bkgd	0.285
Total	2499			1664					

Digestive System Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-49 [a] and [b]), there is no significant variation in the association between digestive system anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands having more than 10 ppt (p=0.890) or more than 5 ppt (p=0.926) current dioxin.

Table 5-49

Pre-post SEA Counts and Rates of Digestive System Anomalies

Variable: Digestive System Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 1: Log₂(Initial Dioxin)

Ranch Hands - Log₂(Initial Dioxin) - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Restriction	Initial Dioxin	Pre-SEA			Post-SEA			p-Value
		n	Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1030)	Low	231	7	30.3	78	1	12.8	0.890
	Medium	276	3	10.9	206	6	29.1	
	High	103	2	19.4	136	3	22.1	
b) D>5 ppt (n=1489)	Low	252	3	11.9	114	2	17.5	0.926
	Medium	545	8	14.7	245	6	24.5	
	High	135	3	22.2	198	4	20.2	

Digestive System Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-50 [a]), there is significant variation in the association between digestive system anomalies and current dioxin with time since duty in SEA and time of conception among full siblings of Ranch Hands having more than 10 ppt (p=0.030).

Without adjustment for covariates (Table 5-50 [b]), there is borderline significant variation in the association between digestive system anomalies and current dioxin with time of conception among full siblings of Ranch Hands having more than 5 ppt current dioxin (p=0.057).

Both the significant variation in Table 5-50 [a] and the borderline significant variation in Table 5-50 [b] are caused by high post-SEA rates of digestive anomalies in children of Ranch Hands with late tours and high dioxin levels and in children of Ranch Hands with early tours and intermediate dioxin levels, relative to the corresponding pre-SEA rates.

Table 5-50

Pre-post SEA Counts and Rates of Digestive System Anomalies

Variable: Digestive System Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 2: Log₂(Current Dioxin), Time

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

Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n)			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	40.3 (5/124)	19.4 (3/155)	0.0 (0/35)	0.030
		>18.6	11.8 (1/85)	7.0 (1/143)	29.0 (2/69)	
	Post-SEA	≤18.6	21.3 (1/47)	17.4 (2/115)	31.3 (2/64)	
		>18.6	0.0 (0/28)	43.5 (4/92)	13.3 (1/75)	

Table 5-50 (Continued)

Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	15.9 (2/126)	29.0 (8/276)	0.0 (0/60)	0.057
		>18.6	0.0 (0/145)	4.2 (1/237)	34.1 (3/88)	
	Post-SEA	≤18.6	0.0 (0/59)	27.8 (4/144)	20.4 (2/98)	
		>18.6	0.0 (0/53)	47.2 (5/106)	10.3 (1/97)	

Digestive System Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-51), there is no significant variation in the overall association between digestive system anomalies and categorized current dioxin with the time of conception among full siblings (p=0.397). Additionally, the association between digestive system anomalies and time of conception among children of Ranch Hands in the Unknown (p=0.863), Low (p=0.242) and High (p=0.344) categories does not differ significantly from the corresponding association among children of Comparisons in the Background category.

Table 5-51

**Pre-post SEA Counts and Rates of
Digestive System Anomalies**

Variable: Digestive System Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
to the Father's Duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1250	14	11.2	812	16	19.7	1.77	All Exp Categ	0.397
Unknown	514	6	11.7	221	4	18.1	1.56	Unk vs Bkgd	0.863
Low	244	2	8.2	148	6	40.5	5.11	Low vs Bkgd	0.242
High	148	3	20.3	195	3	15.4	0.76	High vs Bkgd	0.344
Total	2156			1376					

Genital Anomalies (All Children)

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

Without adjustment for covariates (Table 5-52 [a] and [b]), there is no significant variation in the association between genital anomalies and initial dioxin with time of conception among children of Ranch Hands having more than 10 ppt (p=0.445) or more than 5 ppt (p=0.906) current dioxin.

Table 5-52

Pre-post SEA Counts and Rates of Genital Anomalies

Variable: Genital Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA			n	Abn	Rate	p-Value
			Pre-SEA Abn	Rate	Post-SEA Abn				
a) D>10 ppt (n=1208)	Low	249	1	4.0	106	1	9.4	0.445	
	Medium	338	8	23.7	245	10	40.8		
	High	113	0	0.0	157	2	12.7		
b) D>5 ppt (n=1748)	Low	286	4	14.0	155	2	12.9	0.906	
	Medium	616	8	13.0	308	11	35.7		
	High	156	3	19.2	227	2	8.8		

Genital Anomalies (All Children)

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

Without adjustment for covariates (Table 5-53 [a] and [b]), there is no significant variation in the association between genital anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 10 ppt ($p=0.690$) or more than 5 ppt ($p=0.312$) current dioxin.

Table 5-53

Pre-post SEA Counts and Rates of Genital Anomalies

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted								
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value		
			Low	Medium	High			
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	0.0 (0/137)	32.8 (6/183)	0.0 (0/37)	0.690		
		>18.6	0.0 (0/95)	17.5 (3/171)	0.0 (0/78)			
	Post-SEA	≤18.6	16.1 (1/62)	59.7 (8/134)	13.9 (1/72)			
		>18.6	0.0 (0/40)	27.8 (3/108)	10.8 (1/93)			
	b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	6.4 (1/157)	19.2 (6/313)		15.2 (1/66)	0.312
			>18.6	20.0 (3/150)	14.8 (4/270)		0.0 (0/102)	
Post-SEA		≤18.6	11.1 (1/90)	46.0 (8/174)	18.2 (2/110)			
		>18.6	0.0 (0/63)	22.1 (3/136)	8.5 (1/117)			

Genital Anomalies (All Children)

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

Without adjustment for covariates (Table 5-54), there is no significant variation in the overall association between genital anomalies and categorized current dioxin with time of conception ($p=0.370$). The association between time of conception and genital anomalies among children of Ranch Hands in the High ($p=0.857$), Low ($p=0.913$) and Unknown ($p=0.144$) categories are not significantly different from the corresponding association among children of Comparisons in the Background category.

Table 5-54

Pre-post SEA Counts and Rates of Genital Anomalies

Variable: Genital Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
 to the Father's Duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1459	15	10.3	981	18	18.3	1.80	All Exp Categ	0.370
Unknown	582	6	10.3	282	1	3.5	0.34	Unk vs Bkgd	0.144
Low	290	8	27.6	174	9	51.7	1.92	Low vs Bkgd	0.913
High	168	1	6.0	227	3	13.2	2.24	High vs Bkgd	0.857
Total	2499			1664					

Genital Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-55 [a] and [b]), there is no significant variation in the association between genital anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands having more than 10 ppt ($p=0.670$) or more than 5 ppt ($p=0.581$) current dioxin.

Table 5-55

Pre-post SEA Counts and Rates of Genital Anomalies

Variable: Genital Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA						p-Value
		Pre-SEA			Post-SEA			
		n	Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1030)	Low	231	1	4.3	78	1	12.8	0.670
	Medium	276	4	14.5	206	6	29.1	
	High	103	0	0.0	136	2	14.7	
b) D>5 ppt (n=1489)	Low	252	4	15.9	114	2	17.5	0.581
	Medium	545	6	11.0	245	7	28.6	
	High	135	1	7.4	198	2	10.1	

Genital Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-56 [a] and [b]), there is no significant variation in the association between genital anomalies and categorized current dioxin with time of conception among full sibling children of Ranch Hands having more than 10 ppt ($p=0.536$) or more than 5 ppt current dioxin ($p=0.303$).

Table 5-56

Pre-post SEA Counts and Rates of Genital Anomalies

Variable: Genital Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model: $\text{Log}_2(\text{Current Dioxin}), \text{Time}$

Ranch Hands - $\text{Log}_2(\text{Current Dioxin}), \text{Time}$ - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	0.0 (0/124)	19.4 (3/155)	0.0 (0/35)	0.536
		>18.6	0.0 (0/85)	14.0 (2/143)	0.0 (0/69)	
	Post-SEA	≤18.6	21.3 (1/47)	52.2 (6/115)	15.6 (1/64)	
		>18.6	0.0 (0/28)	10.9 (1/92)	13.3 (1/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	7.9 (1/126)	14.5 (4/276)	0.0 (0/60)	0.303
		>18.6	20.7 (3/145)	12.7 (3/237)	0.0 (0/88)	
	Post-SEA	≤18.6	16.9 (1/59)	48.6 (7/144)	10.2 (1/98)	
		>18.6	0.0 (0/53)	9.4 (1/106)	10.3 (1/97)	

Genital Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-57), there is no overall variation in the association between genital anomalies and categorized current dioxin with time of conception among full siblings (p=0.219). The associations between time of conception and genital anomalies among children of Ranch Hands in the High (p=0.545), Low (p=0.760) and Unknown (p=0.162) categories are not significantly different from the corresponding association among children of Comparisons in the Background category.

Table 5-57

Pre-post SEA Counts and Rates of Genital Anomalies

Variable: Genital Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
 to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1250	13	10.4	812	16	19.7	1.91	All Exp Categ	0.219
Unknown	514	6	11.7	221	1	4.5	0.38	Unk vs Bkgd	0.162
Low	244	5	20.5	148	7	47.3	2.37	Low vs Bkgd	0.760
High	148	0	0.0	195	2	10.3	----	High vs Bkgd	0.545
Total	2156			1376					

Urinary System Anomalies (All Children)

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

Without adjustment for covariates (Table 5-58 [a] and [b]), there is no significant variation in the association between urinary system anomalies and initial dioxin with time of conception among children of Ranch Hands having more than 10 ppt (p=0.446) or more than 5 ppt (p=0.979) current dioxin.

Table 5-58

**Pre-post SEA Counts and Rates of
Urinary System Anomalies**

Variable: Urinary System Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA						p-Value
		n	Pre-SEA Abn	Rate	n	Post-SEA Abn	Rate	
a) D>10 ppt (n=1208)	Low	249	2	8.0	106	3	28.3	0.446
	Medium	338	5	14.8	245	6	24.5	
	High	113	2	17.7	157	4	25.5	
b) D>5 ppt (n=1748)	Low	286	4	14.0	155	2	12.9	0.979
	Medium	616	7	11.4	308	7	22.7	
	High	156	3	19.2	227	6	26.4	

Urinary System Anomalies (All Children)

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

Without adjustment for covariates (Table 5-59 [a] and [b]), there is no significant variation in the association between urinary system anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 10 ppt (p=0.895) or more than 5 ppt (p=0.637) current dioxin.

Table 5-59

Pre-post SEA Counts and Rates of
Urinary System Anomalies

Variable: Urinary System Anomalies
Restrictions: Full Siblings of Ranch Hands
Categories: Time of Conception Relative to the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	0.0 (0/137)	16.4 (3/183)	27.0 (1/37)	0.895
		>18.6	21.1 (2/95)	5.8 (1/171)	25.6 (2/78)	
	Post-SEA	≤18.6	16.1 (1/62)	22.4 (3/134)	13.9 (1/72)	
		>18.6	25.0 (1/40)	37.0 (4/108)	32.3 (3/93)	
b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	12.7 (2/157)	9.6 (3/313)	15.2 (1/66)	0.637
		>18.6	13.3 (2/150)	14.8 (4/270)	19.6 (2/102)	
	Post-SEA	≤18.6	22.2 (2/90)	17.2 (3/174)	18.2 (2/110)	
		>18.6	0.0 (0/63)	36.8 (5/136)	25.6 (3/117)	

Urinary System Anomalies (All Children)

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

Without adjustment for covariates (Table 5-60), there is no significant variation in the overall association between urinary system anomalies and categorized current dioxin with time of conception (p=0.504). The associations between time of conception and urinary system anomalies among children of Ranch Hands in the High (p=0.645), Low (p=0.142) and Unknown (p=0.913) categories are not significantly different from the corresponding association among children of Comparisons in the Background category.

Table 5-60

Pre-post SEA Counts and Rates of Urinary System Anomalies

Variable: Urinary System Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1459	21	14.4	981	12	12.2	0.85	All Exp Categ	0.504
Unknown	582	9	15.5	282	4	14.2	0.92	Unk vs Bkgd	0.913
Low	290	4	13.8	174	6	34.5	2.55	Low vs Bkgd	0.142
High	168	3	17.9	227	5	22.0	1.24	High vs Bkgd	0.645
Total	2499			1664					

Urinary System Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-61 [a] and [b]), there is no significant variation in the association between urinary system anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands having more than 10 ppt (p=0.256) or more than 5 ppt (p=0.822) current dioxin.

Table 5-61

Pre-post SEA Counts and Rates of Urinary System Anomalies

Variable: Urinary System Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 1: Log₂(Initial Dioxin)

Ranch Hands - Log₂(Initial Dioxin) - Unadjusted

Exposure Restriction	Initial Dioxin	Time of Conception Relative to the Father's Duty in SEA						p-Value
		Pre-SEA			Post-SEA			
		n	Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n= 1030)	Low	231	1	4.3	78	2	25.6	0.256
	Medium	276	4	14.5	206	6	29.1	
	High	103	2	19.4	136	3	22.1	
b) D>5 ppt (n=1489)	Low	252	4	15.9	114	2	17.5	0.822
	Medium	545	5	9.2	245	6	24.5	
	High	135	3	22.2	198	5	25.3	

Urinary System Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-62 [a] and [b]), there is no significant variation in the association between urinary system anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands having more than 10 ppt (p=0.973) or more than 5 ppt (p=0.928) current dioxin.

Table 5-62

Pre-post SEA Counts and Rates of
Urinary System Anomalies

Variable: Urinary System Anomalies
Restrictions: Full Siblings of Ranch Hands
Categories: Time of Conception Relative to the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n)			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	0.0 (0/124)	6.5 (1/155)	28.6 (1/35)	0.973
		>18.6	23.5 (2/85)	7.0 (1/143)	29.0 (2/69)	
	Post-SEA	≤18.6	21.3 (1/47)	17.4 (2/115)	15.6 (1/64)	
		>18.6	35.7 (1/28)	43.5 (4/92)	26.7 (2/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	15.9 (2/126)	3.6 (2/276)	16.7 (1/60)	0.928
		>18.6	13.8 (2/145)	16.9 (4/237)	22.7 (2/88)	
	Post-SEA	≤18.6	33.9 (2/59)	13.9 (2/144)	20.4 (2/98)	
		>18.6	0.0 (0/53)	47.2 (5/106)	20.6 (2/97)	

Urinary System Anomalies (Full Siblings)

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

Without adjustment for covariates (Table 5-63), there is no significant variation in the overall association between urinary system anomalies and categorized current dioxin with time since duty in SEA among full sibling children ($p=0.360$). However, the association between urinary system anomalies and time of conception among children of Ranch Hands in the Low current dioxin category, $OR=4.23$, is borderline significantly increased relative to the association among children of Comparisons in the Background category, $OR=0.89$, ($p=0.093$). The association between time of conception and urinary system anomalies among children of Ranch Hands in the High ($p=0.881$) and Unknown ($p=0.834$) categories are not significantly different from the corresponding association among children of Comparisons in the Background category.

Table 5-63

Pre-post SEA Counts and Rates of Urinary System Anomalies

Variable: Urinary System Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1250	19	15.2	812	11	13.5	0.89	All Exp Categ	0.360
Unknown	514	9	17.5	221	4	18.1	1.03	Unk vs Bkgd	0.834
Low	244	2	8.2	148	5	33.8	4.23	Low vs Bkgd	0.093
High	148	3	20.3	195	4	20.5	1.01	High vs Bkgd	0.881
Total	2156			1376					

Musculoskeletal Deformities (All Children)

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

Without adjustment for covariates (Table 5-64 [a] and [b]), there is no significant variation in the association between musculoskeletal deformities and initial dioxin with time of conception among children of Ranch Hands having more than 10 ppt (p=0.518) or more than 5 ppt (p=0.442) current dioxin.

Table 5-64

Pre-post SEA Counts and Rates of Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception relative to the Father's Duty in SEA
 Model 1: Log₂(Initial Dioxin)

Ranch Hands - Log₂(Initial Dioxin) - Unadjusted

Exposure Restriction	Initial Dioxin	n	Time of Conception Relative to the Father's Duty in SEA			n	Abn	Rate	p-Value
			Pre-SEA	Abn	Rate				
a) D>10 ppt (n=1208)	Low	249	19	76.3	106	11	103.8	0.518	
	Medium	338	13	38.5	245	40	163.3		
	High	113	9	79.6	157	14	89.2		
b) D>5 ppt (n=1748)	Low	286	16	55.9	155	20	129.0	0.442	
	Medium	616	32	51.9	308	39	126.6		
	High	156	10	64.1	227	29	127.8		

Musculoskeletal Deformities (All Children)

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

Without adjustment for covariates (Table 5-65 [a]), there is significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 10 ppt current dioxin (p=0.017). This significance is due to a decreasing trend in musculoskeletal deformity rates with current dioxin among post-SEA children of Ranch Hands with early tours and generally increasing trends elsewhere.

Without adjustment for covariates (Table 5-65 [b]), there is no significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 5 ppt current dioxin (p=0.587).

Table 5-65

Pre-post SEA Counts and Rates of
Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
Restrictions: All Children of Ranch Hands
Categories: Time of Conception Relative to the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	94.9 (13/137)	76.5 (14/183)	108.1 (4/37)	0.017
		>18.6	31.6 (3/95)	17.5 (3/171)	64.1 (5/78)	
	Post-SEA	≤18.6	129.0 (8/62)	104.5 (14/134)	180.6 (13/72)	
		>18.6	175.0 (7/40)	157.4 (17/108)	64.5 (6/93)	
b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	44.6 (7/157)	92.7 (29/313)	60.6 (4/66)	0.587
		>18.6	33.3 (5/150)	29.6 (8/270)	49.0 (5/102)	
	Post-SEA	≤18.6	155.6 (14/90)	126.4 (22/174)	145.5 (16/110)	
		>18.6	79.4 (5/63)	169.1 (23/136)	68.4 (8/117)	

Musculoskeletal Deformities (All Children)

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

Without adjustment for covariates (Table 5-66), there is no significant variation in the overall association between musculoskeletal deformities and categorized current dioxin with time of conception (p=0.913). The associations between time of conception and musculoskeletal deformities among children of Ranch Hands in the High (p=0.584), Low (p=0.821) and Unknown (p=0.739) categories are not significantly different from the corresponding association among children of Comparisons in the Background category.

Table 5-66

Pre-post SEA Counts and Rates of Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1459	81	55.5	981	132	134.6	2.65	All Exp Categ	0.913
Unknown	582	26	44.7	282	34	120.6	2.93	Unk vs Bkgd	0.739
Low	290	16	55.2	174	25	143.7	2.87	Low vs Bkgd	0.821
High	168	9	53.6	227	24	105.7	2.09	High vs Bkgd	0.584
Total	2499			1664					

Musculoskeletal Deformities (Full Siblings)

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

Without adjustment for covariates (Table 5-67 [a] and [b]), there is no significant variation in the association between musculoskeletal deformities and initial dioxin with time of conception among full sibling children of Ranch Hands having more than 10 ppt (p=0.329) or more than 5 ppt (p=0.727).

Table 5-67

**Pre-post SEA Counts and Rates of
Musculoskeletal Deformities**

Variable: Musculoskeletal Deformities
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA						p-Value
		n	Pre-SEA Abn	Rate	n	Post-SEA Abn	Rate	
a) D>10 ppt (n=1030)	Low	231	18	77.9	78	10	128.2	0.329
	Medium	276	10	36.2	206	32	155.3	
	High	103	9	87.4	136	13	95.6	
b) D>5 ppt (n=1489)	Low	252	15	59.5	114	10	87.7	0.727
	Medium	545	29	53.2	245	30	122.4	
	High	135	10	74.1	198	27	136.4	

Musculoskeletal Deformities (Full Siblings)

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

Without adjustment for covariates (Table 5-68 [a]), there is significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.019$). There is a decreasing trend in musculoskeletal deformity rates with current dioxin among post-SEA children of Ranch Hands with early tours and generally increasing trends elsewhere.

Without adjustment for covariates (Table 5-68 [b]), there is no significant variation in the association between musculoskeletal deformities and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.386$).

Table 5-68

Pre-post SEA Counts and Rates of
Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
Restrictions: Full Siblings of Ranch Hands
Categories: Time of Conception Relative to the
Father's Duty in SEA
Model 2: \log_2 (Current Dioxin), Time

Ranch Hands - \log_2 (Current Dioxin), Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n)			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	96.8 (12/124)	77.4 (12/155)	114.3 (4/35)	0.019
		>18.6	35.3 (3/85)	14.0 (2/143)	72.5 (5/69)	
	Post-SEA	≤18.6	170.2 (8/47)	95.7 (11/115)	203.1 (13/64)	
		>18.6	178.6 (5/28)	152.2 (14/92)	53.3 (4/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	55.6 (7/126)	94.2 (26/276)	66.7 (4/60)	0.386
		>18.6	34.5 (5/145)	29.5 (7/237)	56.8 (5/88)	
	Post-SEA	≤18.6	101.7 (6/59)	138.9 (20/144)	153.1 (15/98)	
		>18.6	56.6 (3/53)	160.4 (17/106)	61.9 (6/97)	

Musculoskeletal Deformities (Full Siblings)

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

Without adjustment for covariates (Table 5-69), there is no significant variation in the overall association between musculoskeletal deformities and categorized current dioxin with time of conception among full siblings (p=0.875). The association between time of conception and musculoskeletal deformities among children of Ranch Hands in the High (p=0.519), Low (p=0.672) and Unknown (p=0.893) categories are not significantly different from the corresponding association among children of Comparisons in the Background category.

Table 5-69

Pre-post SEA Counts and Rates of Musculoskeletal Deformities

Variable: Musculoskeletal Deformities
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA Abn	Pre-SEA Rate	Post-SEA n	Post-SEA Abn	Post-SEA Rate	Odds Ratio	Category Contrast	p-Value
Background	1250	78	62.4	812	115	141.6	2.48	All Exp Categ	0.875
Unknown	514	22	42.8	221	23	104.1	2.60	Unk vs Bkgd	0.893
Low	244	13	53.3	148	21	141.9	2.94	Low vs Bkgd	0.672
High	148	9	60.8	195	21	107.7	1.86	High vs Bkgd	0.519
Total	2156			1376					

Anomalies of the Skin (All Children)

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

Without adjustment for covariates (Table 5-70 [a] and [b]), there is no significant variation in the association between anomalies of the skin and initial dioxin with time of conception among children of Ranch Hands having more than 10 ppt (p=0.913) or more than 5 ppt (p=0.916) current dioxin.

Table 5-70

Pre-post SEA Counts and Rates of Anomalies of the Skin

Variable: Anomalies of the Skin
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 1: $\text{Log}_2(\text{Initial Dioxin})$

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

Time of Conception Relative to the Father's Duty in SEA

Exposure Restriction	Initial Dioxin	Pre-SEA			Post-SEA			p-Value
		n	Abn	Rate	n	Abn	Rate	
a) D>10 ppt (n=1208)	Low	249	1	4.0	106	2	18.9	0.913
	Medium	338	7	20.7	245	6	24.5	
	High	113	0	0.0	157	2	12.7	
b) D>5 ppt (n=1748)	Low	286	2	7.0	155	2	12.9	0.916
	Medium	616	9	14.6	308	8	26.0	
	High	156	0	0.0	227	2	8.8	

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 5-71 [a]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 10 ppt current dioxin (p=0.624).

Without adjustment for covariates (Table 5-71 [b]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands having more than 5 ppt current dioxin (p=0.119).

Table 5-71

Pre-post SEA Counts and Rates of Anomalies of the Skin

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	7.3 (1/137)	32.8 (6/183)	0.0 (0/37)	0.624
		>18.6	0.0 (0/95)	5.8 (1/171)	0.0 (0/78)	
	Post-SEA	≤18.6	16.1 (1/62)	29.9 (4/134)	13.9 (1/72)	
		>18.6	0.0 (0/40)	27.8 (3/108)	10.8 (1/93)	
b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	6.4 (1/157)	19.2 (6/313)	15.2 (1/66)	0.119
		>18.6	6.7 (1/150)	7.4 (2/270)	0.0 (0/102)	
	Post-SEA	≤18.6	22.2 (2/90)	28.7 (5/174)	9.1 (1/110)	
		>18.6	0.0 (0/63)	22.1 (3/136)	8.5 (1/117)	

Anomalies of the Skin (All Children)

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

Without adjustment for covariates (Table 5-72), there is no significant variation in the overall association between anomalies of the skin and categorized current dioxin with time of conception ($p=0.854$). The corresponding contrasts of children of Ranch Hand fathers in the High ($p=0.606$), Low ($p=0.444$) and Unknown ($p=0.661$) categories versus children of Comparisons in the Background category are not significant.

Table 5-72

Pre-post SEA Counts and Rates of Anomalies of the Skin

Variable: Anomalies of the Skin
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted									
Time of Conception Relative to the Father's Duty in SEA									
Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1459	11	7.5	981	21	21.4	2.88	All Exp Categ	0.854
Unknown	582	5	8.6	282	5	17.7	2.08	Unk vs Bkgd	0.661
Low	290	6	20.7	174	6	34.5	1.69	Low vs Bkgd	0.444
High	168	1	6.0	227	2	8.8	1.48	High vs Bkgd	0.606
Total	2499			1664					

Anomalies of the Skin (Full Siblings)

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

Without adjustment for covariates (Table 5-73 [a] and [b]), there is no significant variation in the association between anomalies of the skin and initial dioxin with time of conception among full sibling children of Ranch Hands having more than 10 ppt ($p=0.403$) or more than 5 ppt ($p=0.759$) current dioxin.

Table 5-73

Pre-post SEA Counts and Rates of Anomalies of the Skin

Variable: Anomalies of the Skin
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA			n	Abn	Rate	p-Value
			Pre-SEA	Abn	Rate				
a) D>10 ppt (n=1030)	Low	231	1	4.3	78	2	25.6	0.403	
	Medium	276	3	10.9	206	5	24.3		
	High	103	0	0.0	136	1	7.4		
b) D>5 ppt (n=1489)	Low	252	2	7.9	114	1	8.8	0.759	
	Medium	545	5	9.2	245	7	28.6		
	High	135	0	0.0	198	1	5.1		

Anomalies of the Skin (Full Siblings)

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

Without adjustment for covariates (Table 5-74 [a]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands having more than 10 ppt current dioxin ($p=0.964$).

Without adjustment for covariates (Table 5-74 [b]), there is no significant variation in the association between anomalies of the skin and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands having more than 5 ppt current dioxin ($p=0.541$).

Table 5-74

Pre-post SEA Counts and Rates of Anomalies of the Skin

Variable: Anomalies of the Skin
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	8.1 (1/124)	12.9 (2/155)	0.0 (0/35)	0.964
		>18.6	0.0 (0/85)	7.0 (1/143)	0.0 (0/69)	
	Post-SEA	≤18.6	21.3 (1/47)	34.8 (4/115)	15.6 (1/64)	
		>18.6	0.0 (0/28)	21.7 (2/92)	0.0 (0/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	7.9 (1/126)	7.2 (2/276)	16.7 (1/60)	0.541
		>18.6	6.9 (1/145)	8.4 (2/237)	0.0 (0/88)	
	Post-SEA	≤18.6	16.9 (1/59)	34.7 (5/144)	10.2 (1/98)	
		>18.6	0.0 (0/53)	18.9 (2/106)	0.0 (0/97)	

Anomalies of the Skin (Full Siblings)

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

Without adjustment for covariates (Table 5-75), there is no significant variation in the overall association between anomalies of the skin and categorized current dioxin with time of conception among full siblings ($p=0.705$). The association between time of conception and anomalies of the skin among children of Ranch Hands in the High ($p=0.363$), Low ($p=0.697$) and Unknown ($p=0.565$) categories are not significantly different from the corresponding association among children of Comparisons in the Background category.

Table 5-75

Pre-post SEA Counts and Rates of Anomalies of the Skin

Variable: Anomalies of the Skin
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA Abn	Pre-SEA Rate	n	Post-SEA Abn	Post-SEA Rate	Odds Ratio	Category Contrast	p-Value
Background	1250	8	6.4	812	15	18.5	2.92	All Exp Categ	0.705
Unknown	514	4	7.8	221	3	13.6	1.75	Unk vs Bkgd	0.565
Low	244	2	8.2	148	5	33.8	4.23	Low vs Bkgd	0.697
High	148	1	6.8	195	1	5.1	0.76	High vs Bkgd	0.363
Total	2156			1376					

Chromosomal Anomalies (All Children)

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

There is insufficient data (Table 5-76) to assess the significance of variation in the association between chromosomal anomalies and initial dioxin with time of conception among children of Ranch Hands.

Table 5-76

Pre-post SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA			n	Abn	Rate	p-Value
			Pre-SEA Abn	Rate	Post-SEA Abn				
a) D>10 ppt (n=1208)	Low	249	0	0.0	106	0	0.0		
	Medium	338	2	5.9	245	0	0.0		
	High	113	0	0.0	157	1	6.4		
b) D>5 ppt (n=1748)	Low	286	0	0.0	155	1	6.5		
	Medium	616	2	3.2	308	0	0.0		
	High	156	0	0.0	227	1	4.4		

Chromosomal Anomalies (All Children)

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

There is insufficient data (Table 5-77) to assess the significance of variation in the association between chromosomal anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands.

Table 5-77

Pre-post SEA Counts and Rates of Chromosomal Anomalies

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	0.0 (0/137)	10.9 (2/183)	0.0 (0/37)	
		>18.6	0.0 (0/95)	0.0 (0/171)	0.0 (0/78)	
	Post-SEA	≤18.6	0.0 (0/62)	0.0 (0/134)	0.0 (0/72)	
		>18.6	0.0 (0/40)	0.0 (0/108)	10.8 (1/93)	
b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	0.0 (0/157)	6.4 (2/313)	0.0 (0/66)	
		>18.6	0.0 (0/150)	0.0 (0/270)	0.0 (0/102)	
	Post-SEA	≤18.6	11.1 (1/90)	0.0 (0/174)	0.0 (0/110)	
		>18.6	0.0 (0/63)	0.0 (0/136)	8.5 (1/117)	

Chromosomal Anomalies (All Children)

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

There is insufficient data (Table 5-78) to assess the significance of variation in the association between chromosomal anomalies and categorized current dioxin with time of conception.

Table 5-78

Pre-post SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
 to the Father's Duty in SEA

Exposure Category	n	Pre-SEA Abn Rate	Post-SEA n Abn Rate	Odds Ratio	Category Contrast	p-Value
Background	1459	2 1.4	981 3 3.1		All Exp Categ	
Unknown	582	0 0.0	282 3 10.6		Unk vs Bkgd	
Low	290	2 6.9	174 0 0.0		Low vs Bkgd	
High	168	0 0.0	227 1 4.4		High vs Bkgd	
Total	2499		1664			

Chromosomal Anomalies (Full Siblings)

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

There is insufficient data (Table 5-79) to assess the significance of variation in the association between chromosomal anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands.

Table 5-79

Pre-post SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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	Time of Conception Relative to the Father's Duty in SEA						p-Value
		n	Pre-SEA Abn	Rate	n	Post-SEA Abn	Rate	
a) D>10 ppt (n=1030)	Low	231	0	0.0	78	0	0.0	
	Medium	276	1	3.6	206	0	0.0	
	High	103	0	0.0	136	1	7.4	
b) D>5 ppt (n=1489)	Low	252	0	0.0	114	1	8.8	
	Medium	545	1	1.8	245	0	0.0	
	High	135	0	0.0	198	1	5.1	

Chromosomal Anomalies (Full Siblings)

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

There is insufficient data (Table 5-80) to assess the significance of variation in the association between chromosomal anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands.

Table 5-80

Pre-post SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	0.0 (0/124)	6.5 (1/155)	0.0 (0/35)	
		>18.6	0.0 (0/85)	0.0 (0/143)	0.0 (0/69)	
	Post-SEA	≤18.6	0.0 (0/47)	0.0 (0/115)	0.0 (0/64)	
		>18.6	0.0 (0/28)	0.0 (0/92)	13.3 (1/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	0.0 (0/126)	3.6 (1/276)	0.0 (0/60)	
		>18.6	0.0 (0/145)	0.0 (0/237)	0.0 (0/88)	
	Post-SEA	≤18.6	16.9 (1/59)	0.0 (0/144)	0.0 (0/98)	
		>18.6	0.0 (0/53)	0.0 (0/106)	10.3 (1/97)	

Chromosomal Anomalies (Full Siblings)

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

There is insufficient data (Table 5-81) to assess the significance of variation in the association between chromosomal anomalies and categorized current dioxin with time of conception among full siblings.

Table 5-81

Pre-post SEA Counts and Rates of Chromosomal Anomalies

Variable: Chromosomal Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the
 Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative
 to the Father's Duty in SEA

Exposure Category	n	Pre-SEA Abn	Pre-SEA Rate	Post-SEA n	Post-SEA Abn	Post-SEA Rate	Odds Ratio	Category Contrast	p-Value
Background	1250	2	1.6	812	3	3.7		All Exp Categ	
Unknown	514	0	0.0	221	3	13.6		Unk vs Bkgd	
Low	244	1	4.1	148	0	0.0		Low vs Bkgd	
High	148	0	0.0	195	1	5.1		High vs Bkgd	
Total	2156			1376					

Other and Unspecified Anomalies (All Children)

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

There is insufficient data (Table 5-82) to assess the significance of variation in the association between other and unspecified anomalies and initial dioxin with time of conception among children of Ranch Hands.

Table 5-82

**Pre-post SEA Counts and Rates of
Other and Unspecified Anomalies**

Variable: Other and Unspecified Anomalies
 Restrictions: All Children of Ranch Hands
 Categories: Time of Conception Relative to 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	Pre-SEA		Post-SEA		p-Value
			Abn	Rate	n	Abn	
a) D>10 ppt (n=1208)	Low	249	0	0.0	106	1	9.4
	Medium	338	4	11.8	245	2	8.2
	High	113	0	0.0	157	0	0.0
b) D>5 ppt (n=1748)	Low	286	1	3.5	155	1	6.5
	Medium	616	1	1.6	308	3	9.7
	High	156	3	19.2	227	0	0.0

Other and Unspecified Anomalies (All Children)

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

There is insufficient data (Table 5-83) to assess the significance of variation in the association between other and unspecified anomalies and current dioxin with time since duty in SEA and time of conception among children of Ranch Hands.

Table 5-83

Pre-post SEA Counts and Rates of
Other and Unspecified Anomalies

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

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1210)	Pre-SEA	≤18.6	0.0 (0/137)	0.0 (0/183)	0.0 (0/37)	
		>18.6	0.0 (0/95)	23.4 (4/171)	0.0 (0/78)	
	Post-SEA	≤18.6	0.0 (0/62)	7.5 (1/134)	0.0 (0/72)	
		>18.6	25.0 (1/40)	9.3 (1/108)	0.0 (0/93)	
b) D>5 ppt (n=1748)	Pre-SEA	≤18.6	0.0 (0/157)	0.0 (0/313)	0.0 (0/66)	
		>18.6	6.7 (1/150)	11.1 (3/270)	9.8 (1/102)	
	Post-SEA	≤18.6	0.0 (0/90)	5.7 (1/174)	0.0 (0/110)	
		>18.6	15.9 (1/63)	14.7 (2/136)	0.0 (0/117)	

Other and Unspecified Anomalies (All Children)

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

There is insufficient data (Table 5-84) to assess the significance of variation in the association between other and unspecified anomalies and categorized current dioxin with time of conception.

Table 5-84

Pre-post SEA Counts and Rates of Other and Unspecified Anomalies

Variable: Other and Unspecified Anomalies
 Restrictions: All Children of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized current dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	n	Pre-SEA		Post-SEA			Odds Ratio	Category Contrast	p-Value
		Abn	Rate	n	Abn	Rate			
Background	1459	3	2.1	981	2	2.0		All Exp Categ	
Unknown	582	2	3.4	282	1	3.5		Unk vs Bkgd	
Low	290	3	10.3	174	2	11.5		Low vs Bkgd	
High	168	1	6.0	227	0	0.0		High vs Bkgd	
Total	2499			1664					

Other and Unspecified Anomalies (Full Siblings)

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

There is insufficient data (Table 5-85) to assess the significance of variation in the association between other and unspecified anomalies and initial dioxin with time of conception among full sibling children of Ranch Hands.

Table 5-85

**Pre-post SEA Counts and Rates of
Other and Unspecified Anomalies**

Variable: Other and Unspecified Anomalies
 Restrictions: Full Siblings of Ranch Hands
 Categories: Time of Conception Relative to 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	Pre-SEA		Post-SEA		p-Value
			Abn	Rate	n	Abn	
a) D>10 ppt (n=1030)	Low	231	0	0.0	78	0	0.0
	Medium	276	2	7.2	206	1	4.9
	High	103	0	0.0	136	0	0.0
b) D>5 ppt (n=1489)	Low	252	1	4.0	114	1	8.8
	Medium	545	1	1.8	245	1	4.1
	High	135	1	7.4	198	0	0.0

Other and Unspecified Anomalies (Full Siblings)

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

There is insufficient data (Table 5-86) to assess the significance of variation in the association between other and unspecified anomalies and current dioxin with time since duty in SEA and time of conception among full sibling children of Ranch Hands.

Table 5-86

Pre-post SEA Counts and Rates of
Other and Unspecified Anomalies

Variable: Other and Unspecified Anomalies
Restrictions: Full Siblings of Ranch Hands
Categories: Time of Conception Relative to the
Father's Duty in SEA
Model 2: $\text{Log}_2(\text{Current Dioxin})$, Time

Ranch Hands - $\text{Log}_2(\text{Current Dioxin})$, Time - Unadjusted						
Exposure Restriction	Time of Conception	Time Since SEA (years)	Anomaly Rate (No./n) Current Dioxin			p-Value
			Low	Medium	High	
a) D>10 ppt (n=1032)	Pre-SEA	≤18.6	0.0 (0/124)	0.0 (0/155)	0.0 (0/35)	
		>18.6	0.0 (0/85)	14.0 (2/143)	0.0 (0/69)	
	Post-SEA	≤18.6	0.0 (0/47)	0.0 (0/115)	0.0 (0/64)	
		>18.6	0.0 (0/28)	10.9 (1/92)	0.0 (0/75)	
b) D>5 ppt (n=1489)	Pre-SEA	≤18.6	0.0 (0/126)	0.0 (0/276)	0.0 (0/60)	
		>18.6	6.9 (1/145)	4.2 (1/237)	11.4 (1/88)	
	Post-SEA	≤18.6	0.0 (0/59)	0.0 (1/144)	0.0 (0/98)	
		>18.6	18.9 (1/53)	9.4 (1/106)	0.0 (0/97)	

Other and Unspecified Anomalies (Full Siblings)

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

There is insufficient data (Table 5-87) to assess the significance of variation in the association between other and unspecified anomalies and categorized current dioxin with time of conception among full siblings.

Table 5-87

Pre-post SEA Counts and Rates of Other and Unspecified Anomalies

Variable: Other and Unspecified Anomalies
 Restrictions: Full Siblings of Ranch Hands and Comparisons
 Categories: Time of Conception Relative to the Father's Duty in SEA
 Model 3: Categorized Current Dioxin

Categorized Current Dioxin - Unadjusted

Time of Conception Relative to the Father's Duty in SEA

Exposure Category	Pre-SEA			Post-SEA			Odds Ratio	Category Contrast	p-Value
	n	Abn	Rate	n	Abn	Rate			
Background	1250	3	2.4	812	2	2.5		All Exp Categ	
Unknown	514	2	3.9	221	1	4.5		Unk vs Bkgd	
Low	244	1	4.1	148	1	6.8		Low vs Bkgd	
High	148	1	6.8	195	0	0.0		High vs Bkgd	
Total	2156			1376					

5.10 Conclusion

Throughout this section, nonsignificant results are indicated by NS, borderline significant results are indicated by NS*. Dioxin by covariate interactions with a with p-value greater than or equal to 0.01 and less than 0.05 are indicated with a preceding double asterisk (**). Four asterisks (****) indicate the presence of an interaction between dioxin and a covariate 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.

At baseline, the significance of changes in the association between reported birth defect (yes,no) and the father's group membership (Ranch Hand, Comparison) with time of birth of the child relative to the father's SEA tour of duty was assessed with a chi-square test and was found significant (p=0.04). The finding was that the Ranch Hand birth defect rate was less than that of the Comparisons in children born before the father's SEA duty and greater than the Comparison rate in children born after the father's SEA duty. That analysis motivated the full verification of all reproductive outcomes.

The baseline analysis used a different definition of birth defect than that used in this report. The baseline definition included all the anomalies specified in the CDC definition and an additional 12 anomalies not included in the CDC definition of birth defect.

Because the databases have been subjected to additional quality control since the baseline report, the baseline analysis was repeated using current data. Additionally, a series of 6 analyses were carried out under various combinations of birth defect definition (baseline, CDC), source (unverified mother's report, verified), restriction (children born during or prior to the fathers baseline physical examination, none) and adjustment (dioxin, none), to explain differences, if any, between current and baseline results. Table 5-88 summarizes the overall findings of each of these 6 analyses. The p-value in Table 5-88 expresses the significance of the birth defect by group by time of birth interaction of the baseline approach. In that table, the CDC definition includes all congenital anomalies.

This series of analyses demonstrates that the baseline finding still holds with current data but is not significant when the mother's reports are restricted to those that could be verified or when the CDC birth defect definition is used.

Table 5-88

**Baseline Analyses with Different Birth Defect Definitions
Data Sources, Restrictions and Adjustments**

Birth Defect Definition	Source	Restriction	Adjustment	p-Value
Baseline	Mother's Report	None	None	0.001
Baseline	Mother's Report	Children Born Before Baseline	Dioxin	0.038
Baseline	Mother's Report and also Verified	Children Born Before Baseline	None	0.032
Baseline	Mother's Report and also Verified	Children Born Before Baseline	Dioxin	NS
CDC	Verified	Children Born Before Baseline	None	NS
CDC	Verified	None	None	NS

Because the baseline approach exhibited a significant result when using the baseline definition of birth defect but not when using the CDC definition, a series of analyses was carried out to determine whether the baseline finding could be attributed to a particular CDC category of birth defects. Each analysis was carried out twice, first with restriction to children born before the baseline examination then without this restriction. The results are summarized in Table 5-89. In Table 5-89 the p-value refers to the birth defect (yes, no) by group (Ranch Hand, Comparison) by time of birth (pre-SEA, post-SEA) interaction. All of the birth defect determinations used in Table 5-89 were verified.

Table 5-89

P-Value Summary of Birth Defect by Time of Conception
(Pre-SEA, Post-SEA) by Group (Ranch Hand, Comparison) Analyses
Unadjusted for Covariates

a) Restricted to Children Born Prior to the Father's AFHS
Baseline Examination

Birth Defect Category	p-Value
Total Congenital	NS
Total Congenital	NS
Circulatory System and Heart	NS
Digestive System	NS
Genital	NS
Urinary	NS*
Musculoskeletal	NS
Skin	NS

b) Without the Restriction to Children Born Prior to the Father's
AFHS Baseline Examination

Birth Defect Category	p-Value
Total Congenital	0.028
Nervous System	NS
Eye	NS
Ear, Face and Neck	NS
Circulatory System and Heart	NS
Respiratory System	0.028
Digestive System	NS
Genital	NS
Urinary	0.036
Musculoskeletal	NS
Skin	NS
Chromosomal Abnormality	NS
Other and Unspecified	NS

With restriction to children born during or prior to the father's base-line physical examination, no significant birth defect by group by time of birth interactions were found with birth defects restricted to any of the categories listed in Table 5-89 (a). The analysis of urinary anomalies found a borderline significant interaction, caused by the Ranch Hand rate (11.4 per 1000) being less than the Comparisons rate (11.8 per 1000) in pre-SEA children with the situation reversed in post-SEA children (Ranch Hand: 18.3 per 1000, Comparison 7.7 per 1000).

With all children being considered [Table 50-89 (b)], significant changes in relative risk were found for total congenital anomalies (p=0.028), respiratory system anomalies (p=0.028) and urinary anomalies (p=0.036). All three of these findings were caused by the Ranch Hand rate being less the Comparisons rate in pre-SEA children and greater than the Comparison rate in post-SEA children.

A series of analyses were carried out with Models 1, 2 and 3 to determine whether any of the previously noted odds ratio changes were associated with the father's dioxin level. Verified birth defects satisfying the definition of each of the 13 CDC categories were assessed in all children and again in full siblings (without restriction to those born prior to the father's base-line examination) without adjustment for covariates. The results are summarized in Tables 5-90, 5-91 and 5-92.

Table 5-90

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

a) All Children

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

Table 5-90 (Continued)

b) Full Siblings

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

Table 5-91

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

a) All Children

Variable	Unadjusted	
	D>10 ppt	D>5 ppt
Total Congenital Anomalies	NS	NS
Nervous System Anomalies	--	--
Eye Anomalies	--	--
Ear, Face and Neck Anomalies	--	--
Circulatory System and Heart Anomalies	NS	NS
Respiratory System Anomalies	--	--
Digestive System Anomalies	0.030	NS*
Genital Anomalies	NS	NS
Urinary System Anomalies	NS	NS
Musculoskeletal Deformities	0.017	NS
Anomalies of the Skin	NS	NS
Chromosomal Anomalies	--	--
Other and Unspecified Anomalies	--	--

Table 5-91 (Continued)

b) Full Siblings

Variable	Unadjusted	
	D>10 ppt	D>5 ppt
Total Congenital Anomalies	NS	NS
Nervous System Anomalies	--	--
Eye Anomalies	--	--
Ear, Face and Neck Anomalies	--	--
Circulatory System and Heart Anomalies	NS	NS
Respiratory System Anomalies	--	--
Digestive System Anomalies	0.030	NS*
Genital Anomalies	NS	NS
Urinary System Anomalies	NS	NS
Musculoskeletal Deformities	0.019	NS
Anomalies of the Skin	NS	NS
Chromosomal Anomalies	--	--
Other and Unspecified Anomalies	--	--

Table 5-92

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

a) All Children

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

Table 5-92 (Continued)

b) Full Siblings

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

The only significant results in these analyses were the Model 2 assessments of digestive system anomalies and musculoskeletal deformities in children of Ranch Hands having more than 10 ppt current dioxin. The digestive system findings were caused by high post-SEA rates in children of Ranch Hands with late tours and high dioxin level and in children of Ranch Hands with early tours and intermediate dioxin levels. The musculoskeletal findings were caused by decreasing post-SEA rates in children of Ranch Hands with early tours, opposite to a corresponding increasing trend in pre-SEA rates. These findings are inconsistent, lack credible biologic explanation, and therefore appear unrelated to dioxin.

In summary, a repetition of the baseline analysis with verified birth defect data revealed a significant reversal in birth defect rates with time of birth of the child relative to the father's duty in SEA, with the Ranch Hand rate being less than the Comparison rate among pre-SEA children and greater than the Comparison rate among post-SEA children. However, after accounting for paternal dioxin level, we found no evidence that this effect was confined to a specific birth defect category and we found no significant association between this change in risk and dioxin. We conclude that this change in relative risk over time is unrelated to dioxin.