TABLE 9-43. (Continued)

Analysis of Schizotypal Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	33.9	All Categories		0.003
Unknown	340	31.9	Unknown vs. Background	-1.9 (-4.3,0.5)	0.114
Low	194	34.0	Low vs. Background	0.2 (-2.8,3.1)	0.914
High	184	38.4	High vs. Background	4.5 (1.5,7.5)	0.004
Total	1,499		(R^2=0.009)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	775	33.9	All Categories		0.053	DRKYR (p=0.063) EDUC (p<0.001)
Unknown	335	32.5	Unknown vs. Background	-1.4 (-3.8,1.0)	0.251	
Low	190	33.5	Low vs. Background	-0.4 (-3.4,2.6)	0.788	
High	180	37.3	High vs. Background	3.4 (0.4,6.5)	0.029	
Total	1,480		(R^2=0.024)			

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

the high current dioxin category was significantly higher than the mean score for the Comparisons in the background category (p=0.004).

After the adjustment for lifetime alcohol history and education, there was only a marginally significant difference detected in the mean schizotypal scores of the four current dioxin categories (Table 9-43 [j]: p=0.053). Concurrent with the results of the unadjusted analysis, the mean score of the Ranch Hands in the high current dioxin category was significantly higher than that of the Comparisons in the background category (p=0.029).

Borderline Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

The unadjusted analysis under the minimal assumption displayed a nonsignificant association between initial dioxin and the MCMI borderline score (Table 9-44 [a]: p=0.202). The maximal unadjusted analysis of the borderline score detected a significant positive association with initial dioxin (Table 9-44 [b]: p=0.028). For the maximal cohort, the unadjusted mean borderline scores became larger for increasing levels of initial dioxin (low, 31.2; medium, 32.5; high, 33.6).

In the adjusted minimal analysis, the association between initial dioxin and the borderline score remained nonsignificant (Table 9-44 [c]: p=0.333). Under the maximal assumption, the adjusted analysis detected a significant interaction between initial dioxin and education (Table 9-44 [d]: p=0.021). To examine this interaction separate analyses are presented for each education-level stratum. For Ranch Hands with a college education, there was a significant increasing association between initial dioxin and the borderline score (Appendix Table H-1: p=0.021). The adjusted mean scores for the low, medium, and high initial dioxin categories were 31.1, 32.4, and 37.8. In contrast, for Ranch Hands with a high school education, the analysis displayed a nonsignificant negative association (Appendix Table H-1: p=0.373).

After deletion of the initial dioxin-by-education interaction, the maximal adjusted analysis exhibited a nonsignificant association between initial dioxin and the MCMI borderline score (Table 9-44 [d]: p=0.388).

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

The unadjusted analysis of the MCMI borderline score based on current dioxin and time since tour did not detect a significant current dioxin-by-time interaction for either the minimal or the maximal cohort (Table 9-44 [e] and [f]: p=0.311 and p=0.809). In the minimal analysis, the association between current dioxin and the borderline score was also nonsignificant within each time stratum. However, for the maximal cohort, there was a marginally significant positive association between current dioxin and the borderline score for those Ranch Hands with time over 18.6 years (Table 9-44 [f]: p=0.072). The unadjusted mean scores for this time stratum for low, medium, and high current dioxin were 30.5, 33.5, and 33.3.

TABLE 9-44.

Analysis of Borderline Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal (n=514) (R^2=0.003)	Low	129	33.2	0.794 (0.622)	0.202
	Medium	256	32.8		
	High	129	34.0		
b) Maximal (n=732) (R^2=0.007)	Low	182	31.2	0.991 (0.451)	0.028
	Medium	368	32.5		
	High	182	33.6		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal (n=505) (R^2=0.033)	Low	128	36.1	0.611 (0.631)	0.333	RACE (p=0.022)
	Medium	250	35.2			DRKYR (p=0.049)
	High	127	36.5			EDUC (p=0.036)
d) Maximal (n=719) (R^2=0.046)	Low	179	35.8**	0.405 (0.469)**	0.388**	INIT*EDUC (p=0.021)
	Medium	362	35.0**			RACE (p=0.019)
	High	178	35.6**			DRKYR (p=0.135)

[a]Slope and standard error based on borderline score versus log_2 dioxin.

**Log_2 (initial dioxin)-by-covariate interaction ($0.01<p\leq0.05$); adjusted mean, adjusted slope, standard error, and p-value derived from a model fitted after deletion of this interaction.

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

TABLE 9-44. (Continued)

Analysis of Borderline Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal						0.311[b]
(n=514)	≤18.6	33.5 (72)	33.3 (128)	32.2 (53)	-0.016 (1.015)	0.988[c]
(R^2=0.005)	>18.6	33.1 (56)	32.1 (129)	35.3 (76)	1.315 (0.832)	0.115[c]
f) Maximal						0.809[b]
(n=732)	≤18.6	30.1 (105)	32.6 (190)	33.9 (82)	0.891 (0.701)	0.204[c]
(R^2=0.007)	>18.6	30.5 (78)	33.5 (175)	33.3 (102)	1.118 (0.620)	0.072[c]

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal						0.334[b]	RACE (p=0.023)
(n=505)	≤18.6	36.6 (71)	36.2 (126)	35.2 (53)	-0.074 (1.014)	0.942[c]	DRKYR (p=0.040)
(R^2=0.035)							EDUC (p=0.039)
	>18.6	35.8 (56)	34.2 (125)	37.5 (74)	1.189 (0.839)	0.157[c]	
h) Maximal						0.739[b]	RACE (p=0.016)
(n=719)	≤18.6	34.1 (104)	35.6 (186)	36.1 (81)	0.314 (0.713)	0.660[c]	DRKYR (p=0.146)
(R^2=0.039)							EDUC (p<0.001)
	>18.6	34.4 (77)	35.8 (172)	34.9 (99)	0.624 (0.628)	0.321[c]	

[a]Slope and standard error based on borderline score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-44. (Continued)

Analysis of Borderline Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	33.3	All Categories		0.170
Unknown	340	31.0	Unknown vs. Background	-2.4 (-4.5,-0.2)	0.033
Low	194	32.5	Low vs. Background	-0.8 (-3.5,1.9)	0.567
High	184	33.5	High vs. Background	0.2 (-2.5,2.9)	0.882
Total	1,499		(R^2=0.003)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	775	33.2**	All Categories		0.415**	DXCAT*EDUC (p=0.033) DRKYR (p=0.003)
Unknown	335	31.5**	Unknown vs. Background	-1.8 (-3.9,0.4)**	0.110**	
Low	190	32.0**	Low vs. Background	-1.2 (-3.9,1.5)**	0.369**	
High	180	32.7**	High vs. Background	-0.6 (-3.3,2.2)**	0.694**	
Total	1,480		(R^2=0.027)			

**Categorized current dioxin-by-covariate interaction ($0.01<p\leq0.05$); adjusted mean, confidence interval, and p-value derived from a model fitted after deletion of this interaction.

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

After adjusting for race, lifetime alcohol history, and education, both the minimal and the maximal analyses found a nonsignificant current dioxin-by-time interaction (Table 9-44 [g] and [h]: p=0.334 and p=0.739, respectively). The association between current dioxin and the borderline score was also nonsignificant within each time stratum.

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

There was not a significant overall difference in the mean borderline scores of the four current dioxin categories (Table 9-44 [i]: p=0.170). However, the mean score for the Ranch Hands in the unknown current dioxin category was significantly lower than the mean score for the Comparisons in the background category (p=0.033). The mean borderline scores for the background, unknown, low, and high current dioxin categories were 33.3, 31.0, 32.5, and 33.5.

In the adjusted analysis, there was a significant interaction between categorized current dioxin and education (Table 9-44 [j]: p=0.033). To investigate this interaction, stratified analyses are presented for each education level. For the high school educated participants, there was no significant difference found among the mean borderline scores of the four current dioxin categories (Appendix Table H-1: p=0.578). The adjusted mean borderline scores for the background, unknown, low, and high categories were 34.3, 36.3, 33.8, and 33.6. For those participants with a college level education, there was a significant difference found among the mean borderline scores of the four categories (p=0.022). The mean score of the unknown category was found to be significantly lower than the mean score of those in the background category (p=0.004).

After deletion of the categorized current dioxin-by-education interaction from the model and adjusting only for education and lifetime alcohol history, there were no significant differences detected among the mean borderline scores of the four current dioxin categories (Table 9-44 [j]: p=0.415).

Paranoid Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

Neither the unadjusted minimal nor maximal analysis detected a significant association between initial dioxin and the MCMI paranoid score (Table 9-45 [a] and [b]: p=0.675 and p=0.729, respectively).

The results of the adjusted analyses were consistently nonsignificant for the minimal and maximal cohorts (Table 9-45 [c] and [d]: p=0.413 and p=0.960).

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

In the unadjusted analysis of the MCMI paranoid score under both the minimal and maximal assumptions, the interactions between current dioxin and time since tour were not significant (Table 9-45 [e] and [f]: p=0.979 and p=0.891, respectively). The associations between current dioxin and the paranoid score were also nonsignificant within each time stratum for both minimal and maximal cohorts.

TABLE 9-45.

Analysis of Paranoid Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal (n=514) (R^2<0.001)	Low	129	51.8	0.227 (0.539)	0.675
	Medium	256	53.7		
	High	129	53.3		
b) Maximal (n=732) (R^2<0.001)	Low	182	52.9	0.139 (0.400)	0.729
	Medium	368	53.1		
	High	182	53.2		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal (n=512) (R^2=0.021)	Low	129	53.8	0.457 (0.557)	0.413	RACE (p=0.080) AGE*ALC (p=0.045)
	Medium	254	55.8			
	High	129	55.8			
d) Maximal (n=727) (R^2=0.016)	Low	181	56.8	-0.021 (0.418)	0.960	RACE (p=0.004) EDUC (p=0.086)
	Medium	365	56.0			
	High	181	56.1			

[a]Slope and standard error based on paranoid score versus log_2 dioxin.

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

TABLE 9-45. (Continued)

Analysis of Paranoid Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal (n=514) (R^2=0.010)	≤18.6	54.7 (72)	54.3 (128)	54.8 (53)	0.522 (0.876)	0.979[b] 0.551[c]
	>18.6	49.8 (56)	52.2 (129)	52.8 (76)	0.551 (0.718)	0.443[c]
f) Maximal (n=732) (R^2=0.008)	≤18.6	53.4 (105)	54.2 (190)	55.4 (82)	0.476 (0.620)	0.891[b] 0.443[c]
	>18.6	51.1 (78)	52.0 (175)	52.0 (102)	0.362 (0.548)	0.509[c]

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal (n=512) (R^2=0.033)	≤18.6	56.7 (72)	56.4 (128)	57.5 (53)	0.852 (0.900)	0.937[b] 0.345[c]	RACE (p=0.056) AGE*ALC (p=0.040)
	>18.6	51.7 (56)	54.2 (127)	55.4 (76)	0.941 (0.740)	0.204[c]	
h) Maximal (n=727) (R^2=0.024)	≤18.6	57.1 (105)	57.3 (187)	58.4 (82)	0.310 (0.634)	0.909[b] 0.626[c]	RACE (p=0.004) EDUC (p=0.107)
	>18.6	54.9 (78)	55.1 (174)	54.9 (101)	0.214 (0.558)	0.701[c]	

[a]Slope and standard error based on paranoid score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-45. (Continued)

Analysis of Paranoid Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	51.5	All Categories		0.191
Unknown	340	52.9	Unknown vs. Background	1.3 (-0.6,3.3)	0.187
Low	194	53.6	Low vs. Background	2.0 (-0.4,4.5)	0.104
High	184	53.5	High vs. Background	2.0 (-0.5,4.5)	0.118
Total	1,499		(R^2=0.003)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	775	53.3	All Categories		0.202	RACE (p=0.025)
						DRKYR (p=0.121)
Unknown	335	55.2	Unknown vs. Background	1.9 (-0.1,3.9)	0.067	EDUC (p<0.001)
Low	190	55.1	Low vs. Background	1.7 (-0.7,4.2)	0.166	
High	180	54.7	High vs. Background	1.4 (-1.2,3.9)	0.284	
Total	1,480		(R^2=0.022)			

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

These findings did not change after adjusting for covariate information (Table 9-45 [g] and [h]: p>0.20 for each analysis).

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

In the unadjusted analysis, there were no significant differences in the mean MCMI paranoid scores of the four current dioxin categories (Table 9-45 [i]: p>0.10 for each analysis).

After adjusting for race, lifetime alcohol history, and education, the overall test of differences among the mean paranoid scores of the four current dioxin categories remained nonsignificant (Table 9-45 [j]: p=0.202). However, there was a marginally significant difference detected between the mean paranoid score of the Comparisons in the background category and the mean paranoid score of the Ranch Hands in the unknown current dioxin category (p=0.067). The adjusted mean paranoid scores for the background, unknown, low, and high current dioxin categories were 53.3, 55.2, 55.1, and 54.7.

Anxiety Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

The unadjusted analysis detected a significant positive association between initial dioxin and the MCMI anxiety score for both minimal and maximal cohorts (Table 9-46 [a] and [b]: p=0.046 and p<0.001). The unadjusted mean anxiety scores under the minimal assumption for the low, medium, and high initial dioxin categoires were 46.8, 47.0 and 49.7. The corresponding mean scores for the maximal cohort were 43.5, 46.6, and 48.5, respectively.

In the adjusted analysis performed under the minimal assumption, there was a significant interaction between initial dioxin and race (Table 9-46 [c]: p=0.017). Separate analyses were performed for the individual race strata. In the Black stratum, there was a significant negative association between initial dioxin the MCMI anxiety score (Appendix Table H-1: p=0.043), and in the non-Black stratum, there was a significant positive association (p=0.036). For the low, medium, and high initial dioxin categories of the Black stratum, the adjusted mean anxiety scores were 54.0, 54.6, and 20.7, respectively. The corresponding means for the low, medium, and high initial dioxin levels in the non-Black stratum were 46.0, 45.8, and 49.5. After deletion of the initial dioxin-by-race interaction from the model and adjusting only for race and education, the positive association between initial dioxin and the anxiety score was only marginally significant (Table 9-46 [c]: p=0.091).

The adjusted analysis also found an initial dioxin-by-race interaction for the maximal cohort (Table 9-46 [d]: p=0.005). The stratified analyses of this interaction displayed a significant negative association between initial dioxin and the anxiety score for the Black stratum (Appendix Table H-1: p=0.016) and a significant positive association for the non-Black stratum (p=0.007). The adjusted mean anxiety scores for the Black stratum decreased with increasing initial dioxin levels (low, 60.8; medium, 55.6; high, 37.7), while the mean scores became larger for increasing initial dioxin for the non-Black stratum (low, 44.5; medium, 45.4; high, 47.6).

TABLE 9-46.

Analysis of Anxiety Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal	Low	129	46.8	1.551 (0.775)	0.046
(n=514)	Medium	256	47.0		
(R^2=0.008)	High	129	49.7		
b) Maximal	Low	182	43.5	1.943 (0.568)	<0.001
(n=732)	Medium	368	46.6		
(R^2=0.016)	High	182	48.5		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal	Low	128	48.7**	1.337 (0.788)**	0.091**	INIT*RACE (p=0.017)
(n=510)	Medium	254	48.5**			EDUC (p=0.082)
(R^2=0.027)	High	128	51.1**			
d) Maximal	Low	181	****	****	****	INIT*RACE (p=0.005)
(n=727)	Medium	365	****			EDUC (p=0.004)
(R^2=0.043)	High	181	****			

[a]Slope and standard error based on anxiety score versus log_2 dioxin.

**Log_2 (initial dioxin)-by-covariate interaction ($0.01<p\leq0.05$); adjusted mean, adjusted slope, standard error, and p-value derived from a model fitted after deletion of this interaction.

****Log_2 (initial dioxin)-by-covariate interaction ($p\leq0.01$); adjusted mean, adjusted slope, standard error, and p-value not presented.

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

TABLE 9-46. (Continued)

Analysis of Anxiety Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal						0.155[b]
(n=514)	≤18.6	47.3	47.5	45.8	-0.023 (1.263)	0.986[c]
(R^2=0.010)		(72)	(128)	(53)		
	>18.6	45.4	47.0	52.1	2.307 (1.036)	0.026[c]
		(56)	(129)	(76)		
f) Maximal						0.917[b]
(n=732)	≤18.6	41.0	45.7	48.8	1.838 (0.883)	0.038[c]
(R^2=0.016)		(105)	(190)	(82)		
	>18.6	46.0	47.1	49.6	1.716 (0.781)	0.028[c]
		(78)	(175)	(102)		

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal						0.202[b]	EDUC (p=0.073)
(n=510)	≤18.6	47.0	47.1	45.1	-0.173 (1.267)	0.891[c]	
(R^2=0.015)		(71)	(127)	(53)			
	>18.6	45.5	46.2	51.0	1.915 (1.047)	0.068[c]	
		(56)	(128)	(75)			
h) Maximal						0.914[b]	RACE (p=0.040)
(n=727)	≤18.6	45.3	48.7	51.2	1.267 (0.897)	0.158[c]	EDUC (p=0.003)
(R^2=0.032)		(105)	(187)	(82)			
	>18.6	50.2	49.8	51.3	1.141 (0.790)	0.149[c]	
		(78)	(174)	(101)			

[a]Slope and standard error based on anxiety score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-46. (Continued)

Analysis of Anxiety Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	47.2	All Categories		0.038
Unknown	340	44.1	Unknown vs. Background	-3.1 (-5.8,-0.4)	0.023
Low	194	46.4	Low vs. Background	-0.8 (-4.1,2.5)	0.630
High	184	49.3	High vs. Background	2.1 (-1.3,5.5)	0.231
Total	1,499		(R^2=0.006)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	776	48.0**	All Categories		0.248**	DXCAT*RACE (p=0.018) AGE*EDUC (p=0.045)
Unknown	338	45.7**	Unknown vs. Background	-2.2 (-4.9,0.5)**	0.107**	
Low	192	46.7**	Low vs. Background	-1.2 (-4.6,2.1)**	0.461**	
High	183	49.2**	High vs. Background	1.3 (-2.2,4.7)**	0.464**	
Total	1,489		(R^2=0.028)			

**Categorized current dioxin-by-covariate interaction ($0.01<p\leq0.05$); adjusted mean, confidence interval, and p-value derived from a model fitted after deletion of this interaction.

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

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

In the unadjusted analysis of the MCMI anxiety score with current dioxin and time since tour under the minimal assumption, the interaction between current dioxin and time was not significant (Table 9-46 [e]: p=0.155). However, there was a significant positive association between current dioxin and the anxiety score for Ranch Hands with time over 18.6 years (p=0.026). The unadjusted mean anxiety scores for low, medium, and high current dioxin were 45.4, 47.0, and 52.1.

Under the maximal assumption, the unadjusted analysis also exhibited a nonsignificant current dioxin-by-time since tour interaction (Table 9-46 [f]: p=0.917). For Ranch Hands with time less than or equal to 18.6 years, a significant positive association was displayed between the anxiety score and current dioxin (p=0.038). For these individuals, the mean scores for low, medium, and high current dioxin were 41.0, 45.7, and 48.8. Within the time greater than 18.6 years stratum, there was also a significant positive association between current dioxin and the anxiety score (p=0.028). The mean unadjusted scores for this stratum similarly became larger for increasing current dioxin (low, 46.0; medium, 47.1; high, 49.6).

After adjusting for education, the minimal analysis still displayed a nonsignificant current dioxin-by-time since tour interaction (Table 9-46 [g]: p=0.202). Within the time over 18.6 years stratum, the positive association between current dioxin and the anxiety score became only marginally significant (p=0.068). The current dioxin-by-time since tour interaction also remained nonsignificant for the maximal analysis after the retention of race and education in the model (Table 9-46 [h]: p=0.914). The association between current dioxin and the anxiety score was no longer significant for either time stratum.

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

In the unadjusted analysis of categorized current dioxin, there was a significant difference found among the mean anxiety scores of the participants in the four current dioxin categories (Table 9-46 [i]: p=0.038). The unadjusted mean scores for the background, unknown, low, and high current dioxin categories were 47.2, 44.1, 46.4, and 49.3. The analysis found the mean anxiety score of Ranch Hands in the unknown category to be significantly lower than the mean score of Comparisons in the background category (p=0.023). The mean anxiety scores of the low and high current dioxin categories did not differ significantly from the mean score of those in the background category (p=0.630 and p=0.231).

The adjusted analysis of the MCMI anxiety score revealed a significant interaction between categorized current dioxin and race (Table 9-46 [j]: p=0.018). After stratifying by race, the adjusted analysis for Black participants detected a marginally significant overall difference among the mean anxiety scores of the four current dioxin categories (Appendix Table H-1: p=0.066). The adjusted mean anxiety scores for the background, unknown, low, and high categories were 45.1, 60.7, 54.6, and 41.7. The mean score of the Ranch Hands in the unknown category was significantly higher than the mean score of the Comparisons in the background category (p=0.021).

The adjusted analysis of the non-Black stratum also detected a marginally significant difference among the mean anxiety scores of the four current dioxin categories (Appendix Table H-1: p=0.071). The mean scores for the background, unknown, low, and high categories were 47.2, 44.2, 45.3, and 48.7. In contrast to the analysis of the Black stratum, the mean anxiety score of the unknown category was significantly lower than the mean score of the background category in the non-Black stratum (p=0.032).

After deletion of the interaction from the model and adjusting for race and an age-by-education interaction, there were no significant differences detected in the mean anxiety scores of the four current dioxin categories (Table 9-46 [j]: p=0.248).

Somatoform Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

In the unadjusted analysis based upon the minimal assumption, the association between initial dioxin and the MCMI somatoform score was not significant (Table 9-47 [a]: p=0.327). However, under the maximal assumption, there was a significant positive association between initial dioxin and the somatoform score (Table 9-47 [b]: p=0.033). The unadjusted mean scores for the low, medium, and high initial dioxin categories of the maximal cohort were 49.1, 51.2, and 51.8. Consistent with the unadjusted results, the adjusted analysis also detected a nonsignificant association between initial dioxin and the somatoform score for the minimal cohort (Table 9-47 [c]: p=0.196) and a significant positive association for the maximal cohort (Table 9-47 [d]: p=0.011).

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

Under both the minimal and the maximal assumptions, the unadjusted analysis of the somatoform score exhibited nonsignificant current dioxin-by-time since tour interactions (Table 9-47 [e] and [f]: p=0.683 and p=0.394, respectively). However, for the time less than or equal to 18.6 years stratum of the maximal cohort, there was a marginally significant positive association between current dioxin and the somatoform score (Table 9-47 [f]: p=0.055). For this time stratum, the mean somatoform scores for low, medium, and high current dioxin were 48.2, 50.0, 53.0.

In the adjusted analysis of the somatoform score, the interaction of current dioxin and time since tour was again nonsignificant under the minimal assumption (Table 9-47 [g]: p=0.670) and the maximal assumption (Table 9-47 [h]: p=0.436). Similarly, after adjusting for age, race, and lifetime alcohol history, the time less than or equal to 18.6 years stratum of the maximal cohort displayed a significant positive association between current dioxin and the somatoform score (Table 9-47 [h]: p=0.030).

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

The unadjusted analysis of categorized current dioxin did not detect a significant overall difference among the mean somatoform scores of the four current dioxin categories (Table 9-47 [i]: p=0.407).

TABLE 9-47.

Analysis of Somatoform Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal (n=514) (R^2=0.002)	Low	129	51.7	0.617 (0.629)	0.327
	Medium	256	50.7		
	High	129	52.9		
b) Maximal (n=732) (R^2=0.006)	Low	182	49.1	0.981 (0.460)	0.033
	Medium	368	51.2		
	High	182	51.8		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal (n=509) (R^2=0.017)	Low	129	54.3	0.811 (0.627)	0.196	RACE (p=0.038)
	Medium	252	53.4			DRKYR (p=0.050)
	High	128	56.0			
d) Maximal (n=724) (R^2=0.022)	Low	180	52.5	1.199 (0.471)	0.011	AGE (p=0.123)
	Medium	365	54.1			RACE (p=0.008)
	High	179	55.6			DRKYR (p=0.040)

[a]Slope and standard error based on somatoform score versus log_2 dioxin.

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

TABLE 9-47. (Continued)

Analysis of Somatoform Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal						0.683[b]
(n=514)	≤18.6	52.3	51.4	50.3	0.374 (1.026)	0.716[c]
(R^2=0.003)		(72)	(128)	(53)		
	>18.6	51.2	50.3	54.0	0.915 (0.841)	0.277[c]
		(56)	(129)	(76)		
f) Maximal						0.394[b]
(n=732)	≤18.6	48.2	50.0	53.0	1.374 (0.714)	0.055[c]
(R^2=0.008)		(105)	(190)	(82)		
	>18.6	51.1	51.1	52.5	0.560 (0.632)	0.375[c]
		(78)	(175)	(102)		

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal						0.670[b]	RACE (p=0.041)
(n=509)	≤18.6	54.7	53.8	53.3	0.494 (1.019)	0.628[c]	DRKYR (p=0.055)
(R^2=0.018)		(72)	(127)	(53)			
	>18.6	54.4	53.0	56.9	1.056 (0.836)	0.207[c]	
		(56)	(126)	(75)			
h) Maximal						0.436[b]	AGE (p=0.134)
(n=724)	≤18.6	51.6	53.3	56.7	1.581 (0.726)	0.030[c]	RACE (p=0.008)
(R^2=0.023)		(104)	(189)	(81)			DRKYR (p=0.041)
	>18.6	54.2	54.0	56.6	0.840 (0.645)	0.193[c]	
		(77)	(173)	(100)			

[a]Slope and standard error based on somatoform score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-47. (Continued)

Analysis of Somatoform Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	51.1	All Categories		0.407
Unknown	340	50.2	Unknown vs. Background	-0.9 (-3.1,1.4)	0.445
Low	194	50.1	Low vs. Background	-0.9 (-3.7,1.8)	0.500
High	184	52.7	High vs. Background	1.6 (-1.2,4.4)	0.260
Total	1,499		(R^2=0.002)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	775	52.4**	All Categories		0.438**	DXCAT*ALC (p=0.019) DXCAT*DRKYR (p=0.007)
Unknown	335	51.9**	Unknown vs. Background	-0.5 (-2.7,1.8)**	0.675**	RACE (p=0.113)
Low	190	51.0**	Low vs. Background	-1.4 (-4.1,1.4)**	0.334**	EDUC (p=0.029)
High	180	53.9**	High vs. Background	1.5 (-1.3,4.4)**	0.296**	AGE*DRKYR (p=0.016)
Total	1,480		(R^2=0.024)			

**Categorized current dioxin-by-covariate interaction ($0.01<p\leq0.05$); adjusted mean, confidence interval, and p-value derived from a model fitted after deletion of this interaction.

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

The adjusted analysis detected significant interactions between categorized current dioxin and current alcohol use and between categorized current dioxin and lifetime alcohol history (Table 9-47 [j]: p=0.019 and p=0.007, respectively). To investigate these interactions, Appendix Table H-1 presents separate analyses for each of four current alcohol use and lifetime alcohol history combination strata (i.e., ≤1 drink/day, ≤40 drink-years; ≤1 drink/day, >40 drink-years; >1 drink/day, ≤40 drink-years; >1 drink/day, and >40 drink years).

The contrasts of the four current dioxin categories were not significant for any of the stratified analyses (Appendix Table H-1: p>0.10 for each analysis). However, the adjusted mean somatoform score of the low category was significantly lower than the mean of the background category (p=0.044) for participants who drank less than or equal to one drink per day but who had more than 40 drink-years. The contrast of the high versus background categories was also marginally significant for this stratum with the mean of the background category again higher (p=0.094). The mean somatoform scores for this stratum were 56.0, 55.2, 47.4, and 49.0 for the background, unknown, low, and high current dioxin categories.

The analysis of the participants who drank more than one drink per day but had 40 drink-years or less detected a marginally significant difference between the mean somatoform score of the Comparisons in the background category and of the Ranch Hands in the high category (Appendix Table H-1: p=0.077). The adjusted mean somatoform scores for this stratum were 48.3, 53.5, 52.0, and 58.4 for the background, unknown, low, and high current dioxin categories.

After deletion of the interaction from the model and adjusting only for race, current alcohol use, education, and an age-by-lifetime alcohol history interaction, there were no significant differences detected among the mean somatoform scores of the four current dioxin categories (Table 9-47 [j]: p=0.438).

Hypomania Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

Based upon the minimal assumption, the unadjusted analysis detected a marginally significant negative association between initial dioxin and the MCMI hypomania score (Table 9-48 [a]: p=0.054). The unadjusted mean scores for the low, medium, and high initial dioxin categories were 21.6, 22.0, and 17.6. For the maximal assumption, there was a nonsignificant negative association between initial dioxin and the hypomania score (Table 9-48 [b]: p=0.133).

Under the minimal assumption, there was a significant interaction between initial dioxin and race (Table 9-48 [c]: p=0.013). To examine this interaction, Blacks and non-Blacks were analyzed separately. For the Black stratum, there was a significant positive association between initial dioxin and the hypomania score (Appendix Table H-1: p=0.036); and for the non-Black stratum, there was a significant negative association (p=0.025). The adjusted mean hypomania scores for the Black stratum were 21.0, 25.8, and 46.6 for the low, medium, and high initial dioxin categories. The corresponding means for the non-Black stratum were 21.7, 22.8, and 17.2. After deletion of the initial dioxin-by-race interaction from

TABLE 9-48.

Analysis of Hypomania Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean[a]	Slope (Std. Error)[b]	p-Value
a) Minimal	Low	129	21.6	-0.189 (0.097)	0.054
(n=514)	Medium	256	22.0		
(R^2=0.007)	High	129	17.6		
b) Maximal	Low	182	20.7	-0.108 (0.072)	0.133
(n=732)	Medium	368	21.8		
(R^2=0.003)	High	182	19.1		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean[a]	Adj. Slope (Std. Error)[b]	p-Value	Covariate Remarks
c) Minimal	Low	128	23.2**	-0.186 (0.102)**	0.069**	INIT*RACE (p=0.013)
(n=505)	Medium	250	24.8**			DRKYR (p=0.013)
(R^2=0.052)	High	127	19.5**			EDUC (p=0.109)
						AGE*RACE (p=0.013)
d) Maximal	Low	179	22.0**	-0.090 (0.076)**	0.236**	INIT*RACE (p=0.039)
(n=719)	Medium	362	24.1**			DRKYR (p=0.002)
(R^2=0.045)	High	178	21.4**			EDUC (p=0.056)
						AGE*RACE (p=0.007)

[a]Transformed from square root scale.

[b]Slope and standard error based on square root hypomania score versus log_2 dioxin.

**Log_2 (initial dioxin)-by-covariate interaction ($0.01<p\leq0.05$); adjusted mean, adjusted slope, standard error, and p-value derived from a model fitted after deletion of this interaction.

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

TABLE 9-48. (Continued)

Analysis of Hypomania Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean[a]/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[b]	p-Value
e) Minimal						0.674[c]
(n=514)	≤18.6	23.0 (72)	21.4 (128)	19.3 (53)	-0.136 (0.159)	0.394[d]
(R^2=0.008)	>18.6	21.0 (56)	21.9 (129)	16.6 (76)	-0.222 (0.130)	0.089[d]
f) Maximal						0.237[c]
(n=732)	≤18.6	20.4 (105)	21.9 (190)	19.1 (82)	-0.017 (0.111)	0.875[d]
(R^2=0.005)	>18.6	22.5 (78)	22.0 (175)	17.7 (102)	-0.193 (0.098)	0.050[d]

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean[a]/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[b]	p-Value	Covariate Remarks
g) Minimal						0.782[c]	AGE (p=0.060)
(n=505)	≤18.6	27.7 (71)	25.4 (126)	22.5 (53)	-0.182 (0.164)	0.268[d]	RACE (p=0.123)
(R^2=0.034)							DRKYR (p=0.013)
	>18.6	24.1 (56)	26.6 (125)	20.0 (74)	-0.239 (0.135)	0.078[d]	EDUC (p=0.097)
h) Maximal						0.162[c]	DRKYR (p=0.003)
(n=719)	≤18.6	21.5 (104)	24.0 (186)	21.5 (81)	0.002 (0.115)	0.985[d]	EDUC (p=0.049)
(R^2=0.042)							AGE*RACE (p=0.029)
	>18.6	25.9 (77)	24.5 (172)	19.8 (99)	-0.203 (0.101)	0.045[d]	

[a]Transformed from square root scale.

[b]Slope and standard error based on square root hypomania score versus log_2 dioxin.

[c]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[d]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-48. (Continued)

Analysis of Hypomania Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean[a]	Contrast	Difference of Means (95% C.I.)[e]	p-Value[f]
Background	781	21.9	All Categories		0.251
Unknown	340	22.4	Unknown vs. Background	0.5 --	0.742
Low	194	22.4	Low vs. Background	0.5 --	0.795
High	184	18.3	High vs. Background	-3.5 --	0.071
Total	1,499		(R^2=0.003)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	775	****	All Categories		****	DXCAT*RACE (p=0.004) AGE (p=0.048)
Unknown	335	****	Unknown vs. Background	****	****	DRKYR (p=0.002)
Low	190	****	Low vs. Background	****	****	EDUC (p=0.009)
High	180	****	High vs. Background	****	****	
Total	1,480		(R^2=0.025)			

[a]Transformed from square root scale.

[e]Difference of means after transformation to original scale; confidence interval on difference of means not given because analysis was performed on square root scale.

[f]p-value is based on difference of means on square root scale.

****Categorized current dioxin-by-covariate interaction ($p \leq 0.01$); adjusted mean, confidence interval, and p-value not presented.

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

the model, there was only a marginally significant negative association between initial dioxin and the hypomania score (Table 9-48 [c]: p=0.069).

The adjusted analysis under the maximal assumption also detected a significant initial dioxin-by-race interaction (Table 9-48 [d]: p=0.039). This interaction was also investigated by stratifying the Ranch Hands by race, and the results were similar to those of the minimal cohort. There was a marginally significant positive association between initial dioxin and the hypomania score in the Black stratum (Appendix Table H-1: p=0.065) and a nonsignificant negative association in the non-Black stratum (p=0.135). The adjusted means for the low, medium, and high initial dioxin categories were 20.7, 20.2, and 49.6 for the Black stratum and 19.9, 22.3, and 18.5 for the non-Black stratum. After deletion of the initial dioxin-by-race interaction, the association between initial dioxin and the MCMI hypomania score was nonsignificant (Table 9-48 [d]: p=0.236).

Model 2: Ranch Hands - Log_2 (Initial Dioxin)

In the unadjusted analysis of the MCMI hypomania score, the interaction of current dioxin and time since tour was not significant for either the minimal or the maximal cohort (Table 9-48 [e] and [f]: p=0.674 and p=0.237). However, under the minimal assumption, the negative association between current dioxin and the hypomania score was marginally significant for the time greater than 18.6 years stratum (Table 9-48 [e]: p=0.089). The unadjusted mean hypomania scores for this stratum were 21.0, 21.9, and 16.6 for low, medium, and high current dioxin. Also, under the maximal assumption, there was a significant negative association between current dioxin and the hypomania score for the time over 18.6 years stratum (Table 9-48 [f]: p=0.050). The unadjusted mean hypomania scores for this stratum decreased steadily for increasing levels of current dioxin (low, 22.5; medium, 22.0; high, 17.7).

After adjusting for covariate information, the current dioxin-by-time since tour interaction remained nonsignificant for both the minimal and the maximal cohort (Table 9-48 [g] and [h]: p=0.782 and p=0.162). Consistent with the unadjusted results, there was a marginally significant negative association between current dioxin and the hypomania score for the time greater than 18.6 years stratum of the minimal cohort (Table 9-48 [g]: p=0.078). Likewise, there was a significant negative association for the same time stratum under the maximal assumption (Table 9-48 [h]: p=0.045).

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

The unadjusted analysis of categorized current dioxin did not detect a significant overall difference among the mean hypomania scores of the four current dioxin categories (Table 9-48 [i]: p=0.251). However, the analysis displayed a marginally significant difference between the mean score of the Comparisons in the background category and the mean score of the Ranch Hands in the high category (p=0.071). The unadjusted mean hypomania scores for the background, unknown, low, and high categories were 21.9, 22.4, 22.4, and 18.3.

The adjusted analysis detected a significant interaction between categorized current dioxin and race (Table 9-48 [j]: p=0.004). To examine this interaction, the participants were

stratified by race and analyzed separately. For the Black stratum, the test for overall differences among the four mean hypomania scores was significant (Appendix Table H-1: p=0.013). The adjusted mean hypomania scores for the Black stratum were 24.0, 42.1, 16.7, and 54.3 for the background, unknown, low, and high current dioxin categories. The mean score of the unknown category was marginally higher than the mean score of the background category (p=0.063) and the mean score of the high category was significantly higher than that of the background category (p=0.015).

The adjusted analysis of the non-Black stratum did not detect a significant overall difference among the mean hypomania scores of the four current dioxin categories (Appendix Table H-1: p=0.125). However, the mean hypomania score of the high current dioxin category was significantly lower than the mean score of the background category (p=0.039). The adjusted mean hypomania scores for the background, unknown, low, and high current dioxin categories of the non-Black stratum were 21.7, 21.6, 23.3, and 17.5.

Dysthymia Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

In the unadjusted analysis of the MCMI dysthymia score, there was not a significant association with initial dioxin for the minimal assumption (Table 9-49 [a]: p=0.184). Based on the maximal assumption, there was a significant positive association between initial dioxin and the dysthymia score (Table 9-49 [b]: p=0.031). The unadjusted mean dysthymia scores for the low, medium, and high initial dioxin categories of the maximal cohort were 48.0, 48.8, and 51.6.

The adjusted analysis of the dysthymia score detected significant initial dioxin-by-race interactions for both the minimal and maximal cohorts (Table 9-49 [c] and [d]: p=0.002 and p=0.008). Separate analyses were performed for Black and non-Black participants (Appendix Table H-1). The stratified analysis of the minimal cohort displayed a significant negative association between the dysthymia score and initial dioxin in the Black stratum (p=0.006) and a marginally significant positive association for the non-Black stratum (p=0.061). The adjusted mean dysthymia scores for the Black stratum were nearly the same for the low and medium initial dioxin categories and decreased for the high category (low, 55.2; medium, 52.1; high, 21.3). In contrast, the adjusted mean dysthymia scores for the non-Black stratum were again nearly the same for the low and medium categories but increased for the high category (low, 49.8; medium, 49.3; high, 52.9).

Similarly, for the maximal assumption, there was a significant negative association between initial dioxin and the dysthymia score for the Black stratum (Appendix Table H-1: p=0.024) and a significant positive association for the non-Black stratum (p=0.010). The adjusted mean dysthymia scores for the low, medium, and high initial dioxin categoires of the Black stratum were 45.0, 55.3, and 34.9. The corresponding mean scores for the non-Black stratum were 48.0, 48.3, and 52.3.

TABLE 9-49.

Analysis of Dysthymia Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal (n=514) (R^2=0.003)	Low	129	50.3	1.052 (0.791)	0.184
	Medium	256	49.5		
	High	129	52.1		
b) Maximal (n=732) (R^2=0.006)	Low	182	48.0	1.293 (0.597)	0.031
	Medium	368	48.8		
	High	182	51.6		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value	Covariate Remarks
c) Minimal (n=514) (R^2=0.022)	Low	129	****	****	****	INIT*RACE (p=0.002)
	Medium	256	****			
	High	129	****			
d) Maximal (n=732) (R^2=0.016)	Low	182	****	****	****	INIT*RACE (p=0.008)
	Medium	368	****			
	High	182	****			

[a]Slope and standard error based on dysthymia score versus log_2 dioxin.

****Log_2 (initial dioxin)-by-covariate interaction ($p \leq 0.01$); adjusted mean, adjusted slope, standard error, and p-value not presented.

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

TABLE 9-49. (Continued)

Analysis of Dysthymia Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal						0.576[b]
(n=514)	≤18.6	49.3	49.5	48.5	0.328 (1.290)	0.799[c]
(R^2=0.005)		(72)	(128)	(53)		
	>18.6	50.7	50.5	53.5	1.262 (1.058)	0.233[c]
		(56)	(129)	(76)		
f) Maximal						0.616[b]
(n=732)	≤18.6	48.0	47.5	50.7	0.886 (0.927)	0.340[c]
(R^2=0.008)		(105)	(190)	(82)		
	>18.6	47.3	50.7	52.1	1.507 (0.820)	0.067[c]
		(78)	(175)	(102)		

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal						0.576[b]	- -
(n=514)	≤18.6	49.3	49.5	48.5	0.328 (1.290)	0.799[c]	
(R^2=0.005)		(72)	(128)	(53)			
	>18.6	50.7	50.5	53.5	1.262 (1.058)	0.233[c]	
		(56)	(129)	(76)			
h) Maximal						0.616[b]	- -
(n=732)	≤18.6	48.0	47.5	50.7	0.886 (0.927)	0.340[c]	
(R^2=0.008)		(105)	(190)	(82)			
	>18.6	47.3	50.7	52.1	1.507 (0.820)	0.067[c]	
		(78)	(175)	(102)			

[a]Slope and standard error based on dysthymia score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-49. (Continued)

Analysis of Dysthymia Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	49.7	All Categories		0.159
Unknown	340	47.1	Unknown vs. Background	-2.5 (-5.4,0.3)	0.078
Low	194	49.4	Low vs. Background	-0.3 (-3.8,3.2)	0.886
High	184	51.5	High vs. Background	1.8 (-1.8,5.4)	0.329
Total	1,499		(R^2=0.003)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	776	49.4**	All Categories		0.450**	DXCAT*RACE (p=0.042)
						ALC (p=0.144)
Unknown	336	47.5**	Unknown vs. Background	-1.9 (-4.8,1.0)**	0.191**	EDUC (p=0.031)
Low	190	48.7**	Low vs. Background	-0.7 (-4.2,2.8)**	0.699**	
High	183	50.5**	High vs. Background	1.1 (-2.5,4.8)**	0.535**	
Total	1,485		(R^2=0.013)			

**Categorized current dioxin-by-covariate interaction ($0.01<p\leq0.05$); adjusted mean, confidence interval, and p-value derived from a model fitted after deletion of this interaction.

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

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

Under the minimal assumption, the unadjusted analysis of the MCMI dysthymia score contained a nonsignificant interaction between current dioxin and time since tour (Table 9-49 [e]: p=0.576). Under the maximal assumption, the unadjusted analysis also displayed a nonsignificant current dioxin-by-time interaction (Table 9-49 [f]: p=0.616). However, for Ranch Hands in the time greater than 18.6 years stratum of the maximal cohort, there was a marginally significant positive association between current dioxin and the dysthymia score (p=0.067). For this time strata, the unadjusted mean dysthymia scores for low, medium, and high current dioxin were 47.3, 50.7, and 52.1.

None of the candidate covariates was retained in the adjusted model for either the minimal or the maximal cohort; thus, the adjusted results (Table 9-49 [g] and [h]) are identical to the unadjusted results.

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

The unadjusted analysis of categorized current dioxin did not detect an overall significant difference among the mean dysthymia scores of the four current dioxin categories (Table 9-49 [i]: p=0.159). However, there was a marginally significant difference between the mean score of the Comparisons in the background category and the mean score of the Ranch Hands in the unknown category (p=0.078). The unadjusted mean dysthymia scores for the background, unknown, low, and high current dioxin categories were 49.7, 47.1, 49.4, and 51.5.

In the adjusted analysis, there was a significant interaction between categorized current dioxin and race (Table 9-49 [j]: p=0.042). After stratifying the participants by race, the adjusted analysis displayed a marginally significant overall difference among the mean dysthymia scores for the Black stratum (Appendix Table H-1: p=0.097). Specifically, the mean score of the Ranch Hands in the high category was marginally lower than the mean score of the Comparisons in the background category (p=0.085). In the non-Black stratum, the analysis did not detect a significant difference among the mean dysthymia scores of the four current dioxin categories (p=0.211). In the Black stratum, the mean score for the high current dioxin category was much lower than the mean scores of the other three categories (background, 48.1; unknown, 55.2; low, 56.8; high, 33.4). Contrastingly, for the non-Black stratum, the mean score of the high category was higher than the mean scores of the other three categories (background, 49.7; unknown, 47.4; low, 48.4; high, 51.5).

After deletion of the categorized current dioxin-by-race interaction from the model, no significant differences were found among the mean dysthymia scores of the four current dioxin categories (Table 9-49 [j]: p=0.450).

Alcohol Abuse Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

In the unadjusted analysis of the MCMI alcohol abuse score, there was no significant association with initial dioxin under either the minimal or the maximal assumption (Table 9-50 [a] and [b]: p=0.781 and p=0.588).

The adjusted analysis also exhibited nonsignificant associations between initial dioxin and the alcohol abuse score for both the minimal and maximal cohorts (Table 9-50 [c] and [d]: p=0.921 and p=0.440, respectively).

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

In both the unadjusted and adjusted minimal and maximal analyses, the current dioxin-by-time since tour interactions and the associations between current dioxin and the MCMI alcohol abuse score within each time stratum were nonsignificant (Table 9-50 [e-h]: p>0.15 for each analysis).

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

The unadjusted analysis did not detect a significant difference among the mean alcohol abuse scores of the four current dioxin categories (Table 9-50 [i]: p=0.898).

The adjusted analysis displayed a significant interaction between categorized current dioxin and race (Table 9-50 [j]: p=0.004). To examine this interaction, the participants were stratified by race and analyzed separately (Appendix Table H-1). In the Black stratum, there was a significant difference among the mean alcohol abuse scores of the four current dioxin categories (Appendix Table H-1: p=0.010). Specifically, the mean scores of the unknown and high current dioxin categories were significantly higher than the mean score of the background category (p=0.008 and p=0.012, respectively). The mean alcohol abuse score of the background category was the lowest of the four categories (background, 30.1; unknown, 44.2; low, 36.7; high, 45.9).

In the non-Black stratum, the mean alcohol abuse scores of the four current dioxin categories were not significantly different (p=0.458). In this stratum, the mean score of the background category was the highest of the four categories (background, 31.4; unknown, 30.5; low, 30.5; high, 29.4).

Drug Abuse Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

In both the unadjusted and the adjusted minimal and maximal analyses, the associations between initial dioxin and the MCMI drug abuse score were nonsignificant (Table 9-51 [a-d]: p>0.35).

TABLE 9-50.

Analysis of Alcohol Abuse Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal (n=514) (R^2<0.001)	Low	129	31.1	0.171 (0.615)	0.781
	Medium	256	30.6		
	High	129	31.6		
b) Maximal (n=732) (R^2<0.001)	Low	182	30.5	0.244 (0.451)	0.588
	Medium	368	30.6		
	High	182	31.6		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal (n=510) (R^2=0.036)	Low	128	35.2	-0.061 (0.615)	0.921	RACE (p=0.002) EDUC (p=0.005)
	Medium	254	34.3			
	High	128	35.2			
d) Maximal (n=727) (R^2=0.045)	Low	181	36.8	-0.357 (0.461)	0.440	RACE (p<0.001) EDUC (p<0.001)
	Medium	365	35.0			
	High	181	35.3			

[a]Slope and standard error based on alcohol abuse score versus log_2 dioxin.

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

TABLE 9-50. (Continued)

Analysis of Alcohol Abuse (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal						0.325[b]
(n=514)	≤18.6	32.5 (72)	30.2 (128)	29.8 (53)	-0.668 (1.003)	0.506[c]
(R^2=0.002)	>18.6	29.4 (56)	31.0 (129)	33.1 (76)	0.609 (0.822)	0.459[c]
f) Maximal						0.384[b]
(n=732)	≤18.6	30.8 (105)	30.8 (190)	29.8 (82)	-0.230 (0.700)	0.742[c]
(R^2=0.002)	>18.6	29.0 (78)	31.5 (175)	32.0 (102)	0.583 (0.619)	0.347[c]

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal						0.455[b]	RACE (p=0.002)
(n=510)	≤18.6	36.4 (71)	33.8 (127)	33.7 (53)	-0.727 (0.992)	0.464[c]	EDUC (p=0.004)
(R^2=0.037)	>18.6	33.5 (56)	34.5 (128)	36.3 (75)	0.228 (0.819)	0.781[c]	
h) Maximal						0.384[b]	AGE (p=0.146)
(n=727)	≤18.6	36.4 (105)	35.0 (187)	32.9 (82)	-1.011 (0.714)	0.157[c]	RACE (p<0.001)
(R^2=0.049)							EDUC (p<0.001)
	>18.6	35.0 (78)	36.0 (174)	34.6 (101)	-0.213 (0.630)	0.736[c]	

[a]Slope and standard error based on alcohol abuse score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-50. (Continued)

Analysis of Alcohol Abuse Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	31.3	All Categories		0.898
Unknown	340	30.5	Unknown vs. Background	-0.8 (-3.0,1.3)	0.443
Low	194	31.0	Low vs. Background	-0.3 (-2.9,2.3)	0.810
High	184	31.0	High vs. Background	-0.3 (-3.0,2.4)	0.811
Total	1,499		(R^2<0.001)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	776	****	All Categories		****	DXCAT*RACE (p=0.004) EDUC (p<0.001)
Unknown	338	****	Unknown vs. Background	****	****	
Low	192	****	Low vs. Background	****	****	
High	183	****	High vs. Background	****	****	
Total	1,489		(R^2=0.023)			

****Categorized current dioxin-by-covariate interaction ($p \leq 0.01$); adjusted mean, confidence interval, and p-value not presented.

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

TABLE 9-51.

Analysis of Drug Abuse Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal (n=514) (R^2<0.001)	Low	129	46.4	-0.501 (0.734)	0.495
	Medium	256	49.4		
	High	129	46.0		
b) Maximal (n=732) (R^2<0.001)	Low	182	45.6	0.151 (0.549)	0.783
	Medium	368	48.1		
	High	182	47.2		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal (n=509) (R^2=0.045)	Low	129	51.7	-0.670 (0.752)	0.373	AGE (p=0.080) RACE (p=0.001) DRKYR (p=0.003)
	Medium	252	54.9			
	High	128	51.4			
d) Maximal (n=724) (R^2=0.044)	Low	180	51.7	-0.220 (0.555)	0.692	AGE (p=0.011) RACE (p<0.001) DRKYR (p<0.001)
	Medium	365	53.6			
	High	179	51.9			

[a]Slope and standard error based on drug abuse score versus log_2 dioxin.

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

TABLE 9-51. (Continued)

Analysis of Drug Abuse Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal (n=514) (R^2=0.012)	≤18.6	48.2 (72)	50.9 (128)	49.0 (53)	0.963 (1.191)	0.247[b] 0.419[c]
	>18.6	45.4 (56)	47.4 (129)	43.9 (76)	-0.823 (0.976)	0.399[c]
f) Maximal (n=732) (R^2=0.009)	≤18.6	45.9 (105)	49.6 (190)	50.3 (82)	1.274 (0.850)	0.204[b] 0.134[c]
	>18.6	42.9 (78)	47.3 (175)	45.1 (102)	-0.169 (0.752)	0.822[c]

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal (n=509) (R^2=0.053)	≤18.6	53.8 (72)	57.0 (127)	55.7 (53)	1.261 (1.176)	0.223[b] 0.284[c]	RACE (p<0.001) DRKYR (p=0.003)
	>18.6	49.9 (56)	52.9 (126)	50.0 (75)	-0.590 (0.965)	0.541[c]	
h) Maximal (n=724) (R^2=0.051)	≤18.6	51.9 (104)	55.1 (189)	55.4 (81)	0.963 (0.854)	0.160[b] 0.260[c]	AGE (p=0.040) RACE (p<0.001) DRKYR (p<0.001)
	>18.6	50.1 (77)	52.8 (173)	49.7 (100)	-0.607 (0.758)	0.424[c]	

[a]Slope and standard error based on drug abuse score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-51. (Continued)

Analysis of Drug Abuse Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	48.2	All Categories		0.746
Unknown	340	47.2	Unknown vs. Background	-1.0 (-3.5,1.5)	0.429
Low	194	48.9	Low vs. Background	0.7 (-2.4,3.8)	0.659
High	184	47.4	High vs. Background	-0.8 (-4.0,2.4)	0.619
Total	1,499		(R^2=0.001)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	780	51.7	All Categories		0.769	AGE (p=0.023)
Unknown	337	51.3	Unknown vs. Background	-0.4 (-2.9,2.1)	0.761	RACE (p<0.001)
Low	192	52.6	Low vs. Background	0.9 (-2.1,4.0)	0.552	DRKYR (p<0.001)
High	181	50.5	High vs. Background	-1.1 (-4.3,2.1)	0.486	
Total	1,490		(R^2=0.023)			

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

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

The unadjusted analysis of the MCMI drug abuse score did not detect a significant current dioxin-by-time since tour interaction in either the minimal or the maximal analysis (Table 9-51 [e] and [f]: p=0.247 and p=0.204). The association between current dioxin and the drug abuse score was also nonsignificant within each time stratum under both minimal and maximal assumptions.

The adjustment for covariate information did not change the lack of significance of the unadjusted results (Table 9-51 [g] and [h]: p>0.15 for each analysis).

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

Neither the unadjusted nor the adjusted analysis of categorized current dioxin detected a significant difference among the mean drug abuse scores of the four current dioxin categories (Table 9-51 [i] and [j]: p=0.746 and p=0.769, respectively).

Psychotic Thinking Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

In the unadjusted analysis of the MCMI psychotic thinking score, there were significant positive associations with initial dioxin under both the minimal and the maximal assumptions (Table 9-52 [a] and [b]: p<0.001 for both analyses). Based on the minimal assumption, the mean psychotic thinking scores for Ranch Hands in the low, medium, and high initial dioxin categories were 28.1, 32.9, and 36.5. The corresponding means under the maximal assumption were 30.6, 30.3, and 36.1, respectively.

The adjusted analysis also found significant positive associations between initial dioxin and the MCMI psychotic thinking score for both the minimal and the maximal cohorts (Table 9-52 [c] and [d]: p=0.001 and p=0.021).

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

The unadjusted analysis of the psychotic thinking score detected marginally significant interactions between current dioxin and time since tour under both the minimal and the maximal assumptions (Table 9-52 [e] and [f]: p=0.059 and p=0.083). Also, under both assumptions, there were significant positive associations between current dioxin and the psychotic thinking score for Ranch Hands with more than 18.6 years since the end of their tour (Table 9-52 [e] and [f]: p<0.001 for both analyses). The mean psychotic thinking scores of Ranch Hands having greater than 18.6 years since tour for low, medium, and high current dioxin were 25.6, 32.5, and 38.5 under the minimal assumption and 27.6, 30.4, and 37.4, respectively, under the maximal assumption.

The adjustment for race and education had very little effect on the results of the analysis of the psychotic thinking score with current dioxin and time since tour. Under both the minimal and the maximal assumptions, there were marginally significant current dioxin-by-time since tour interactions (Table 9-52 [g] and [h]: p=0.074 and p=0.057). Also, for Ranch

TABLE 9-52.

Analysis of Psychotic Thinking Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal (n=514) (R^2=0.030)	Low	129	28.1	2.866 (0.725)	<0.001
	Medium	256	32.9		
	High	129	36.5		
b) Maximal (n=732) (R^2=0.022)	Low	182	30.6	2.147 (0.534)	<0.001
	Medium	368	30.3		
	High	182	36.1		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal (n=510) (R^2=0.096)	Low	128	30.4	2.343 (0.716)	0.001	RACE (p=0.094) EDUC (p<0.001)
	Medium	254	33.9			
	High	128	37.4			
d) Maximal (n=727) (R^2=0.072)	Low	181	36.1	1.266 (0.545)	0.021	RACE (p=0.033) EDUC (p<0.001)
	Medium	365	32.9			
	High	181	37.5			

[a]Slope and standard error based on psychotic thinking score versus log_2 dioxin.

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

TABLE 9-52. (Continued)

Analysis of Psychotic Thinking Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal						0.059[b]
(n=514)	≤18.6	29.6	33.9	32.8	1.324 (1.178)	0.262[c]
(R^2=0.038)		(72)	(128)	(53)		
	>18.6	25.6	32.5	38.5	4.209 (0.966)	<0.001[c]
		(56)	(129)	(76)		
f) Maximal						0.083[b]
(n=732)	≤18.6	29.4	31.5	35.9	1.262 (0.826)	0.127[c]
(R^2=0.028)		(105)	(109)	(82)		
	>18.6	27.6	30.4	37.4	3.179 (0.731)	<0.001[c]
		(78)	(175)	(102)		

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal						0.074[b]	RACE (p=0.100)
(n=510)	≤18.6	31.4	35.0	33.7	0.933 (1.151)	0.418[c]	EDUC (p<0.001)
(R^2=0.103)		(71)	(127)	(53)			
	>18.6	28.3	33.2	39.1	3.586 (0.950)	<0.001[c]	
		(56)	(128)	(75)			
h) Maximal						0.057[b]	RACE (p=0.035)
(n=727)	≤18.6	34.4	33.9	37.4	0.307 (0.828)	0.711[c]	EDUC (p<0.001)
(R^2=0.079)		(105)	(187)	(82)			
	>18.6	32.2	33.0	38.4	2.363 (0.729)	0.001[c]	
		(78)	(174)	(101)			

[a]Slope and standard error based on psychotic thinking score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-52. (Continued)

Analysis of Psychotic Thinking Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	32.6	All Categories		0.004
Unknown	340	30.1	Unknown vs. Background	-2.5 (-5.0,0.0)	0.053
Low	194	31.9	Low vs. Background	-0.7 (-3.9,2.4)	0.643
High	184	36.7	High vs. Background	4.1 (0.9,7.3)	0.012
Total	1,499		(R^2=0.009)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	775	34.4	All Categories		0.215	AGE (p=0.106)
Unknown	335	32.8	Unknown vs. Background	-1.6 (-4.1,1.0)	0.223	RACE (p=0.106)
Low	190	33.1	Low vs. Background	-1.3 (-4.5,1.8)	0.400	DRKYR (p=0.004)
High	180	36.4	High vs. Background	2.0 (-1.2,5.3)	0.220	EDUC (p<0.001)
Total	1,480		(R^2=0.045)			

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

Hands with greater than 18.6 years since the end of their tour, there were significant positive associations between current dioxin and the psychotic thinking score for both the minimal and maximal cohorts (Table 9-52 [g] and [h]: $p<0.001$ and $p=0.001$).

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

In the unadjusted analysis of the MCMI psychotic thinking score with Ranch Hands and Comparisons by current dioxin category, the contrast of the four current dioxin categories was significant (Table 9-52 [i]: $p=0.004$). The unadjusted mean psychotic thinking scores for the background, unknown, low, and high current dioxin categories were 32.6, 30.1, 31.9, and 36.7. The contrast of the mean psychotic thinking scores of the unknown category versus the background category was marginally significant ($p=0.053$). Also, the difference between the mean psychotic thinking scores of the high category and the background category was significant ($p=0.012$).

After adjusting for age, race, lifetime alcohol history, and education, there was no significant difference detected among the mean psychotic thinking scores of the four current dioxin categories (Table 9-52 [j]: $p=0.215$).

Psychotic Depression Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

The unadjusted analysis of the MCMI psychotic depression score detected significant positive associations with initial dioxin under both the minimal and maximal assumptions (Table 9-53 [a] and [b]: $p=0.005$ and $p<0.001$). The unadjusted mean psychotic depression scores for the minimal cohort were 22.4, 23.4, and 26.7 for the low, medium, and high initial dioxin categories. The corresponding means for the maximal cohort were 22.0, 22.1, and 26.5.

The minimal adjusted analysis also displayed a significant positive association between the psychotic depression score and initial dioxin (Table 9-53 [c]: $p=0.035$). After adjusting for race, lifetime alcohol history, and education, the maximal analysis detected only a marginally significant positive relationship between initial dioxin and the MCMI psychotic depression score (Table 9-53 [d]: $p=0.081$).

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

In the unadjusted analysis of the psychotic depression score with current dioxin and time since tour, the current dioxin-by-time interaction was not significant for either the minimal or the maximal cohort (Table 9-53 [e] and [f]: $p=0.262$ and $p=0.195$). However, there were significant positive associations between current dioxin and the psychotic depression score for Ranch Hands with more than 18.6 years since tour under both the minimal and maximal assumptions (Table 9-53 [e] and [f]: $p=0.006$ and $p<0.001$). In the minimal cohort, the mean psychotic depression scores for Ranch Hands with early tours for low, medium, and high current dioxin were 21.8, 23.6, and 28.0. Under the maximal assumption, the mean psychotic depression scores also became larger with increasing current dioxin levels for this time stratum (low, 19.1; medium, 22.9; high, 27.1).

TABLE 9-53.
Analysis of Psychotic Depression Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal (n=514) (R^2=0.016)	Low	129	22.4	2.122 (0.746)	0.005
	Medium	256	23.4		
	High	129	26.7		
b) Maximal (n=732) (R^2=0.016)	Low	182	22.0	1.842 (0.537)	<0.001
	Medium	368	22.1		
	High	182	26.5		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal (n=505) (R^2=0.082)	Low	128	24.7	1.567 (0.741)	0.035	RACE (p=0.114)
	Medium	250	24.6			ALC (p=0.125)
	High	127	27.6			DRKYR (p=0.020)
						EDUC (p<0.001)
d) Maximal (n=719) (R^2=0.070)	Low	179	27.3	0.963 (0.551)	0.081	RACE (p=0.040)
	Medium	362	24.6			DRKYR (p=0.007)
	High	178	27.9			EDUC (p<0.001)

[a]Slope and standard error based on psychotic depression score versus log_2 dioxin.

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

TABLE 9-53. (Continued)

Analysis of Psychotic Depression Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal						0.262[b]
(n=514)	≤18.6	22.5	23.3	25.2	0.988 (1.217)	0.417[c]
(R^2=0.017)		(72)	(128)	(53)		
	>18.6	21.8	23.6	28.0	2.755 (0.997)	0.006[c]
		(56)	(129)	(76)		
f) Maximal						0.195[b]
(n=732)	≤18.6	20.7	23.4	24.9	1.128 (0.833)	0.176[c]
(R^2=0.019)		(105)	(190)	(82)		
	>18.6	19.1	22.9	27.1	2.571 (0.737)	<0.001[c]
		(78)	(175)	(102)		

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal						0.352[b]	RACE (p=0.127)
(n=505)	≤18.6	24.8	24.7	26.5	0.670 (1.192)	0.574[c]	ALC (p=0.124)
(R^2=0.083)		(71)	(126)	(53)			DRKYR (p=0.018)
	>18.6	23.8	24.5	28.6	2.101 (0.986)	0.034[c]	EDUC (p<0.001)
		(56)	(125)	(74)			
h) Maximal						0.180[b]	RACE (p=0.042)
(n=719)	≤18.6	25.6	26.0	27.0	0.303 (0.837)	0.717[c]	DRKYR (p=0.005)
(R^2=0.074)		(104)	(186)	(81)			EDUC (p<0.001)
	>18.6	23.2	25.3	27.5	1.769 (0.737)	0.017[c]	
		(77)	(172)	(99)			

[a]Slope and standard error based on psychotic depression versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-53. (Continued)

Analysis of Psychotic Depression Score (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	23.6	All Categories		0.070
Unknown	340	21.4	Unknown vs. Background	-2.2 (-4.7,0.3)	0.091
Low	194	22.8	Low vs. Background	-0.8 (-3.9,2.4)	0.633
High	184	26.1	High vs. Background	2.6 (-0.7,5.8)	0.119
Total	1,499		(R^2=0.005)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	775	23.5	All Categories		0.475	DRKYR (p=0.002)
						AGE*RACE (p=0.042)
Unknown	335	22.1	Unknown vs. Background	-1.4 (-4.0,1.1)	0.274	ALC*EDUC (p=0.033)
Low	190	22.5	Low vs. Background	-1.0 (-4.1,2.2)	0.543	
High	180	24.8	High vs. Background	1.3 (-2.0,4.5)	0.450	
Total	1,480		(R^2=0.040)			

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

The adjusted analysis also did not detect a significant interaction between current dioxin and the MCMI psychotic depression score under either assumption (Table 9-53 [e] and [f]: p=0.352 and p=0.180). Similar to the unadjusted results, the adjusted analysis displayed significant positive associations between current dioxin and the psychotic depression score for Ranch Hands with greater than 18.6 years since tour under both the minimal and maximal assumptions (Table 9-53 [g] and [h]: p=0.034 and p=0.017).

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

In the unadjusted analysis of the MCMI psychotic depression score, the overall contrast of the four current dioxin categories was marginally significant (Table 9-53 [i]: p=0.070). The mean psychotic depression scores for the background, unknown, low, and high current dioxin categories were 23.6, 21.4, 22.8, and 26.1. The contrast of Ranch Hands in the unknown current dioxin category versus Comparisons in the background category was marginally significant (p=0.091) with the Ranch Hands having a lower mean psychotic depression score.

After adjusting for lifetime alcohol history, an age-by-race interaction, and a current alcohol use-by-education interaction, the analysis did not detect a significant overall difference among the mean MCMI psychotic depression scores of the four current dioxin categories (Table 9-53 [j]: p=0.475).

Psychotic Delusion Score—MCMI

Model 1: Ranch Hands - Log_2 (Initial Dioxin)

Based on the minimal assumption, the unadjusted analysis displayed a nonsignificant association between initial dioxin and the MCMI psychotic delusion score (Table 9-54 [a]: p=0.141). However, under the maximal assumption, there was a marginally significant positive relationship between initial dioxin and the psychotic delusion score (Table 9-54 [b]: p=0.065). The mean psychotic delusion scores became larger for increasing levels of current dioxin (low, 42.3; medium, 43.9; high, 46.0).

The minimal analysis of the psychotic delusion score remained nonsignificant after adjustment for covariate information (Table 9-54 [c]: p=0.282). After the adjustment for race, education, and an age-by-lifetime alcohol history interaction, the association between initial dioxin and the psychotic delusion score was also nonsignificant under the maximal assumption (Table 9-54 [d]: p=0.368).

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

The unadjusted analysis of the psychotic delusion score with current dioxin and time since tour did not detect a significant current dioxin-by-time interaction for either the minimal or the maximal cohort (Table 9-54 [e] and [f]: p=0.218 and p=0.271). For Ranch Hands with greater than 18.6 years since tour, there were significant positive associations between current dioxin and the psychotic delusion score under both the minimal and maximal assumptions (Table 9-54 [e] and [f]: p=0.041 and p=0.020). In the minimal cohort, the mean psychotic delusion scores for Ranch Hands with more than 18.6 years since the end of their

TABLE 9-54.

Analysis of Psychotic Delusion Score (MCMI)

Ranch Hands - Log_2 (Initial Dioxin) - Unadjusted

Assumption	Initial Dioxin	n	Mean	Slope (Std. Error)[a]	p-Value
a) Minimal	Low	129	41.9	1.050 (0.713)	0.141
(n=514)	Medium	256	45.3		
(R^2=0.004)	High	129	45.8		
b) Maximal	Low	182	42.3	0.982 (0.531)	0.065
(n=732)	Medium	368	43.9		
(R^2=0.005)	High	182	46.0		

Ranch Hands - Log_2 (Initial Dioxin) - Adjusted

Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
c) Minimal	Low	128	41.8	0.774 (0.718)	0.282	ALC (p=0.062)
(n=508)	Medium	252	44.8			EDUC (p=0.002)
(R^2=0.029)	High	128	44.9			
d) Maximal	Low	179	46.2	0.508 (0.564)	0.368	RACE (p=0.085)
(n=719)	Medium	362	46.1			EDUC (p<0.001)
(R^2=0.039)	High	178	47.8			AGE*DRKYR (p=0.012)

[a]Slope and standard error based psychotic delusion score versus log_2 dioxin.

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

TABLE 9-54. (Continued)

Analysis of Psychotic Delusion Score (MCMI)

Ranch Hands - Log_2 (Current Dioxin) and Time - Unadjusted

Assumption	Time (Yrs.)	Mean/(n) Current Dioxin Low	Medium	High	Slope (Std. Error)[a]	p-Value
e) Minimal						0.218[b]
(n=514)	≤18.6	44.4	45.3	45.3	0.096 (1.161)	0.934[c]
(R^2=0.009)		(72)	(128)	(53)		
	>18.6	38.8	45.2	46.3	1.947 (0.952)	0.041[c]
		(56)	(129)	(76)		
f) Maximal						0.271[b]
(n=732)	≤18.6	43.3	44.7	45.6	0.487 (0.823)	0.554[c]
(R^2=0.009)		(105)	(190)	(82)		
	>18.6	40.7	43.2	46.1	1.698 (0.728)	0.020[c]
		(78)	(175)	(102)		

Ranch Hands - Log_2 (Current Dioxin) and Time - Adjusted

Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin Low	Medium	High	Adj. Slope (Std. Error)[a]	p-Value	Covariate Remarks
g) Minimal						0.267[b]	ALC (p=0.066)
(n=508)	≤18.6	44.2	44.5	44.3	-0.127 (1.156)	0.912[c]	EDUC (p=0.002)
(R^2=0.032)		(71)	(127)	(53)			
	>18.6	39.0	44.9	45.5	1.531 (0.957)	0.110[c]	
		(56)	(126)	(75)			
h) Maximal						0.180[b]	RACE (p=0.086)
(n=719)	≤18.6	46.9	46.6	46.9	-0.153 (0.855)	0.858[c]	EDUC (p<0.001)
(R^2=0.042)		(104)	(186)	(81)			AGE*DRKYR (p=0.012)
	>18.6	43.8	46.1	47.9	1.320 (0.756)	0.081[c]	
		(77)	(172)	(99)			

[a]Slope and standard error based on psychotic delusion score versus log_2 dioxin.

[b]Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

[c]Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

Note: Minimal--Low: >10-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt.
Maximal--Low: >5-9.01 ppt; Medium: >9.01-33.3 ppt; High: >33.3 ppt.

TABLE 9-54. (Continued)

Analysis of Psychotic Delusion (MCMI)

i) Ranch Hands and Comparisons by Current Dioxin Category - Unadjusted

Current Dioxin Category	n	Mean	Contrast	Difference of Means (95% C.I.)	p-Value
Background	781	42.1	All Categories		0.076
Unknown	340	43.1	Unknown vs. Background	0.9 (-1.7,3.5)	0.497
Low	194	45.1	Low vs. Background	3.0 (-0.3,6.2)	0.073
High	184	45.9	High vs. Background	3.7 (0.4,7.0)	0.026
Total	1,499		(R^2=0.005)		

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

Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.)	p-Value	Covariate Remarks
Background	775	44.2	All Categories		0.213	RACE (p=0.062)
Unknown	335	46.1	Unknown vs. Background	1.8 (-0.8,4.5)	0.166	AGE*ALC (p=0.004)
Low	190	46.7	Low vs. Background	2.5 (-0.7,5.7)	0.125	AGE*DRKYR (p=0.030)
High	180	46.7	High vs. Background	2.5 (-0.8,5.8)	0.144	ALC*DRKYR (p=0.036)
Total	1,480		(R^2=0.045)			ALC*EDUC (p=0.010)

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

tour were 38.8, 45.2, and 46.3 for low, medium, and high current dioxin. The corresponding mean psychotic delusion scores for the same time stratum of the maximal cohort were 40.7, 43.2, and 46.1, respectively.

After adjusting the minimal analysis for current alcohol use and education, the interaction between current dioxin and time since tour remained nonsignificant (Table 9-54 [g]: p=0.267). Under the maximal assumption the current dioxin-by-time interaction was also nonsignificant (Table 9-54 [h]: p=0.180), but for Ranch Hands with more than 18.6 years since the end of their tour, there was a marginally significant positive association between current dioxin and the psychotic delusion score (p=0.081).

Model 3: Ranch Hands and Comparisons by Current Dioxin Category

In the unadjusted analysis of the psychotic delusion score, the contrast of the four current dioxin categories was marginally significant (Table 9-54 [i]: p=0.076). The mean psychotic delusion scores for the background, unknown, low, and high current dioxin categories were 42.1, 43.1, 45.1, and 45.9. The contrast of the Ranch Hands in the low category versus the Comparisons in the background category was marginally significant (p=0.073) with the Ranch Hands having a higher mean psychotic delusion score than the Comparisons. Also, the mean psychotic delusion score of the Ranch Hands in the high current dioxin category was significantly higher than the mean score of the Comparisons in the background category (p=0.026).

After adjusting for race and several significant covariate interactions, the analysis of the psychotic delusion score for the four current dioxin categories was not significant (Table 9-54 [j]: p=0.213).

DISCUSSION

Prior to the 1982 Baseline study, little scientifically validated information existed regarding the relationship between dioxin exposure and disturbances of cognition and emotions in man. The Baseline and 1985 examinations attempted to explore these possible relationships using well-established questionnaires, personality inventories, and neuropsychological assessment techniques. These instruments included the Cornell Medical Index (CMI), the MMPI, and the HRB.

In the 1982 Baseline study, the analysis of extensive data generated by the CMI, MMPI, and HRB revealed few statistically significant differences between the Ranch Hand and Comparison groups. More specifically, the two groups did not differ significantly on several tests of cognitive (cerebral) function. The Ranch Hand group reported a moderately greater number of diffuse medical (somatic) complaints on the CMI. They also registered higher (but not statistically significant) scores on the MMPI scales that are influenced most heavily by physical complaints such as generalized feelings of lassitude and malaise, energy loss, and mental and physical slowing.

There were no compelling Ranch Hand-Comparison group test differences observed during the 1985 examination. Nevertheless, the possibility of a relationship between dioxin

exposure and the subsequent development of psychological or psychophysiological disorders could not be entirely ruled out.

To promote maximum compliance among the subjects, the 1987 examination included the SCL-90-R and MCMI evaluations. The SCL-90-R is a 90-item checklist of physical and mental symptoms that provides a reasonable measure of health-related concerns and associated anxiety, depression, and general emotional discomfort. The MCMI provided backup measures of depression, anxiety, somatization, and hypochondriasis for the SCL-90-R, while also screening for personality disorders and major psychiatric syndromes including psychoses. Both the SCL-90-R and the MCMI have been extensively used in research and some clinical settings requiring economical assessment of psychiatric disorders, physical disability status, and response to specific therapies. In addition, verified histories of psychological disorders and self-reported sleep disorders were also included in the 1987 examination.

The unadjusted initial dioxin analyses revealed several statistically significant results for the verified questionnaire, sleep disorder, and SCL-90-R variables. However, when adjusted for effects of covariate factors (i.e., age, education, alcohol use, and race), none of these results remained significant.

After adjustment for covariate factors, 9 of the 20 MCMI scale results remained statistically significant under either the minimal or the maximal assumption (positive: schizoid, avoidant, dependent, schizotypal, somatoform, psychotic thinking, and psychotic depression scores; negative: histrionic and narcissistic scores). Such results suggest the possibility of a relationship between personality disturbances and/or psychotic disorders and extrapolated initial TCDD levels. However, examination of interview data and a review of MCMI test structure indicates that the MCMI results should be interpreted with caution.

The adjusted analyses of the verified questionnaire findings did not display a statistically significant positive relationship with initial dioxin for psychoses of the type observed on the MCMI psychotic thinking scale. Similarly, verified questionnaire data did not exhibit significant adjusted results on measures of anxiety or neuroses of the type that would be anticipated in a population suffering from the high incidence of personality disturbances implied by the MCMI data.

The number of statistically significant MCMI results may have been inflated by test construction intricacies that have been described by Millon (34) and Choca (35). These investigations revealed substantial (50% to 65%) item overlap for the schizoid, avoidant, dependent, schizotypal, psychotic thinking, and psychotic depression scales. These same scales are also positively correlated at levels ranging from 0.56 to 0.94. Difficulties with overlapping components also extend to the histrionic and narcissistic scales which correlate -0.52 on average with the schizoid, avoidant, schizotypal, and psychotic thinking scales.

The remaining statistically significant MCMI scale result was observed on the somatoform scale. This result does not appear to be related to structural factors. According to the MCMI manual (34), the somatoform scale correlates 0.43 with the somatization scale of the SCL-90-R. The absence of statistically significant results on the somatization or

positive symptom total scales of the SCL-90-R is inconsistent with significant MCMI somatoform scale findings.

Adjusted current dioxin and time since tour analyses for the verified questionnaire and sleep disorder variables were generally not significant. Of the SCL-90-R variables, the anxiety scale was positively related to current dioxin for Ranch Hands with time greater than 18.6 years. For these Ranch Hands, marginally significant results were also observed on the somatization scale of the SCL-90-R and the anxiety scale of the MCMI. The MCMI manual (34) reveals that these two scales correlate with the anxiety scale of the SCL-90-R at 0.67 and 0.52, respectively. Internally consistent results of this type suggest the possibility of latent and now emerging anxiety or psychophysiological disorders. However, additional inspection of the verified questionnaire data did not reveal evidence for significant anxiety disorders.

Review of the adjusted analyses of MCMI data revealed multiple statistically significant results. These results appeared predominantly on the scales with high correlations as described above. The possibility that these findings may be related in part to structural test factors is again noted. However, the majority of significant results on scales designed to reflect personality and psychotic disorders are observed primarily for Ranch Hands with tours more than 18.6 years ago. The possibility of emerging latent disorders is suggested, but inspection of verified questionnaire data and SCL-90-R results failed to reveal corroborating evidence of time-related psychoses or neuroses.

A review of the adjusted findings for the categorized current dioxin analyses of questionnaire and SCL-90-R data revealed only one clearly significant result for Ranch Hands in the high current dioxin category. These participants reported frightening dreams. A recent study (36) revealed that frightening dreams has proved to be one of the more consistent clinical indicators manifested in studies of chronic PTSD. However, in the context of the present study, frightening dreams is not likely to represent a significant dose-related sleep abnormality in that all other indicators of sleep disorders failed to meet the criteria required for statistical significance with TCDD exposure.

The adjusted analyses of the MCMI variables revealed only two statistically significant results in the high current dioxin category. These results were obtained on the schizoid and schizotypal scales. Previously discussed factors of test structure and an absence of any corroborating verified questionnaire data combine to reduce the likelihood that these results are associated with a dose-response effect.

In summary, a tri-model approach was employed to scrutinize several complex relationships between dependent psychological variables and objectively determined TCDD levels. This expanded analysis permitted a more sophisticated and empirical approach to the problem of determining to what extent the body burden of dioxin might be associated with psychological and/or psychophysiological disorders. There was a relatively large number of statistically significant results for the MCMI variables. These findings may be spurious associations due to the interrelatedness of the MCMI scales inherent to the test development structure. These results were not corroborated by the verified questionnaire data results and the SCL-90-R variables. Based on these analyses, the incidence of