Table 12-15. Analysis of SCL-90-R Psychoticism (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED

Dioxin Category	n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
Comparison	1,196		
Background RH	374	0.71 (0.47,1.07)	0.104
Low RH	236	0.83 (0.53,1.28)	0.394
High RH	235	0.95 (0.64,1.40)	0.786
Low plus High RH	471	0.88 (0.65,1.21)	0.447

[a] Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED

1987 Dioxin Category Summary Statistics			Analysis Results for Log_2 (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[a]	p-Value
Low	288	24 (8.3)	1.24 (1.08,1.42)	0.002
Medium	287	30 (10.5)		
High	284	50 (17.6)		

[a] Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED

Analysis Results for Log_2 (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
843	1.06 (0.91,1.23)	0.484

[a] Relative risk for a twofold increase in 1987 dioxin.

The Model 2 unadjusted analysis revealed a marginally significant positive association between initial dioxin and SCL-90-R psychoticism scores (Table 12-15(c): p=0.065, Est. RR=1.19). After adjustment for covariates, the association was nonsignificant (Table 12-15(d): p=0.838).

A significant difference in the prevalence of high SCL-90-R psychoticism scores was found in the unadjusted Model 3 analysis between Ranch Hands in the background category (8.7%) and Comparisons (14.5%) (Table 12-15(e): p=0.006, Est. RR=0.58). Results became nonsignificant after covariate adjustment (Table 12-15(f): p=0.104). All other Model 3 contrasts were nonsignificant (Table 12-15(e,f): p>0.23 for all remaining contrasts).

The positive association between the 1987 dioxin levels and the SCL-90-R psychoticism scores was significant in the Model 4 unadjusted analysis (Table 12-15(g): p=0.002, Est. RR=1.24). The result became nonsignificant after covariate adjustment (Table 12-15(h): p=0.484).

12.2.2.2.9 SCL-90-R Somatization

The somatization dimension reflects distress arising from perceptions of bodily dysfunction. Complaints focusing on cardiovascular, gastrointestinal, respiratory, and other systems with strong autonomic mediation are included. Headaches, pain, and discomfort of the gross musculature and additional somatic equivalents of anxiety are components of the definition. These symptoms and signs have all been demonstrated to have high prevalence in disorders demonstrated to have a functional etiology, although all may be reflections of true physical disease. The symptoms comprising the somatization dimension are headaches, faintness or dizziness, pains in heart or chest, pains in lower back, nausea or upset stomach, soreness of muscles, trouble getting breath, hot or cold spells, numbness or tingling in parts of body, lump in throat, weakness in parts of body, and heavy feelings in arms or legs.

All Model 1 unadjusted and adjusted results from the analysis of SCL-90-R somatization were nonsignificant (Table 12-16(a,b): p>0.13 for each contrast).

Table 12-16. Analysis of SCL-90-R Somatization

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

Occupational Category	Group	n	Number (%) High	Est. Relative Risk (95% C.I.)	p-Value
All	***Ranch Hand***	***866***	***143 (16.5)***	***1.03 (0.82,1.30)***	***0.797***
	Comparison	***1,249***	***201 (16.1)***		
Officer	Ranch Hand	341	25 (7.3)	1.00 (0.59,1.71)	0.987
	Comparison	493	36 (7.3)		
Enlisted Flyer	Ranch Hand	150	33 (22.0)	0.73 (0.44,1.21)	0.223
	Comparison	187	52 (27.8)		
Enlisted Groundcrew	Ranch Hand	375	85 (22.7)	1.18 (0.86,1.62)	0.300
	Comparison	569	113 (19.9)		

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	***1.02 (0.80,1.31)***	***0.847***
Officer	1.02 (0.60,1.74)	0.948
Enlisted Flyer	0.67 (0.40,1.13)	0.133
Enlisted Groundcrew	1.22 (0.88,1.70)	0.232

Table 12-16. Analysis of SCL-90-R Somatization (Continued)

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

Initial Dioxin Category Summary Statistics			Analysis Results for Log_2 (Initial Dioxin)[a]	
Initial Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[b]	p-Value
Low	160	34 (21.3)	0.98 (0.83,1.17)	0.840
Medium	161	33 (20.5)		
High	157	31 (19.8)		

[a] Adjusted for percent body fat at the time of the blood measurement of dioxin.
[b] Relative risk for a twofold increase in initial dioxin.

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

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

Analysis Results for Log_2 (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
471	0.76 (0.62,0.94)	0.010

[a] Relative risk for a twofold increase in initial dioxin.

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

Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.)[a,b]	p-Value
Comparison	1,211	194 (16.0)		
Background RH	381	44 (11.6)	0.71 (0.50,1.01)	0.056
Low RH	239	48 (20.1)	1.31 (0.92,1.86)	0.136
High RH	239	50 (20.9)	1.34 (0.95,1.91)	0.098
Low plus High RH	478	98 (20.5)	1.33 (1.01,1.74)	0.042

[a] Relative risk and confidence interval relative to Comparisons.
[b] Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 12-16. Analysis of SCL-90-R Somatization (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED

Dioxin Category	n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
Comparison	1,196		
Background RH	374	0.92 (0.63,1.34)	0.669
Low RH	236	1.36 (0.93,1.97)	0.108
High RH	235	0.92 (0.63,1.33)	0.643
Low plus High RH	471	1.11 (0.84,1.48)	0.457

[a] Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED

1987 Dioxin Category Summary Statistics			Analysis Results for Log_2 (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[a]	p-Value
Low	288	30 (10.4)	1.16 (1.03,1.31)	0.013
Medium	287	51 (17.8)		
High	284	61 (21.5)		

[a] Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED

Analysis Results for Log_2 (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
845	0.95 (0.83,1.09)	0.458

[a] Relative risk for a twofold increase in 1987 dioxin.

The unadjusted analysis of the association between initial dioxin (Model 2) and the prevalence of SCL-90-R somatization showed no significant results (Table 12-16(c): p=0.840). After adjustment for covariates, the association became significant and negative (Table 12-16(d): p=0.010, Adj. RR=0.76). As initial dioxin increased, the prevalence of high somatization scores decreased.

The unadjusted Model 3 analysis revealed a marginally significant difference in the prevalence of high SCL-90-R somatization scores between Ranch Hands in the background dioxin category (11.6%) and Comparisons (16.0%) (Table 12-16(e): p=0.056, Est. RR=0.71). Results were also marginally significant for the Ranch Hands in the high dioxin category contrast, where more Ranch Hands (20.9%) than Comparisons (16.0%) had a high somatization score (Table 12-16(e): p=0.098, Est. RR=1.34). Similarly, results were significant for the low and high dioxin categories combined, where more Ranch Hands

(20.5%) had a high somatization score than did Comparisons (16.0%) (Table 12-16(e): p=0.042, Est. RR=1.33). All contrasts were nonsignificant when adjusted for covariates (Table 12-16(f): p>0.10).

The Model 4 unadjusted analysis revealed a significant positive association between the 1987 dioxin levels and the prevalence of SCL-90-R somatization scores (Table 12-16(g): p=0.013, Est. RR=1.16). The result was nonsignificant after covariate adjustment (Table 12-16(h): p=0.458).

12.2.2.2.10 SCL-90-R Global Severity Index (GSI)

The GSI represents the best single indicator of the current level or depth of the disorder and should be used in most instances where a single summary measure is required. The GSI combines information on numbers of symptoms and intensity of perceived distress.

A marginally significant difference between Ranch Hand and Comparison enlisted flyers was found from the Model 1 unadjusted and adjusted analyses of SCL-90-R GSI (Table 12-17(a,b): p=0.091, Est. RR=0.61; p=0.066, Adj. RR=0.57, respectively). More Comparison enlisted flyers (21.9%) than Ranch Hand enlisted flyers (14.7%) displayed high GSI scores. All other Model 1 contrasts and each Model 2 analysis were nonsignificant (Table 12-17(a–d): p>0.15 for each analysis).

Table 12-17. Analysis of SCL-90-R Global Severity Index (GSI)

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

Occupational Category	Group	n	Number (%) High	Est. Relative Risk (95% C.I.)	p-Value
All	***Ranch Hand***	***866***	***118 (13.6)***	***0.85 (0.67,1.09)***	***0.204***
	Comparison	***1,249***	***195 (15.6)***		
Officer	Ranch Hand	341	23 (6.7)	0.89 (0.52,1.53)	0.676
	Comparison	493	37 (7.5)		
Enlisted Flyer	Ranch Hand	150	22 (14.7)	0.61 (0.35,1.08)	0.091
	Comparison	187	41 (21.9)		
Enlisted Groundcrew	Ranch Hand	375	73 (19.5)	0.93 (0.67,1.29)	0.681
	Comparison	569	117 (20.6)		

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	***0.87 (0.67,1.13)***	***0.285***
Officer	0.93 (0.54,1.61)	0.805
Enlisted Flyer	0.57 (0.32,1.04)	0.066
Enlisted Groundcrew	0.97 (0.70,1.36)	0.876

Table 12-17. Analysis of SCL-90-R Global Severity Index (GSI) (Continued)

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

Initial Dioxin Category Summary Statistics			Analysis Results for Log_2 (Initial Dioxin)[a]	
Initial Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[b]	p-Value
Low	160	23 (14.4)	1.08 (0.90,1.29)	0.415
Medium	161	30 (18.6)		
High	157	29 (18.5)		

[a] Adjusted for percent body fat at the time of the blood measurement of dioxin.
[b] Relative risk for a twofold increase in initial dioxin.

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

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

	Analysis Results for Log_2 (Initial Dioxin)	
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
471	0.86 (0.69,1.06)	0.157

[a] Relative risk for a twofold increase in initial dioxin.

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

Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.)[ab]	p-Value
Comparison	1,211	185 (15.3)		
Background RH	381	35 (9.2)	0.59 (0.40,0.87)	0.007
Low RH	239	35 (14.6)	0.94 (0.63,1.39)	0.754
High RH	239	47 (19.7)	1.30 (0.91,1.86)	0.153
Low plus High RH	478	82 (17.2)	1.10 (0.83,1.47)	0.500

[a] Relative risk and confidence interval relative to Comparisons.
[b] Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 12-17. Analysis of SCL-90-R Global Severity Index (GSI) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED

Dioxin Category	n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
Comparison	1,196		
Background RH	374	0.77 (0.51,1.15)	0.200
Low RH	236	1.03 (0.69,1.55)	0.877
High RH	235	0.93 (0.64,1.36)	0.711
Low plus High RH	471	0.98 (0.73,1.32)	0.897

[a] Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED

1987 Dioxin Category Summary Statistics			Analysis Results for Log_2 (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[a]	p-Value
Low	288	23 (8.0)	1.24 (1.09,1.41)	0.001
Medium	287	38 (13.2)		
High	284	56 (19.7)		

[a] Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED

Analysis Results for Log_2 (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
845	1.04 (0.90,1.21)	0.555

[a] Relative risk for a twofold increase in 1987 dioxin.

The unadjusted analysis of Model 3 revealed an increased prevalence of high SCL-90-R GSI scores among Comparisons (15.3%) than among Ranch Hands in the background category (9.2%) (Table 12-17(e): p=0.007, Est. RR=0.59). Analysis of this contrast when adjusted for covariates was nonsignificant (p=0.200), as were all other Model 3 contrasts (Table 12-17(f): p>0.15 for all other contrasts).

Examination of the association between 1987 dioxin levels and the prevalence of high SCL-90-R GSI scores revealed a significant positive result (Table 12-17(g): p=0.001, Est. RR=1.24). The prevalence of high GSI scores increased as 1987 dioxin levels increased. The adjusted analysis was nonsignificant (Table 12-17(h): p=0.555).

12.2.2.2.11 SCL-90-R Positive Symptom Total (PST)

The PST is simply a count of the number of symptoms the participant reports as experiencing to any degree. When used configurally in conjunction with the GSI, information on style of response and numbers of symptoms endorsed can be helpful in appreciating the clinical picture.

The results from both the unadjusted and adjusted Model 1 analyses of SCL-90-R PST across all occupations showed a marginally significant difference between Ranch Hands and Comparisons (Table 12-18(a,b): p=0.076, Est. RR=0.81; p=0.083, Adj. RR=0.80, respectively). The prevalence of high SCL-90-R PST scores was greater among Comparisons (17.1%) than among Ranch Hands (14.2%). All other Model 1 contrasts were nonsignificant (Table 12-18(a,b): p>0.16 for all remaining contrasts).

Table 12-18. Analysis of SCL-90-R Positive Symptom Total (PST)

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

Occupational Category	Group	n	Number (%) High	Est. Relative Risk (95% C.I.)	p-Value
All	***Ranch Hand***	***866***	***123 (14.2)***	***0.81 (0.63,1.02)***	***0.076***
	Comparison	***1,249***	***213 (17.1)***		
Officer	Ranch Hand	341	25 (7.3)	0.77 (0.46,1.28)	0.310
	Comparison	493	46 (9.3)		
Enlisted Flyer	Ranch Hand	150	26 (17.3)	0.72 (0.42,1.25)	0.245
	Comparison	187	42 (22.5)		
Enlisted Groundcrew	Ranch Hand	375	72 (19.2)	0.84 (0.61,1.17)	0.306
	Comparison	569	125 (22.0)		

(b) MODEL 2: RANCH HANDS VS. COMPARISONS – ADJUSTED

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	0.80 (0.63,1.01)	0.061
Officer	0.80 (0.48,1.33)	0.382
Enlisted Flyer	0.67 (0.38,1.18)	0.168
Enlisted Groundcrew	0.86 (0.61,1.20)	0.365

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

Initial Dioxin Category Summary Statistics			Analysis Results for Log_2 (Initial Dioxin)[a]	
Initial Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[b]	p-Value
Low	160	23 (14.4)	1.04 (0.87,1.25)	0.647
Medium	161	34 (21.1)		
High	157	28 (17.8)		

[a] Adjusted for percent body fat at the time of the blood measurement of dioxin.
[b] Relative risk for a twofold increase in initial dioxin.

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

Table 12-18. Analysis of SCL-90-R Positive Symptom Total (PST) (Continued)

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

Analysis Results for Log_2 (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
471	0.82 (0.66,1.02)	0.067

[a] Relative risk for a twofold increase in initial dioxin.

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

Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.)[ab]	p-Value
Comparison	1,211	204 (16.9)		
Background RH	381	36 (9.5)	0.54 (0.37,0.78)	0.001
Low RH	239	40 (16.7)	0.98 (0.68,1.42)	0.921
High RH	239	45 (18.8)	1.10 (0.77,1.58)	0.604
Low plus High RH	478	85 (17.8)	1.04 (0.79,1.37)	0.790

[a] Relative risk and confidence interval relative to Comparisons.
[b] Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED

Dioxin Category	n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
Comparison	1,196		
Background RH	374	0.67 (0.45,0.99)	0.045
Low RH	236	1.04 (0.71,1.54)	0.830
High RH	235	0.78 (0.53,1.15)	0.209
Low plus High RH	471	0.90 (0.67,1.21)	0.496

[a] Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 12-18. Analysis of SCL-90-R Positive Symptom Total (PST) (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED

1987 Dioxin Category Summary Statistics			Analysis Results for Log_2 (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[a]	p-Value
Low	288	26 (9.0)	1.22 (1.07,1.38)	0.003
Medium	287	37 (12.9)		
High	284	58 (20.4)		

[a] Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED

Analysis Results for Log_2 (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
845	1.02 (0.89,1.18)	0.764

[a] Relative risk for a twofold increase in 1987 dioxin.

The association between initial dioxin and SCL-90-R PST was nonsignificant in the Model 2 unadjusted analysis but marginally significant in the adjusted analysis (Table 12-18(c,d): p=0.647, Est. RR=1.04; p=0.067, Adj. RR=0.82, for the unadjusted and adjusted analyses, respectively). After adjustment, PST scores decreased with initial dioxin.

The unadjusted and adjusted results from the Model 3 analysis of SCL-90-R PST displayed a significant difference in the prevalence of high SCL-90-R PST scores between Ranch Hands in the background category (9.5%) and Comparisons (16.9%) (Table 12-18(e,f): p=0.001, Est. RR=0.54; p=0.045, Adj. RR=0.67, respectively). All other Model 3 contrasts were nonsignificant (Table 12-18(e,f): p>0.20 for all remaining contrasts).

The Model 4 unadjusted analysis showed a significant positive association between 1987 dioxin levels and the prevalence of high SCL-90-R PST scores (Table 12-18(g): p=0.003, Est. RR=1.22). After adjustment for covariates, the association was nonsignificant (Table 12-18(h): p=0.764).

12.2.2.2.12 SCL-90-R Positive Symptom Distress Index (PSDI)

The PSDI is a pure intensity measure, in a sense, "corrected" for numbers of symptoms. It functions primarily as a measure of response style in the sense of communicating whether the patient is "augmenting" or "attenuating" symptomatic distress in his style of reporting his disorder.

All results from the analysis of SCL-90-R PSDI were nonsignificant for Models 1, 2, and 4 (Table 12-19(a–d,g–h): p>0.10 for each Model 1, 2, and 4 analysis).

Table 12-19. Analysis of SCL-90-R Positive Symptom Distress Index (PSDI)

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

Occupational Category	Group	n	Number (%) High	Est. Relative Risk (95% C.I.)	p-Value
All	***Ranch Hand***	***866***	***69 (8.0)***	***1.20 (0.86,1.67)***	***0.280***
	Comparison	***1,249***	***84 (6.7)***		
Officer	Ranch Hand	341	14 (4.1)	1.20 (0.58,2.47)	0.622
	Comparison	493	17 (3.5)		
Enlisted Flyer	Ranch Hand	150	13 (8.7)	0.84 (0.40,1.76)	0.642
	Comparison	187	19 (10.2)		
Enlisted Groundcrew	Ranch Hand	375	42 (11.2)	1.37 (0.88,2.12)	0.158
	Comparison	569	48 (8.4)		

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

Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
All	***1.20 (0.86,1.69)***	***0.283***
Officer	1.29 (0.62,2.68)	0.495
Enlisted Flyer	0.78 (0.36,1.66)	0.513
Enlisted Groundcrew	1.37 (0.88,2.12)	0.165

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

Initial Dioxin Category Summary Statistics			Analysis Results for Log_2 (Initial Dioxin)[a]	
Initial Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[b]	p-Value
Low	160	14 (8.8)	1.00 (0.79,1.26)	0.992
Medium	161	20 (12.4)		
High	157	13 (8.3)		

[a] Adjusted for percent body fat at the time of the blood measurement of dioxin.
[b] Relative risk for a twofold increase in initial dioxin.

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

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

Analysis Results for Log_2 (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
471	0.80 (0.61,1.05)	0.107

[a] Relative risk for a twofold increase in initial dioxin.

Table 12-19. Analysis of SCL-90-R Positive Symptom Distress Index (PSDI) (Continued)

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

Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.)[ab]	p-Value
Comparison	1,211	78 (6.4)		
Background RH	381	22 (5.8)	0.90 (0.55,1.47)	0.671
Low RH	239	19 (8.0)	1.25 (0.74,2.11)	0.399
High RH	239	28 (11.7)	1.91 (1.21,3.02)	0.006
Low plus High RH	478	47 (9.8)	1.55 (1.05,2.27)	0.026

[a] Relative risk and confidence interval relative to Comparisons.
[b] Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED

Dioxin Category	n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
Comparison	1,196		
Background RH	374	1.16 (0.70,1.92)	0.572
Low RH	236	1.31 (0.77,2.23)	0.325
High RH	235	1.38 (0.85,2.23)	0.191
Low plus High RH	471	1.34 (0.91,1.99)	0.143

[a] Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.
Comparison: 1987 Dioxin ≤ 10 ppt.
Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.
Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.
High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED

1987 Dioxin Category Summary Statistics			Analysis Results for Log_2 (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.)[a]	p-Value
Low	288	16 (5.6)	1.13 (0.97,1.33)	0.130
Medium	287	21 (7.3)		
High	284	32 (11.3)		

[a] Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

Table 12-19. Analysis of SCL-90-R Positive Symptom Distress Index (PSDI) (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log_2 (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.)[a]	p-Value
845	0.96 (0.81,1.15)	0.675

[a] Relative risk for a twofold increase in 1987 dioxin.

The unadjusted Model 3 analysis revealed significant differences between Comparisons and Ranch Hands in both the high dioxin category and the low and high dioxin categories combined (Table 12-19(e): p=0.006, Est. RR=1.91; p=0.026, Est. RR=1.55, respectively). Both contrasts found more Ranch Hands (11.7% and 9.8%, respectively) than Comparisons (6.4%) with a high SCL-90-R PSDI score. Each contrast was nonsignificant in the adjusted analysis, as were all other Model 3 contrasts (Table 12-19(f): p>0.14 for all other contrasts).

12.3 DISCUSSION

Neuropsychiatric symptoms are encountered commonly in clinical practice and challenge the primary care physician to distinguish those that reflect primary psychological disorders from those secondary to an underlying medical condition. Anxiety and depression, for example, are frequently associated with organic illness, whether established or perceived, and often complicate both accurate diagnosis and response to therapy.

In behavioral medical practice, standardized interview protocols and testing instruments are well established in the assessment of emotional status and cognitive function. The psychological assessment protocols used in the baseline and 1985 follow-up examinations included the WAIS, the MMPI, the CI, and the CMI. The negative reaction of participants to the burdensome length and repetition of these instruments led to the introduction at the 1987 examinations of the more economical SCL-90-R and the MCMI.

In their published reviews of the world's literature, *Veterans and Agent Orange* (33, 34), The Institute of Medicine concluded that there was insufficient evidence to link herbicide exposure with neuropsychiatric and cognitive disorders. Among the most important methodological limitations cited was the possibility that a true psychological effect may be below the power of epidemiological studies to detect, particularly given the time lapse between exposure and testing. Other limitations include the confounding by the effects of combat stress and, as noted above in the introduction to the psychological assessment, the significant association of psychological symptoms with the self-perception of exposure.

Analyses of the 1997 psychometric data yielded few significant results, most of which were limited to diagnoses established by a medical records review. Although the overall prevalence of the five diagnoses was similar in each cohort, "other neuroses" occurred significantly more often in Ranch Hand enlisted groundcrew than in Comparisons (64.7% vs. 57.1%), becoming even more significant after adjustment for covariates. Evidence for a dioxin effect was noted in Model 3 as "other neuroses" occurred significantly more often in Ranch Hands in the high and low initial serum dioxin categories relative to Comparisons in both the unadjusted and adjusted analyses. Further, with respect to 1987 serum dioxin levels, a dose-response pattern was noted with a prevalence of 45.0 percent, 53.5 percent, and 64.9 percent, respectively, in the low, medium, and high dioxin categories. After adjustment for covariates, the effect was no longer significant.

In contrast to the 1992 examination results noted above, analyses of the SCL-90-R indices yielded no significant group or occupational differences between the Ranch Hand and Comparison cohorts, nor were there any significant associations with either the extrapolated initial or 1987 serum dioxin levels.

12.4 SUMMARY

Five psychological disorders verified by a medical records review and 12 measures from the SCL-90-R inventory were examined in the psychology assessment. The SCL-90-R consisted of nine primary symptom dimensions and three broad indices of psychological distress. Each endpoint was examined for a significant association, both unadjusted and adjusted for covariates, with group (Model 1), initial dioxin (Model 2), categorized dioxin (Model 3), and the 1987 dioxin levels (Model 4).

12.4.1 Model 1: Group Analysis

Differences between Ranch Hands and Comparisons were examined, both across all occupations and within each occupational stratum, for the psychology endpoints described above. The results are summarized and presented in Table 12-20. In enlisted groundcrew, a significantly greater percentage of Ranch Hands than Comparisons had a history of other neuroses for both the unadjusted and adjusted analyses. Other variables displaying either significant or marginally significant results from the SCL-90-R were anxiety, depression, interpersonal sensitivity, phobic anxiety, global severity index, and positive symptom total. These results were found from the analysis combining all occupations or from the officer or enlisted flyer strata. The analyses showed a greater percentage of Comparisons than Ranch Hands with high SCL-90-R scores.

Table 12-20. Summary of Group Analysis (Model 1) for Psychological Variables (Ranch Hands vs. Comparisons)

	UNADJUSTED			
Variable	All	Officer	Enlisted Flyer	Enlisted Groundcrew
Medical Records				
Psychoses	NS	NS	NS	ns
Alcohol Dependence	NS	ns	NS	NS
Drug Dependence	ns	ns	--	NS
Anxiety	NS	ns	NS	NS
Other Neuroses	NS	ns*	NS	+0.021
Psychological Examination (SCL-90-R)				
Anxiety	ns	ns	ns	ns
Depression	ns*	ns	-0.038	ns
Hostility	ns	ns	ns	ns
Interpersonal Sensitivity	ns*	ns	ns*	ns
Obsessive-Compulsive Behavior	ns	ns	ns	ns
Paranoid Ideation	ns	ns	ns	NS
Phobic Anxiety	ns	ns*	ns	NS
Psychoticism	ns*	ns	ns	ns
Somatization	NS	NS	ns	NS
Global Severity Index (GSI)	ns	ns	ns*	ns
Positive Symptom Total (PST)	ns*	ns	ns	ns
Positive Symptom Distress Index (PSDI)	NS	NS	ns	NS

Table 12-20. Summary of Group Analysis (Model 1) for Psychological Variables (Ranch Hands vs. Comparisons) (Continued)

Note: NS or ns: Not significant (p>0.10).
ns*: Marginally significant (0.05<p≤0.10).
+: Relative risk ≥1.00.
–: Relative risk <1.00.
--: Analysis not performed because of the sparse number of participants with a drug dependence.

P-value given if p≤0.05.

A capital "NS" denotes a relative risk of 1.00. A lowercase "ns" denotes relative risk less than 1.00.

	ADJUSTED			
Variable	All	Officer	Enlisted Flyer	Enlisted Groundcrew
Medical Records				
Psychoses	NS	NS	NS	ns
Alcohol Dependence	NS	ns	ns	NS
Drug Dependence	ns	--	--	ns
Anxiety	NS	ns	NS	NS
Other Neuroses	NS	ns	NS	+0.011
Psychological Examination (SCL-90-R)				
Anxiety	ns	ns	ns*	NS
Depression	ns*	ns	–0.013	ns
Hostility	ns	ns	ns	ns
Interpersonal Sensitivity	ns*	ns	–0.029	ns
Obsessive-Compulsive Behavior	ns	ns	ns	ns
Paranoid Ideation	ns	ns	ns	NS
Phobic Anxiety	ns	ns*	ns	NS
Psychoticism	ns	ns	ns	ns
Somatization	NS	NS	ns	NS
Global Severity Index (GSI)	ns	ns	ns*	ns
Positive Symptom Total (PST)	ns*	ns	ns	ns
Positive Symptom Distress Index (PSDI)	NS	NS	ns	NS

Note: NS or ns: Not significant (p>0.10).
ns*: Marginally significant (0.05<p≤0.10).
+: Relative risk ≥1.00.
–: Relative risk <1.00.
--: Analysis not performed because of the sparse number of participants with a drug dependence.

P-value given if p≤0.05.

A capital "NS" denotes a relative risk of 1.00. A lowercase "ns" denotes relative risk less than 1.00.

12.4.2 Model 2: Initial Dioxin Analysis

Associations between initial dioxin and each psychological endpoint were examined. The unadjusted analyses displayed only two marginally significant associations, both of which indicated more high SCL-90-R scores as initial dioxin increased. The association became nonsignificant in the adjusted analysis. Adjusted analyses of SCL-90-R anxiety, interpersonal sensitivity, and somatization revealed significant associations with initial dioxin, but high SCL-90-R scores decreased as initial dioxin increased. A marginally significant association was found between initial dioxin and the SCL-90-R positive symptom total, but high positive symptom total scores decreased as initial dioxin increased. The results of the initial dioxin analyses are shown in Table 12-21.

Table 12-21. Summary of Initial Dioxin Analysis (Model 2) for Psychological Variables (Ranch Hands Only)

Variable	Unadjusted	Adjusted
Medical Records		
Psychoses	ns	ns
Alcohol Dependence	NS	NS
Drug Dependence	--	--
Anxiety	NS	ns
Other Neuroses	NS	ns
Psychological Examination (SCL-90-R)		
Anxiety	ns	–0.016
Depression	NS	ns
Hostility	NS	ns
Interpersonal Sensitivity	ns	–0.026
Obsessive-Compulsive Behavior	NS	ns
Paranoid Ideation	NS	ns
Phobic Anxiety	NS*	ns
Psychoticism	NS*	ns
Somatization	ns	–0.010
Global Severity Index (GSI)	NS	ns
Positive Symptom Total (PST)	NS	ns*
Positive Symptom Distress Index (PSDI)	NS	ns

Note: NS or ns: Not significant ($p>0.10$).
NS* or ns*: Marginally significant ($0.05<p\leq0.10$).
–: Relative risk <1.00.
--: Analysis not performed because of the sparse number of participants with a drug dependence.
P-value given if $p\leq0.05$.
A capital "NS" denotes a relative risk of 1.00. A lowercase "ns" denotes relative risk less than 1.00.

12.4.3 Model 3: Categorized Dioxin Analysis

Differences between Ranch Hands, categorized by dioxin levels, and Comparisons in the history of psychological disorders and the prevalence of high SCL-90-R scores were examined. A summary of the analyses is given in Table 12-22. Several significant and marginally significant results were found from the unadjusted analysis within each categorization of dioxin. Each result became nonsignificant after covariate adjustment, except for the analyses of other neuroses and SCL-90-R positive symptom total. In addition, the significant result from the unadjusted analysis of SCL-90-R phobic anxiety, which found a larger percentage of Comparisons than background Ranch Hands with high scores, became marginally

significant in the adjusted analysis. Ranch Hands in the low dioxin category and the low and high dioxin categories combined displayed a significantly higher prevalence of other neuroses than Comparisons in both the unadjusted and adjusted analyses. For the adjusted analysis of the SCL-90-R positive symptom total, a significant difference between Ranch Hands in the background category and Comparisons was found where Comparisons had the greater percentage of high SCL-90-R T-scores.

Table 12-22. Summary of Categorized Dioxin Analysis (Model 3) for Psychological Variables (Ranch Hands vs. Comparisons)

Variable	UNADJUSTED			
	Background Ranch Hands vs. Comparisons	Low Ranch Hands vs. Comparisons	High Ranch Hands vs. Comparisons	Low plus High Ranch Hands vs. Comparisons
Medical Records				
Psychoses	ns	NS	NS	NS
Alcohol Dependence	ns	NS	NS	NS
Drug Dependence	NS	ns	ns	ns
Anxiety	ns*	NS	NS	NS
Other Neuroses	–0.018	+0.041	+0.008	+0.002
Psychological Examination (SCL-90-R)				
Anxiety	ns*	ns	NS	NS
Depression	ns*	ns	NS	ns
Hostility	ns*	ns	NS	ns
Interpersonal Sensitivity	–0.003	ns	NS	ns
Obsessive-Compulsive Behavior	–0.032	ns	ns	ns
Paranoid Ideation	ns	ns	NS*	NS
Phobic Anxiety	–0.009	NS	+0.027	NS
Psychoticism	–0.006	ns	NS	ns
Somatization	ns*	NS	NS*	+0.042
Global Severity Index (GSI)	–0.007	ns	NS	NS
Positive Symptom Total (PST)	–0.001	ns	NS	NS
Positive Symptom Distress Index (PSDI)	ns	NS	+0.006	+0.026

Note: NS or ns: Not significant ($p>0.10$).
NS* or ns*: Marginally significant ($0.05<p\leq0.10$).
+: Relative risk ≥1.00.
–: Relative risk <1.00.

P-value given if $p\leq0.05$.

A capital "NS" denotes a relative risk of 1.00 or greater. A lowercase "ns" denotes relative risk less than 1.00.

Variable	ADJUSTED			
	Background Ranch Hands vs. Comparisons	Low Ranch Hands vs. Comparisons	High Ranch Hands vs. Comparisons	Low plus High Ranch Hands vs. Comparisons
Medical Records				
Psychoses	ns	NS	ns	NS
Alcohol Dependence	NS	NS	NS	NS
Drug Dependence	NS	--	--	--
Anxiety	ns	NS	ns	ns

Table 12-22. Summary of Categorized Dioxin Analysis (Model 3) for Psychological Variables (Ranch Hands vs. Comparisons) (Continued)

Variable	ADJUSTED			
	Background Ranch Hands vs. Comparisons	Low Ranch Hands vs. Comparisons	High Ranch Hands vs. Comparisons	Low plus High Ranch Hands vs. Comparisons
Other Neuroses	ns	+0.036	NS	+0.038
Psychological Examination (SCL-90-R)				
Anxiety	ns	NS	ns	ns
Interpersonal Sensitivity	ns	ns	ns	ns
Obsessive-Compulsive Behavior	ns	NS	ns	ns
Paranoid Ideation	ns	ns	NS	NS
Phobic Anxiety	ns*	NS	NS	NS
Psychoticism	ns	ns	ns	ns
Somatization	ns	NS	ns	NS
Global Severity Index (GSI)	ns	NS	ns	ns
Positive Symptom Total (PST)	–0.045	NS	ns	ns
Positive Symptom Distress Index (PSDI)	NS	NS	NS	NS

Note: NS or ns: Not significant ($p>0.10$).
ns*: Marginally significant ($0.05<p\leq0.10$).
+: Relative risk ≥1.00.
–: Relative risk <1.00.
--: Analysis not performed because of the sparse number of participants with a drug dependence.

P-value given if $p\leq0.05$.

A capital "NS" denotes a relative risk of 1.00. A lowercase "ns" denotes relative risk less than 1.00.

12.4.4 Model 4: 1987 Dioxin Level Analysis

The relation between the 1987 dioxin levels and the psychological endpoints was examined. Unadjusted analyses revealed significant or marginally significant associations for a history of anxiety and other neuroses and for most of the SCL-90-R measures. These associations indicated that disorders or high SCL-90-R scores increased as 1987 dioxin increased. After adjustment for covariates, all results became nonsignificant. A summary of the analyses is given in Table 12-23.

Table 12-23. Summary of 1987 Dioxin Analysis (Model 4) for Psychological Variables (Ranch Hands Only)

Variable	Unadjusted	Adjusted
Medical Records		
Psychoses	NS	NS
Alcohol Dependence	NS	ns
Drug Dependence	ns	ns
Anxiety	+0.011	ns
Other Neuroses	+<0.001	NS
Psychological Examination (SCL-90-R)		
Anxiety	NS*	ns
Interpersonal Sensitivity	NS*	ns
Obsessive-Compulsive Behavior	NS*	NS

Table 12-23. Summary of 1987 Dioxin Analyses (Model 4) for Psychological Variables (Ranch Hands Only) (Continued)

Variable	Unadjusted	Adjusted
Paranoid Ideation	+0.032	NS
Phobic Anxiety	+0.001	NS
Psychoticism	+0.002	NS
Somatization	+0.013	ns
Global Severity Index (GSI)	+0.001	NS
Positive Symptom Total (PST)	+0.003	NS
Positive Symptom Distress Index (PSDI)	NS	ns

Note: NS or ns: Not significant ($p>0.10$).
NS*: Marginally significant ($0.05<p\leq0.10$).
+: Relative risk ≥ 1.00.

P-value given if $p\leq0.05$.

A capital "NS" denotes a relative risk of 1.00. A lowercase "ns" denotes relative risk less than 1.00.

12.5 CONCLUSION

Five psychological disorders, which were verified by a medical records review, and 12 measures from the SCL-90-R inventory were examined in the psychology assessment. The SCL-90-R consisted of nine primary symptom dimensions and three broad indices of psychological distress. In enlisted groundcrew, a significantly greater percentage of Ranch Hands than Comparisons had a history of other neuroses for both the unadjusted analyses and the analyses adjusted for covariates. All other adjusted analyses of Ranch Hands versus Comparisons that were significant showed a greater percentage of Comparisons than Ranch Hands with high SCL-90-R scores.

Associations between initial dioxin and the psychological endpoints in the analyses adjusted for covariates were either nonsignificant or revealed a significant decrease in high SCL-90-R scores as initial dioxin increased.

Differences in the history of psychological disorders and the prevalence of high SCL-90-R scores were examined between Comparisons and Ranch Hands categorized by dioxin levels. Ranch Hands in the low dioxin category and the low and high dioxin categories combined displayed a significantly higher prevalence of other neuroses than Comparisons in both the unadjusted and adjusted analyses.

The relation between the 1987 dioxin levels and the psychological endpoints was examined; all results were nonsignificant.

In conclusion, Ranch Hand veterans exhibited a significantly increased prevalence of other neuroses among enlisted groundcrew, the occupation with the highest dioxin levels and, presumably, the greatest herbicide exposure. Consistent increases in the prevalence of other neuroses with dioxin levels were found. No consistent relation was found between any SCL-90-R score and any measure of herbicide or dioxin exposure. The relation between other neuroses and herbicide exposure and dioxin levels will be described in greater detail in a separate report.

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