

TABLE N-2.

**Summary of Models Without Adjustment for Percent
Body Fat for Endocrine Variables**

Ranch Hands - Log₂ (Initial Dioxin)				
Variable/ (Table Ref.)	Assumption	Adj. Relative Risk (95% C.I.) ^a	p-Value	Covariate Remarks
Testes (15-6 [c])	Minimal (n=516)	1.53 (1.07,2.18)	0.027	AGE (p<0.001)
Testes (15-6 [d])	Maximal (n=736)	1.52 (1.13,2.02)	0.007	AGE (p<0.001)

Ranch Hands - Log₂ (Current Dioxin) and Time

Variable/ (Table Ref.)	Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.) ^a	p-Value	Covariate Remarks
Testes (15-6 [g])	Minimal (n=516)			0.164 ^b	AGE (p<0.001)
		≤18.6	2.29 (1.21,4.32)	0.011 ^c	
		>18.6	1.32 (0.82,2.14)	0.253 ^c	
Testes (15-6 [h])	Maximal (n=736)			0.345 ^b	AGE (p<0.001)
		≤18.6	1.87 (1.14,3.06)	0.007 ^c	
		>18.6	1.39 (0.94,2.05)	0.099 ^c	

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Testes (15-6 [j])	Background	785	All Categories		0.022	AGE (p<0.001) RACE (p=0.069)
	Unknown	343	Unknown vs. Background	0.87 (0.39,1.93)	0.732	
	Low	193	Low vs. Background	0.73 (0.24,2.18)	0.575	
	High	187	High vs. Background	3.43 (1.52,7.75)	0.003	
	Total	1,508				

TABLE N-2. (Continued)

**Summary of Models Without Adjustment for Percent
Body Fat for Endocrine Variables**

Ranch Hands - Log₂ (Initial Dioxin)

Variable/ (Table Ref.)	Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value	Covariate Remarks
Testosterone ^d (15-13 [c])	Minimal (n=501)	Low	124	527.9**	-0.2828 (0.1235)**	0.023**	INIT*PERS (p=0.008) AGE (p<0.001)
		Medium	250	525.6**			
		High	127	489.7**			
Testosterone ^d (15-13 [d])	Maximal (n=711)	Low	175	559.9**	-0.3055 (0.0905)**	<0.001**	INIT*PERS (p=0.001) AGE (p<0.001) RACE (p=0.084)
		Medium	356	544.3**			
		High	180	508.5**			

Ranch Hands - Log₂ (Current Dioxin) and Time

Variable/ (Table Ref.)	Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value	Covariate Remarks
			Low	Medium	High			
Testosterone ^d (15-13 [g])	Minimal (n=516)	≤18.6	533.2 (71)	512.7 (127)	482.0 (54)	-0.3674 (0.2015)	0.456 ^e 0.069 ^f	AGE (p<0.001)
		>18.6	525.8 (57)	536.9 (130)	495.1 (77)		0.279 ^f	
Testosterone ^d (15-13 [h])	Maximal (n=736)	≤18.6	573.0 (105)	515.1 (189)	538.2 (83)	-0.3531 (0.1407)	0.494 ^e 0.012 ^f	AGE (p<0.001) RACE (p=0.150)
		>18.6	547.0 (79)	550.9 (176)	507.2 (104)		0.069 ^f	

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.) ^g	p-Value ^h	Covariate Remarks
Testosterone ^d (15-13 [j])	Background	785	514.0	All Categories		<0.001	AGE*RACE (p=0.019)
	Unknown	343	545.9	Unknown vs. Background	31.9 --	0.001	
	Low	193	513.3	Low vs. Background	- 0.7 --	0.953	
	High	187	482.9	High vs. Background	-31.1 --	0.010	
	Total	1,508					

TABLE N-2. (Continued)

Summary of Models Without Adjustment for Percent Body Fat for Endocrine Variables

Ranch Hands - Log₂ (Initial Dioxin)				
Variable/ (Table Ref.)	Assumption	Adj. Relative Risk (95% C.I.) ^a	p-Value	Covariate Remarks
Testosterone (15-14 [c])	Minimal (n=516)	0.98 (0.60,1.60)	0.923	AGE (p=0.051)
Testosterone (15-14 [d])	Maximal (n=736)	1.21 (0.85,1.73)	0.309	AGE (p=0.010)

Ranch Hands - Log₂ (Current Dioxin) and Time

Variable/ (Table Ref.)	Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.) ^a	p-Value	Covariate Remarks
Testosterone (15-14 [g])	Minimal (n=516)	≤18.6	0.75 (0.26,2.18)	0.983 ^b	--
		>18.6	0.74 (0.40,1.38)	0.600 ^c	
				0.347 ^c	
Testosterone (15-14 [h])	Maximal (n=736)	≤18.6	1.40 (0.65,3.00)	0.413 ^b	AGE (p=0.033)
		>18.6	0.96 (0.62,1.51)	0.387 ^c	
				0.873 ^c	

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Testosterone (15-14 [j])	Background	750	All Categories		0.516**	DXCAT*PERS (p=0.045)
	Unknown	326	Unknown vs. Background	0.54 (0.15,1.91)**	0.339**	AGE (p=0.021)
	Low	189	Low vs. Background	0.95 (0.27,3.37)**	0.931**	RACE (p=0.107)
	High	181	High vs. Background	1.71 (0.54,5.45)**	0.361**	
	Total	1,446				

TABLE N-2. (Continued)

**Summary of Models Without Adjustment for Percent
Body Fat for Endocrine Variables**

Ranch Hands - Log₂ (Initial Dioxin)							
Variable/ (Table Ref.)	Assumption	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value	Covariate Remarks
2-Hour Post- Prandial Glucose ⁱ (15-15 [c])	Minimal (n=467)	Low	117	110.7	0.0254 (0.0109)	0.020	AGE (p<0.001)
		Medium	231	112.8			
		High	119	115.6			
2-Hour Post- Prandial Glucose ⁱ 15-15 [d])	Maximal (n=654)	Low	168	108.0	0.0235 (0.0080)	0.003	AGE (p<0.001) PERS (p=0.133)
		Medium	328	111.6			
		High	158	115.8			

Ranch Hands - Log₂ (Current Dioxin) and Time

Variable/ (Table Ref.)	Assumption	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value	Covariate Remarks
			Low	Medium	High			
2-Hour Post- Prandial Glucose ⁱ (15-15 [g])	Minimal (n=453)	≤18.6	106.3** (60)	111.1** (114)	113.7** (48)	0.0292 (0.0173)**	0.471*** 0.092** ^f	CURR*TIME*PERS (p=0.010) AGE (p=0.002)
		>18.6	123.5** (51)	109.7** (113)	120.1** (67)	0.0133 (0.0148)**	0.368** ^f	
2-Hour Post- Prandial Glucose ⁱ (15-15 [h])	Maximal (n=654)	≤18.6	109.4 (98)	110.0 (168)	115.1 (70)	0.0170 (0.0122)	0.469 ^e 0.164 ^f	AGE (p<0.001) PERS (p=0.124)
		>18.6	101.9 (72)	115.0 (156)	117.2 (90)	0.0286 (0.0110)	0.009 ^f	

TABLE N-2. (Continued)

Summary of Models Without Adjustment for Percent Body Fat for Endocrine Variables

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.) ^j	p-Value ^k	Covariate Remarks
2-Hour Post- Prandial Glucose ⁱ (15-15 [j])	Background	705	111.1	All Categories		0.010	AGE (p<0.001) PERS (p=0.081)
	Unknown	314	107.0	Unknown vs. Background	-4.1 --	0.035	
	Low	175	110.1	Low vs. Background	-1.0 --	0.676	
	High	160	116.5	High vs. Background	5.4 --	0.041	
	Total	1,354					

Ranch Hands - Initial Dioxin (Categorized)

Variable/ (Table Ref.)	Assumption	Initial Dioxin Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
2-Hour Post- Prandial Glucose (15-16 [c])	Minimal (n=467)	Overall [†] M vs. L ^l H vs. L ^l M vs. L ^m H vs. L ^m	 1.19 (0.67,2.14) 1.05 (0.51,2.16) 2.97 (0.41,21.43) 7.99 (1.10,57.96)	 0.147 0.554 0.894 0.279 0.040	AGE (p<0.001)
2-Hour Post- Prandial Glucose (15-16 [d])	Maximal (n=678)	Overall [†] M vs. L ^l H vs. L ^l M vs. L ^m H vs. L ^m	 1.45 (0.92,2.29) 1.31 (0.70,2.43) 1.40 (0.47,4.20) 3.85 (1.28,11.57)	 0.091 0.107 0.396 0.543 0.016	AGE (p<0.001)

TABLE N-2. (Continued)

Summary of Models Without Adjustment for Percent Body Fat for Endocrine Variables

Ranch Hands - Current Dioxin (Categorized) and Time

Variable/ (Table Ref.)	Assumption	Time (Yrs.)	Current Dioxin Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
2-Hour Post- Prandial Glucose (15-16 [g])	Minimal (n=467)	≤18.6	C-by-T*		0.421	AGE (p=0.003)
			Overall†		0.177	RACE (p=0.399)
			M vs. L ^l	1.52 (0.60,3.86)	0.381 ⁿ	
			H vs. L ^l	1.31 (0.39,4.38)	0.661 ⁿ	
			M vs. L ^m	1.23 (0.15,10.36)	0.847 ⁿ	
			H vs. L ^m	7.13 (0.95,53.61)	0.056 ⁿ	
		>18.6	Overall†		0.140	
			M vs. L ^l	0.49 (0.23,1.03)	0.060 ⁿ	
			H vs. L ^l	0.62 (0.26,1.46)	0.272 ⁿ	
			M vs. L ^m	0.66 (0.08,5.59)	0.705 ⁿ	
			H vs. L ^m	2.84 (0.39,20.47)	0.299 ⁿ	
2-Hour Post- Prandial Glucose (15-16 [h])	Maximal (n=678)	≤18.6	C-by-T*		0.741	AGE (p<0.001)
			Overall†		0.102	RACE (p=0.141)
			M vs. L ^l	1.28 (0.65,2.50)	0.480 ⁿ	
			H vs. L ^l	1.12 (0.41,3.08)	0.830 ⁿ	
			M vs. L ^m	1.28 (0.24,6.90)	0.772 ⁿ	
			H vs. L ^m	7.71 (1.70,35.04)	0.008 ⁿ	
		>18.6	Overall†		0.518	
			M vs. L ^l	1.02 (0.54,1.90)	0.963 ⁿ	
			H vs. L ^l	1.31 (0.61,2.77)	0.487 ⁿ	
			M vs. L ^m	0.52 (0.11,2.50)	0.413 ⁿ	
			H vs. L ^m	2.32 (0.61,8.91)	0.219 ⁿ	

TABLE N-2. (Continued)

**Summary of Models Without Adjustment for Percent
Body Fat for Endocrine Variables**

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
2-Hour Post- Prandial Glucose (15-16 [j])	Background	705	All Categories		0.092	AGE (p<0.001) RACE (p=0.250) PERS (p=0.085)
	Unknown	314	Unknown vs. Background ^l	0.96 (0.66,1.40)	0.835	
	Low	175	Low vs. Background ^l	1.09 (0.69,1.72)	0.702	
	High	160	High vs. Background ^l	1.45 (0.90,2.35)	0.126	
			Unknown vs. Background ^m	0.66 (0.27,1.59)	0.357	
	Total	1,354	Low vs. Background ^m	0.51 (0.15,1.81)	0.299	
			High vs. Background ^m	2.60 (1.17,5.81)	0.019	

Ranch Hands - Log₂ (Initial Dioxin)

Variable/ (Table Ref.)	Assumption	Adj. Relative Risk (95% C.I.) ^a	p-Value	Covariate Remarks
Composite Diabetes Indicator (15-17 [c])	Minimal (n=517)	1.51 (1.21,1.87)	<0.001	AGE (p<0.001)
Composite Diabetes Indicator (15-17 [d])	Maximal (n=738)	1.55 (1.30,1.85)	<0.001	AGE (p<0.001) RACE (p=0.082)

Ranch Hands - Log₂ (Current Dioxin) and Time

Variable/ (Table Ref.)	Assumption	Time (Yrs.)	Adj. Relative Risk (95% C.I.) ^a	p-Value	Covariate Remarks
Composite Diabetes Indicator (15-17 [g])	Minimal (n=517)	≤18.6	1.52 (1.04,2.21)	0.029 ^c	AGE (p<0.001)
		>18.6	1.62 (1.22,2.14)	0.001 ^c	
Composite Diabetes Indicator (15-17 [h])	Maximal (n=738)	≤18.6	1.72 (1.29,2.30)	<0.001 ^c	AGE (p<0.001) RACE (p=0.075)
		>18.6	1.49 (1.19,1.87)	0.001 ^c	

TABLE N-2. (Continued)

Summary of Models Without Adjustment for Percent Body Fat for Endocrine Variables

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Current Dioxin Category	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Composite Diabetes Indicator (15-17 [jj])	Background	782	All Categories		<0.001**	DXCAT*AGE (p=0.024)
	Unknown	344	Unknown vs. Background	0.63 (0.37,1.08)**	0.095**	
	Low	193	Low vs. Background	1.04 (0.58,1.85)**	0.906**	
	High	187	High vs. Background	2.95 (1.82,4.79)**	<0.001**	
	Total	1,506				

^aRelative risk for a twofold increase in dioxin.

^bTest of significance for homogeneity of relative risks (current dioxin continuous, time categorized).

^cTest of significance for relative risk equal to 1 (current dioxin continuous, time categorized).

^dMeans transformed from square root scale; slope and standard error based on square root of testosterone versus $\log_2$ dioxin.

^eTest of significance for homogeneity of slopes (current dioxin continuous, time categorized).

^fTest of significance for slope equal to 0 (current dioxin continuous, time categorized).

^gDifference of means after transformation to original scale; confidence interval on difference of means not given because analysis was performed on square root scale.

^hP-value based on difference of means on square root scale.

ⁱMeans transformed from natural logarithm scale; slope and standard error based on natural logarithm of 2-hour postprandial glucose versus $\log_2$ dioxin.

^jDifference of means after transformation to original scale; confidence interval on difference of means not given because analysis was performed on natural logarithm scale.

^kP-value based on difference of means on natural logarithm scale.

^lImpaired contrasted with normal.

^mDiabetic contrasted with normal.

ⁿTest of significance for relative risk equal to 1 (current dioxin and time categorized).

^{**}Dioxin-by-covariate interaction ($p \leq 0.05$); adjusted mean/slope/relative risk, standard error/confidence interval, and p-value derived from a model fitted after deletion of this interaction.

[†]Overall test of independence of current dioxin and 2-hour postprandial glucose within time stratum.

Note: Initial Dioxin: 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.

Low: 25-93 ppt; Medium: >93-292 ppt; High: >292 ppt (for 2-hour postprandial glucose).

Current Dioxin: 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.

Low: >5-14.65 ppt; Medium: >14.65-45.75 ppt; High: >45.75 ppt (for 2-hour postprandial glucose).

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.

M vs. L: Medium dioxin category versus low dioxin category.

H vs. L: High dioxin category versus low dioxin category.

TABLE N-3.

**Summary of Dioxin-by-Covariate Interactions Without Adjustment
for Percent Body Fat for Endocrine Variables**

Ranch Hands - Log₂ (Initial Dioxin)

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
Testosterone ^a (Minimal-- 15-13 [c])	Initial-by- Personality Type	Type A	Low	59	542.8	-0.6872 (0.1944)	<0.001
			Medium	107	521.4		
			High	53	451.0		
		Type B	Low	65	523.0	-0.0315 (0.1586)	0.843
			Medium	143	526.6		
			High	74	518.7		
Testosterone ^a (Maximal-- 15-13 [d])	Initial-by- Personality Type	Type A	Low	92	581.4	-0.6267 (0.1389)	<0.001
			Medium	156	552.3		
			High	79	487.8		
		Type B	Low	83	538.9	-0.0243 (0.1210)	0.841
			Medium	200	544.7		
			High	101	533.6		

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Percent Abnormal Low	Contrast	Adj. Relative Risk (95% C.I.)	p-Value
Testosterone (15-14 [j])	Categorized Current Dioxin-by- Personality Type	Type A	Background	316	0.6	All		0.085
			Unknown	158	1.3	U vs. B	2.05 (0.28,14.75)	0.477
			Low	80	0.0	L vs. B	--	--
			High	78	3.8	H vs. B	8.11 (1.31,50.37)	0.025
		Type B	Background	434	2.5	All		0.346
			Unknown	168	0.6	U vs. B	0.24 (0.03,1.85)	0.169
			Low	109	2.8	L vs. B	1.10 (0.30,4.05)	0.884
			High	103	1.0	H vs. B	0.50 (0.06,3.98)	0.511

TABLE N-3. (Continued)

**Summary of Dioxin-by-Covariate Interactions Without Adjustment
for Percent Body Fat for Endocrine Variables**

Ranch Hands - Log₂ (Current Dioxin) and Time

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value
				Low	Medium	High		
2-Hour Post- Prandial Glucose ^b (Minimal-- 15-15 [g])	Current-by- Time-by- Personality Type	Type A						0.113 ^c
			≤18.6	111.0 (33)	107.0 (45)	106.6 (19)	-0.0173 (0.0289)	0.551 ^d
			>18.6	119.0 (21)	108.6 (51)	125.0 (30)	0.0392 (0.0221)	0.076 ^d
		Type B						0.031 ^c
			≤18.6	103.1 (27)	114.3 (69)	119.5 (29)	0.0525 (0.0225)	0.020 ^d
			>18.6	127.0 (30)	109.8 (62)	116.2 (37)	-0.0114 (0.0195)	0.558 ^d

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Percent Diabetic	Contrast	Adj. Relative Risk (95% C.I.)	p-Value
Composite Diabetes Indicator (15-17 [j])	Categorized Current Dioxin-by- Age	Born ≥1942	Background	321	5.3	All		0.125
			Unknown	118	3.4	U vs. B	0.63 (0.21,1.90)	0.411
			Low	80	2.5	L vs. B	0.46 (0.10,2.03)	0.304
			High	117	9.4	H vs. B	1.86 (0.84,4.09)	0.125
		Born <1942	Background	461	10.2	All		<0.001
			Unknown	226	6.6	U vs. B	0.63 (0.34,1.15)	0.129
			Low	113	12.4	L vs. B	1.25 (0.66,2.35)	0.498
			High	70	28.6	H vs. B	3.52 (1.93,6.42)	<0.001

^aAdjusted means transformed from square root scale; adjusted slope and standard error based on square root of testosterone versus log₂ dioxin.

^bAdjusted means transformed from natural logarithm scale; adjusted slope and standard error based on natural logarithm of 2-hour postprandial glucose versus log₂ dioxin.

^cTest of significance for homogeneity of slopes (current dioxin continuous, time categorized).

^dTest of significance for slope equal to 0 (current dioxin continuous, time categorized).

--: Analysis not performed due to category with no abnormalities.

Note: Initial Dioxin: 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.

Current Dioxin: 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.

All: All categories.

Background (B) (Comparisons): Current Dioxin ≤10 ppt.

Unknown (U) (Ranch Hands): Current Dioxin ≤10 ppt.

Low (L) (Ranch Hands): 15 ppt < Current Dioxin ≤33.3 ppt.

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

APPENDIX N-1.

Data Displays for the Endocrine Assessment

The following figures graphically display relationships between the dependent variables and measures of dioxin for the endocrine assessment. The panels are arranged as follows:

Panel	Group	Assumption	Dioxin Measure
a	Ranch Hand	Minimal	Initial
b	Ranch Hand	Maximal	Initial
c	Comparison	--	Current
d	Ranch Hand	--	Current

Dioxin measures are presented in original units, but spacing of intervals is based on the logarithm (base 2) scale, similar to the statistical analysis. The dependent variable is also presented in original units, but spacing is based on the scale used for analysis, as described in the chapter. For continuous variables, current dioxin values of 0.0 ppt are displayed as 0.3 ppt. For these variables, the reference line indicates the general relationship, unadjusted for any covariates, between the (transform of the) dependent variable and $\log_2$ dioxin. For discrete variables, the percent of participants that exhibited an abnormal condition is displayed on the vertical axis for given intervals of dioxin. The intervals of dioxin and the sample sizes (assuming no missing data or exclusions) for each of these intervals are given below. A list of figures found in this appendix follows the table.

Dioxin Interval	Dioxin Scale Midpoint	Panel			
		a	b	c	d
		Sample Size			
0.0-0.5	0.25	0	0	42	8
>0.5-2.0	1	0	0	28	8
>2.0-8.0	4	0	0	681	249
>8.0-32.0	16	0	23	52	408
>32.0-128.0	64	219	417	1	158
>128.0-512.0	256	234	234	0	33
>512.0-2,048.0	1024	65	65	0	2
>2,048.0	4096	3	3	0	0

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N-1-12	Testosterone (Continuous) versus Dioxin.....	N-1-14
N-1-13	Testosterone (Discrete) versus Dioxin.....	N-1-15
N-1-14	Fasting Glucose (Continuous) versus Dioxin.....	N-1-16
N-1-15	Fasting Glucose (Discrete) versus Dioxin.....	N-1-17
N-1-16	2-Hour Postprandial Glucose (Continuous) versus Dioxin.....	N-1-18
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N-1-18	2-Hour Postprandial Glucose (Diabetic) versus Dioxin.....	N-1-20
N-1-19	Composite Diabetes Indicator versus Dioxin.....	N-1-21

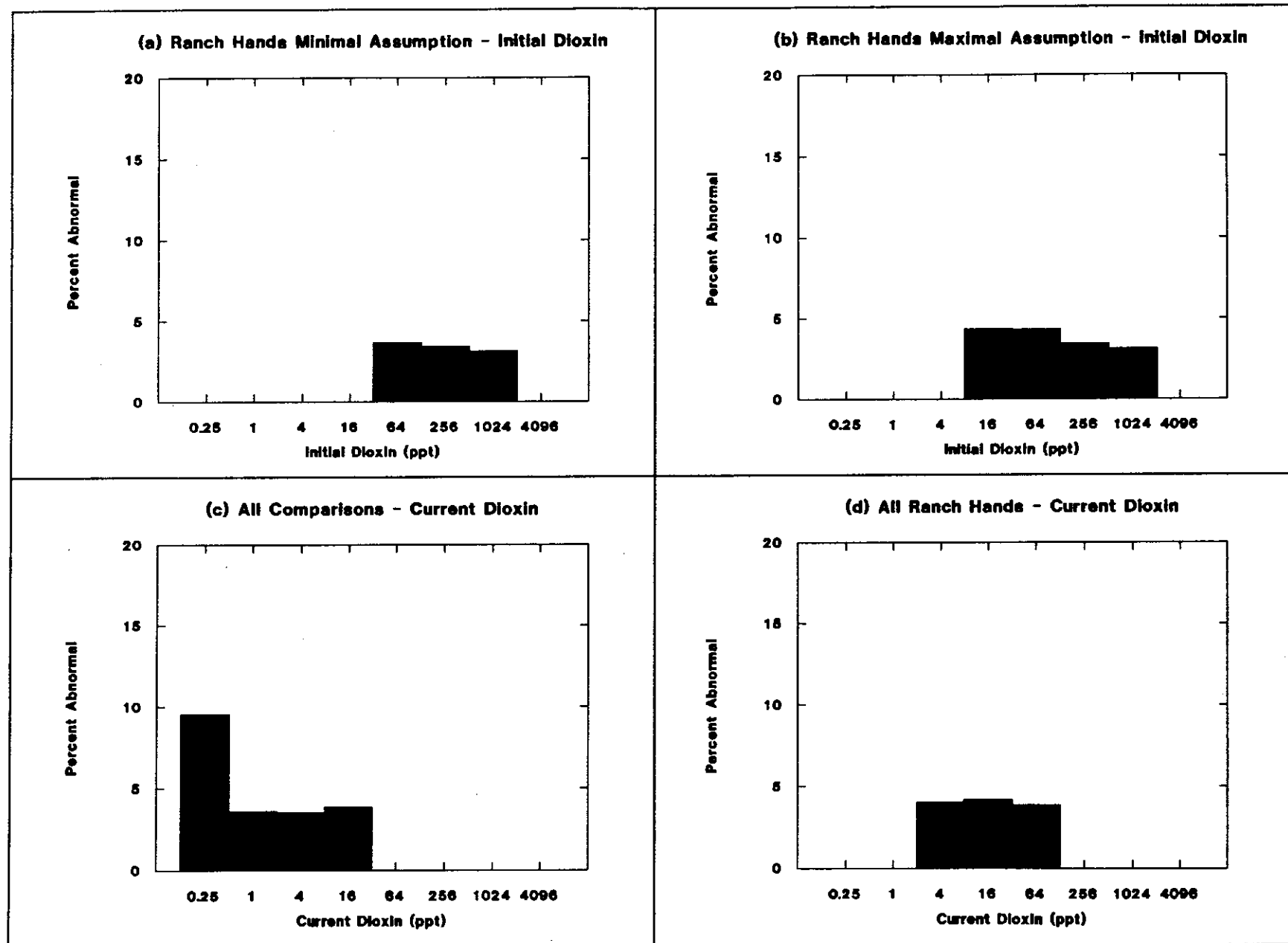


FIGURE N-1-1. Current Thyroid Function versus Dioxin

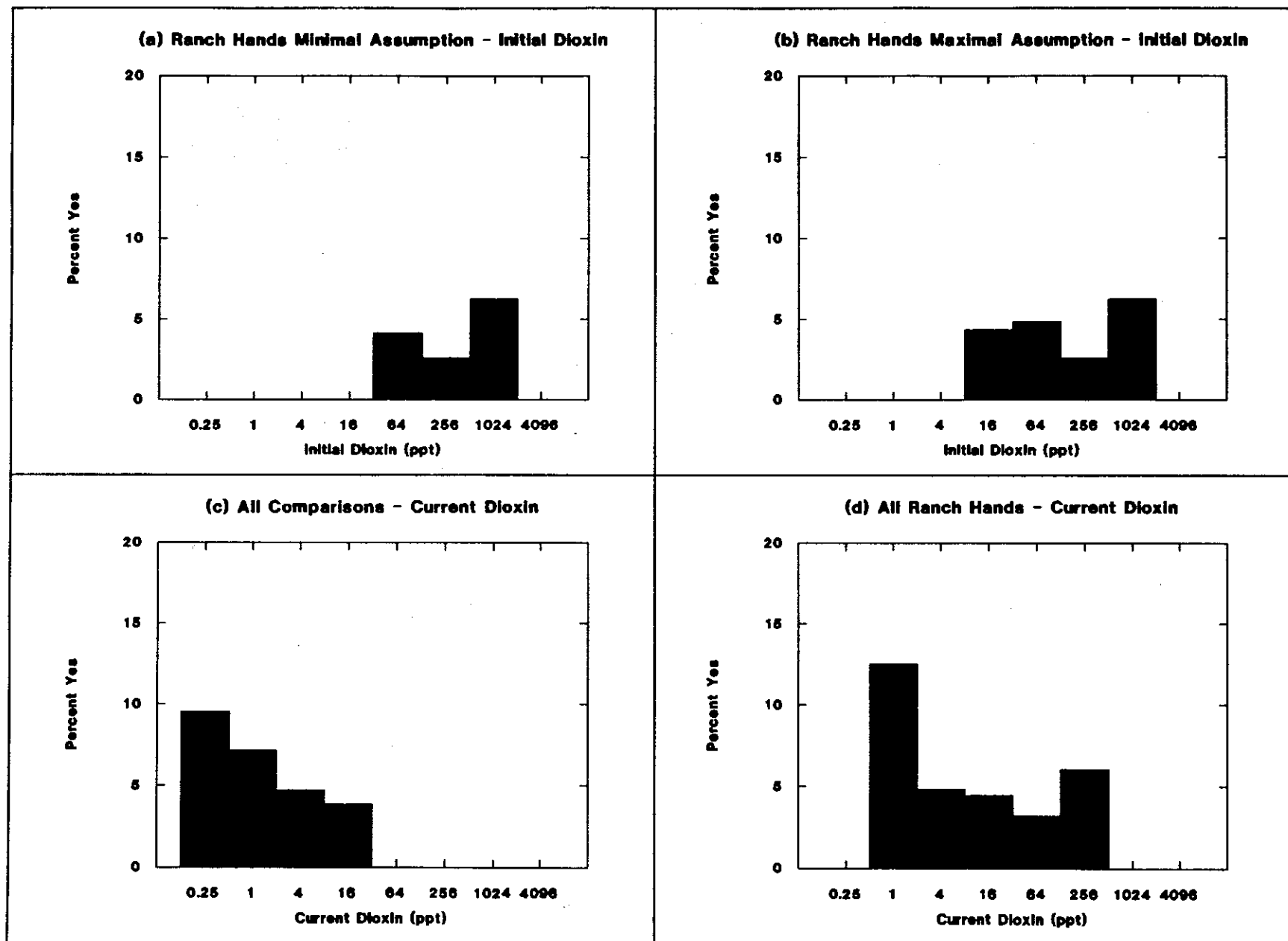


FIGURE N-1-2. History of Thyroid Disease versus Dioxin

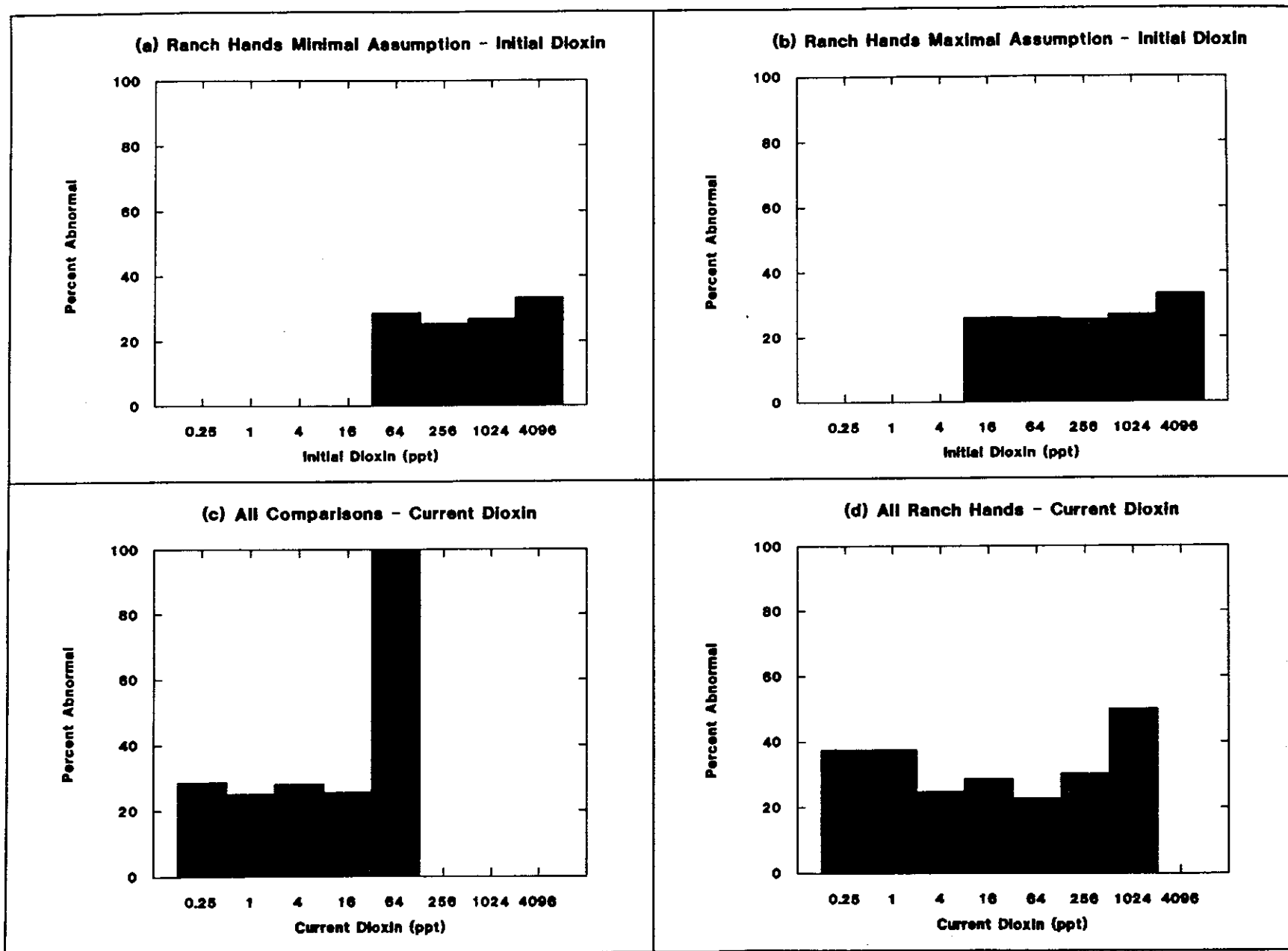


FIGURE N-1-3. Thyroid Gland versus Dioxin

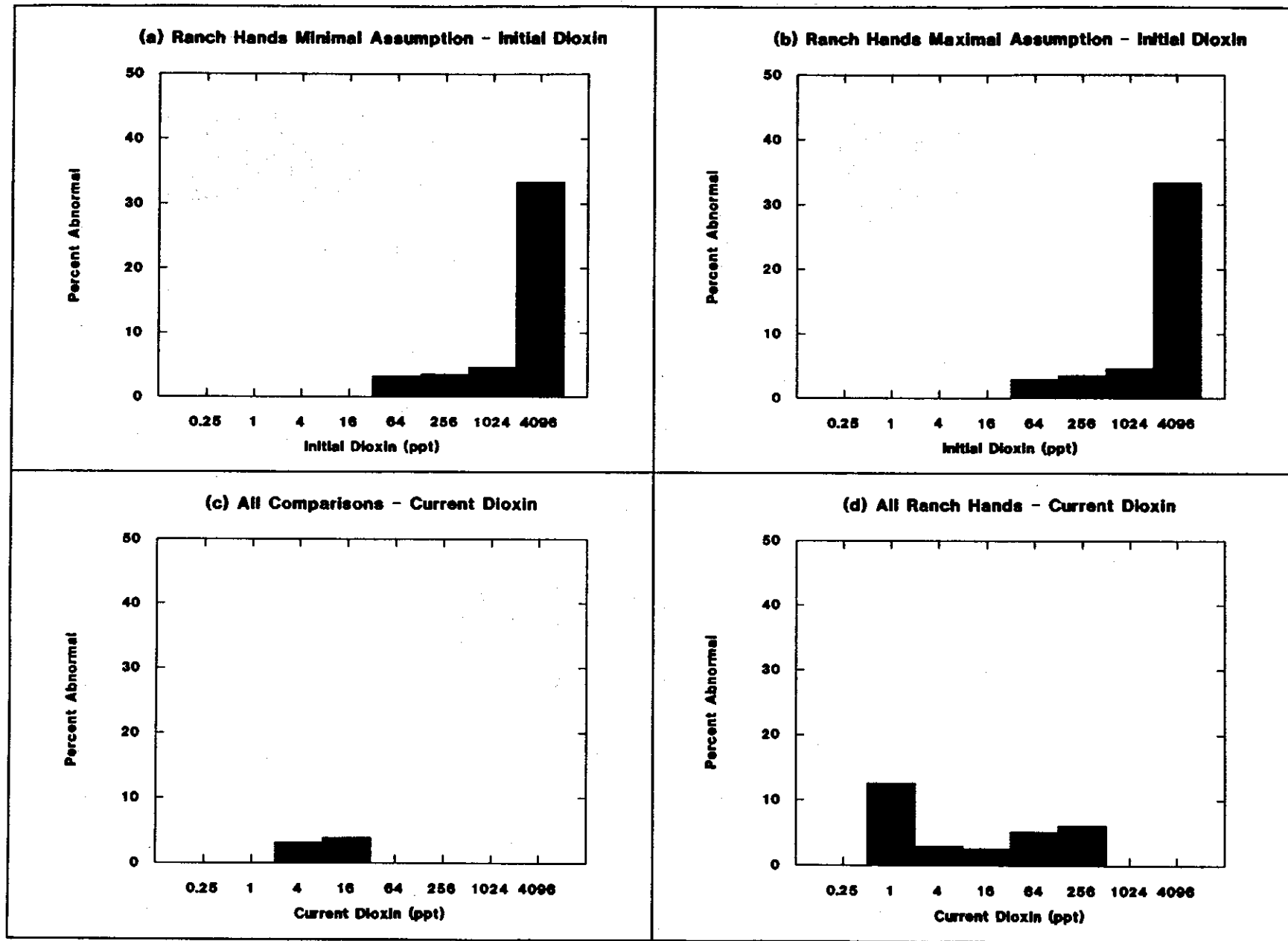


FIGURE N-1-4. Testes Gland versus Dioxin

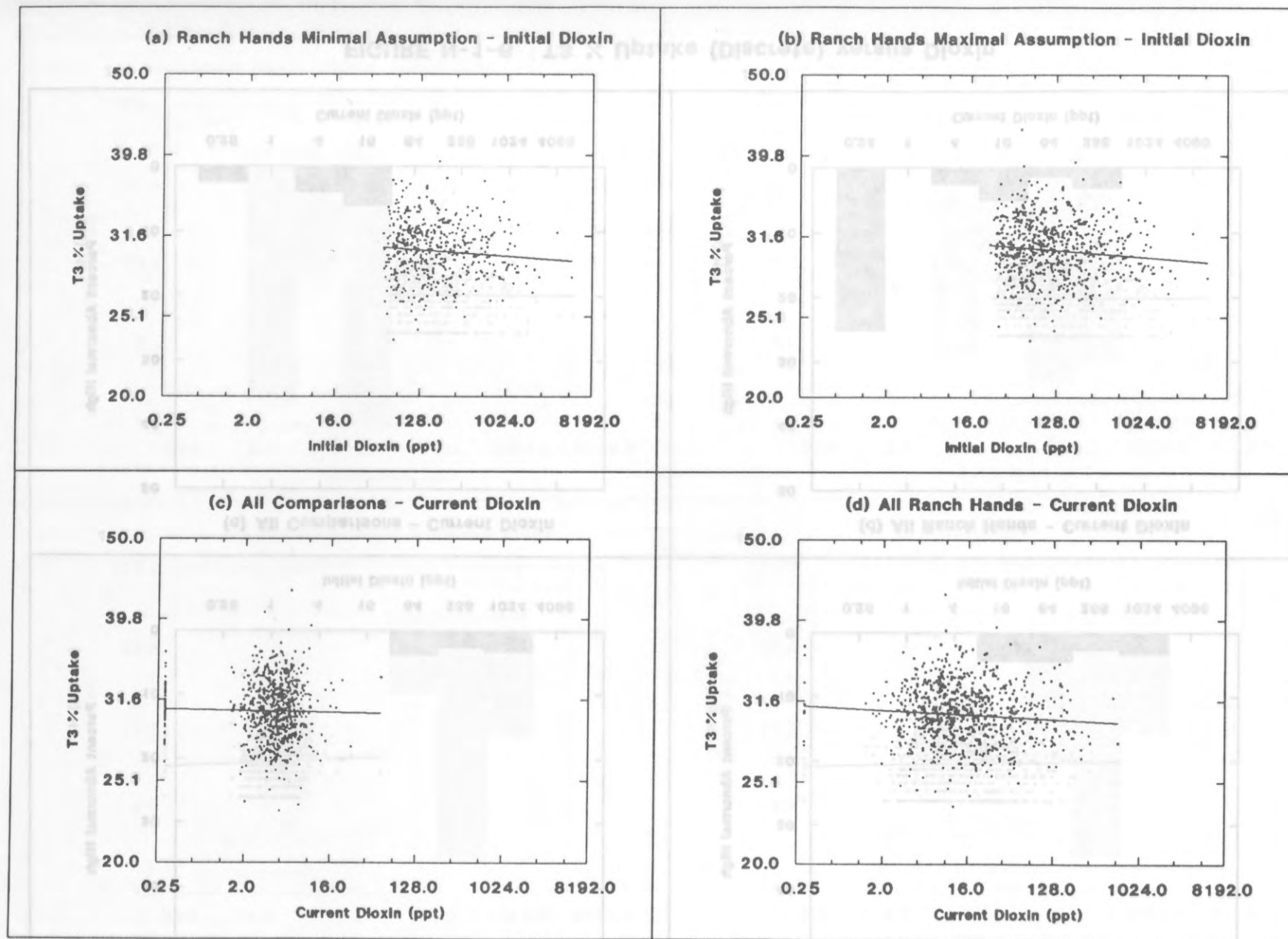


FIGURE N-1-5. T3 % Uptake (Continuous) versus Dioxin

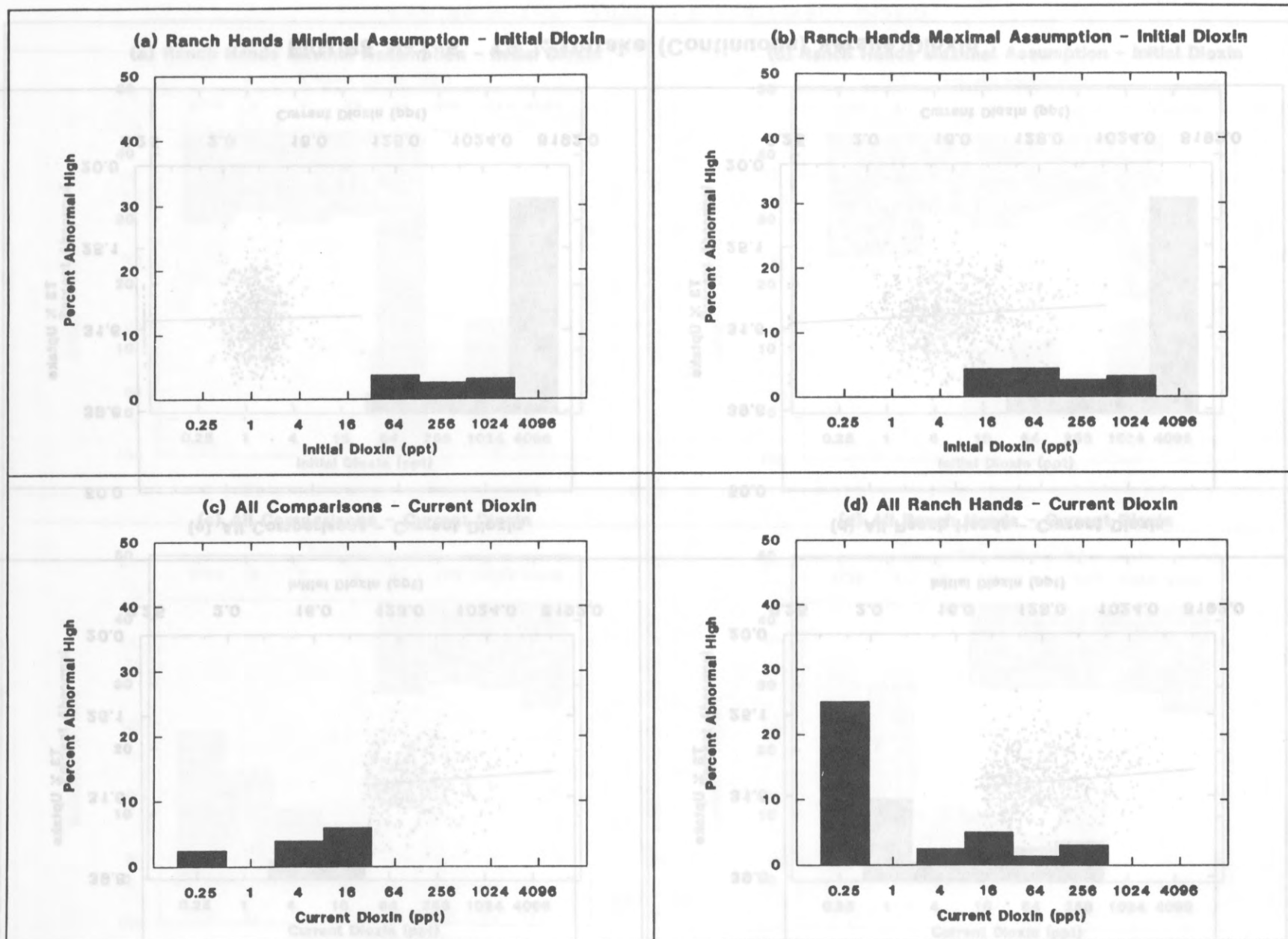


FIGURE N-1-6. T3 % Uptake (Discrete) versus Dioxin

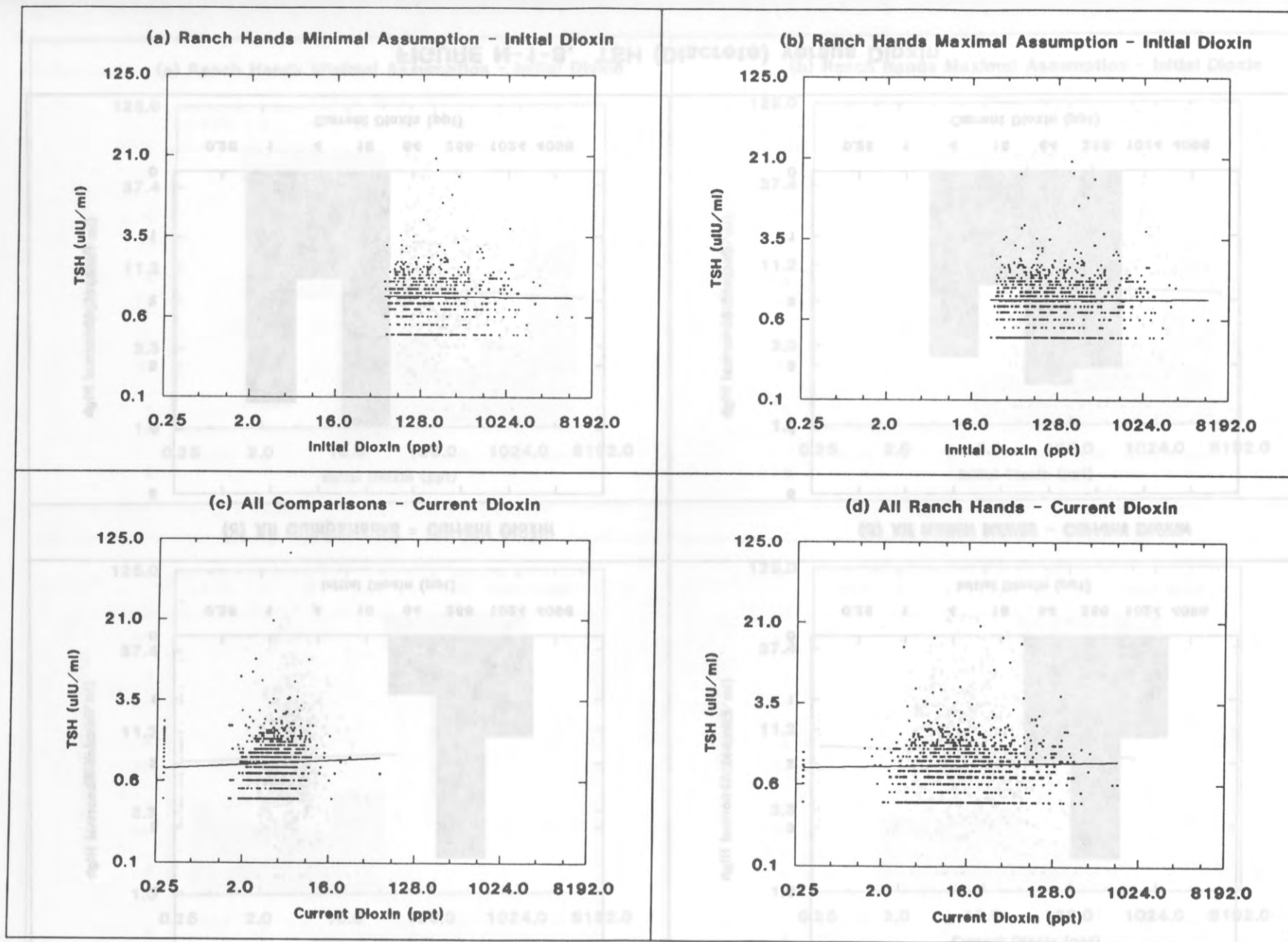
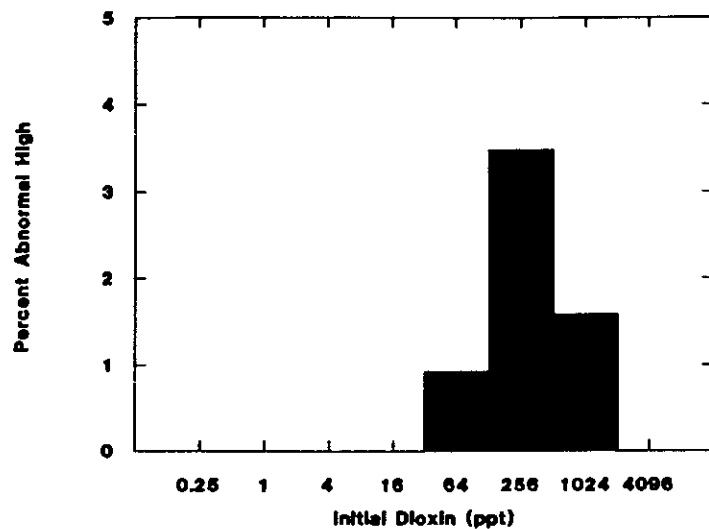
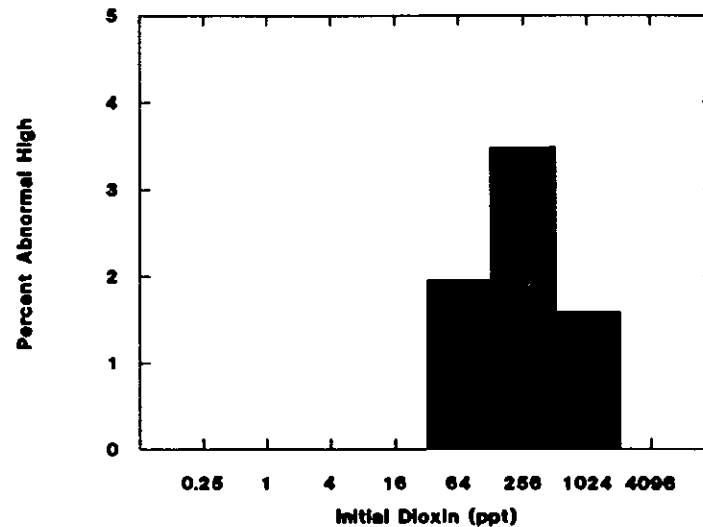
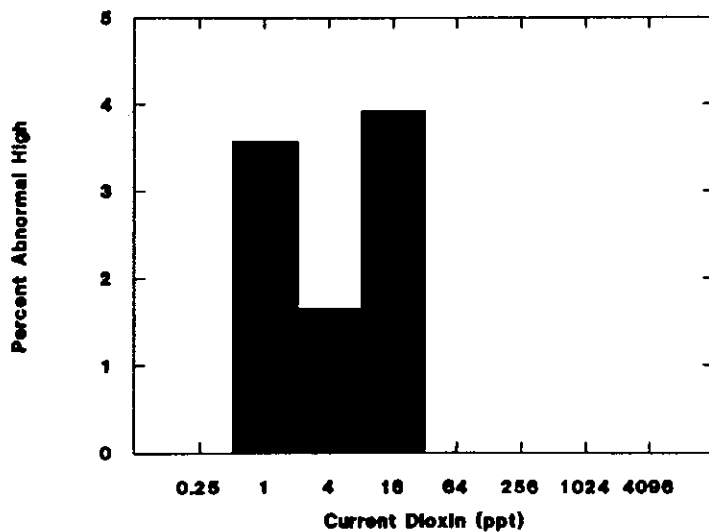
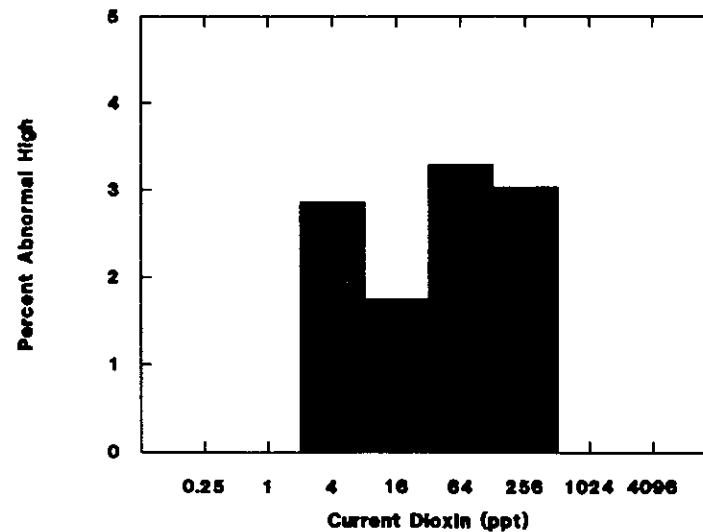


FIGURE N-1-7. TSH (Continuous) versus Dioxin

(a) Ranch Hands Minimal Assumption - Initial Dioxin**(b) Ranch Hands Maximal Assumption - Initial Dioxin****(c) All Comparisons - Current Dioxin****(d) All Ranch Hands - Current Dioxin****FIGURE N-1-8. TSH (Discrete) versus Dioxin**

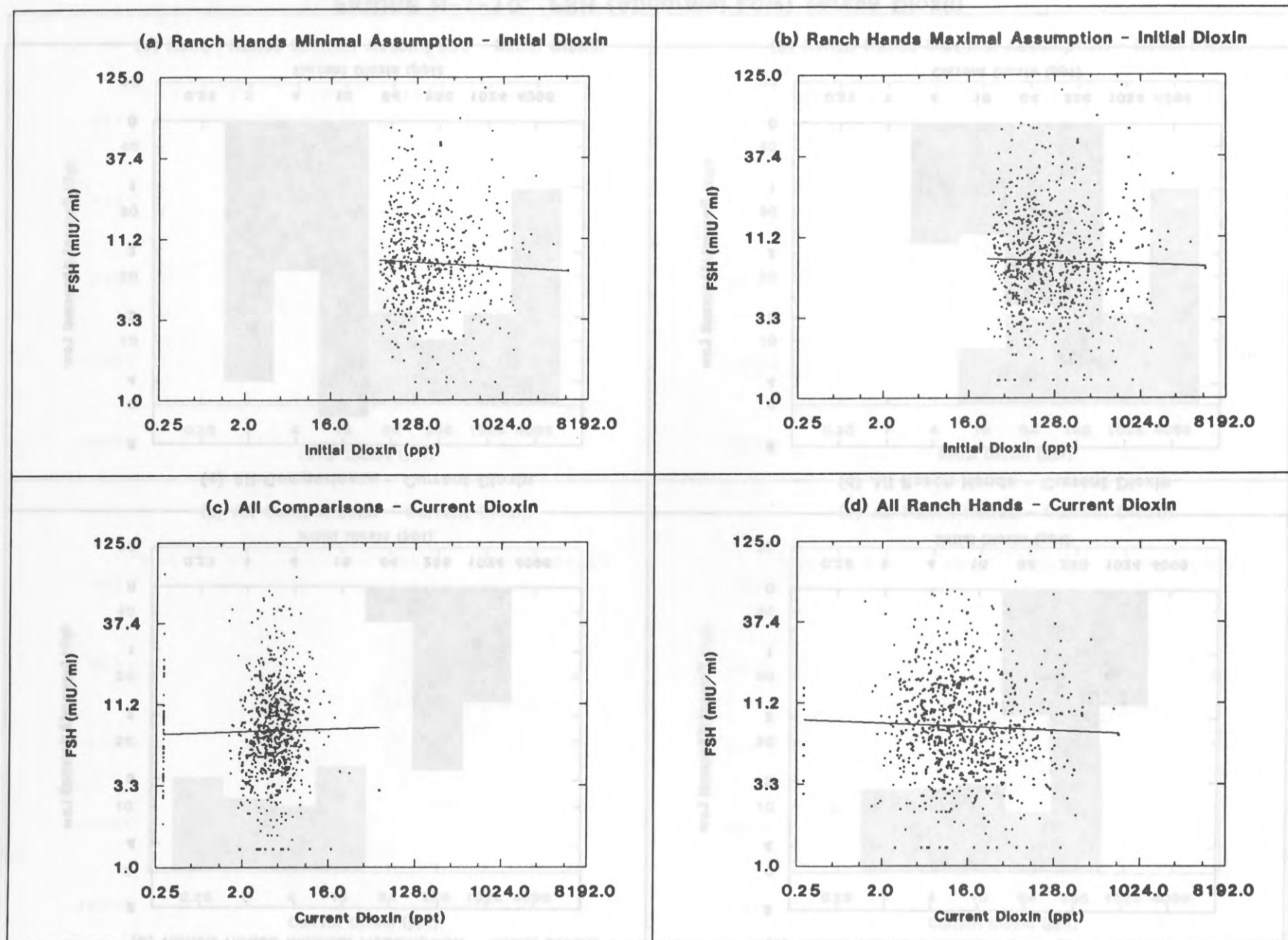


FIGURE N-1-9. FSH (Continuous) versus Dioxin

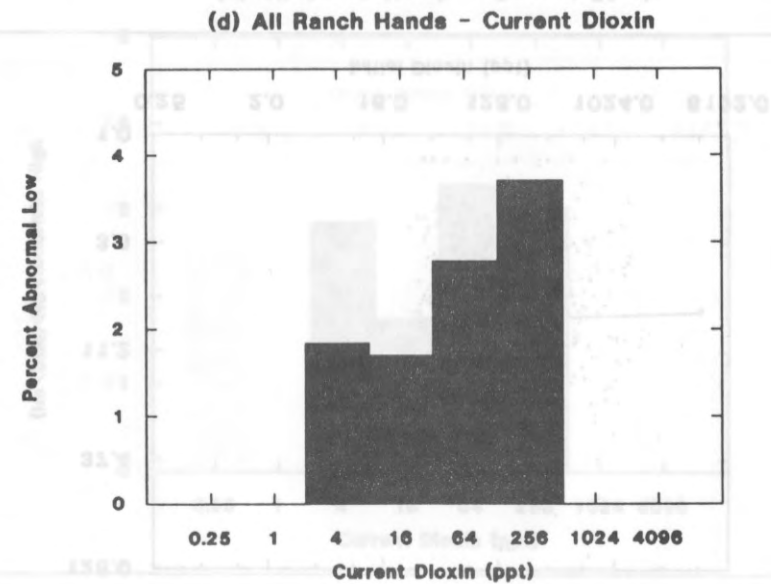
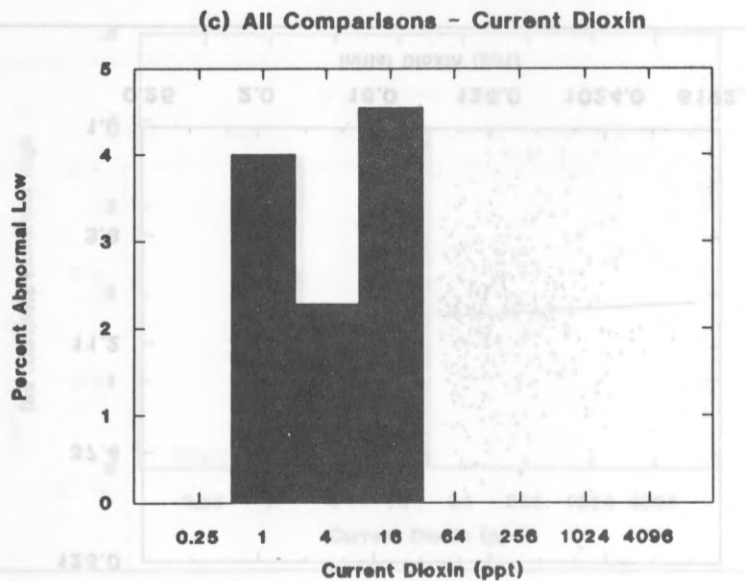
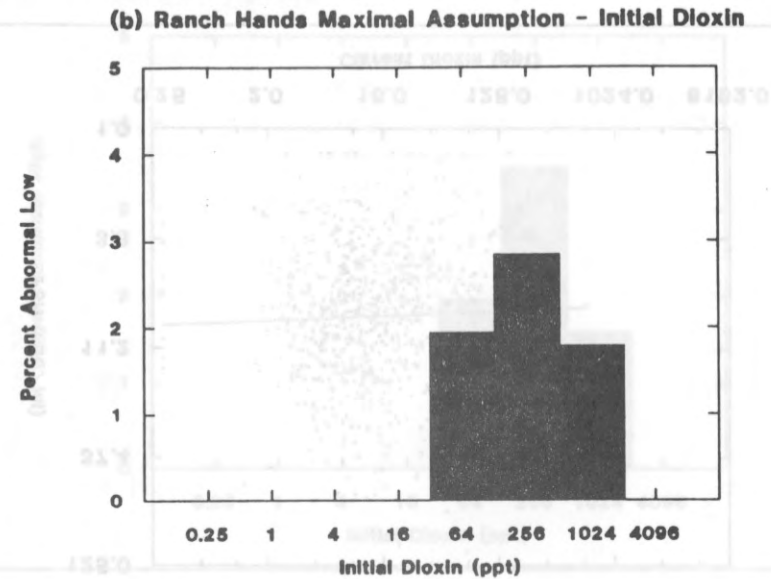
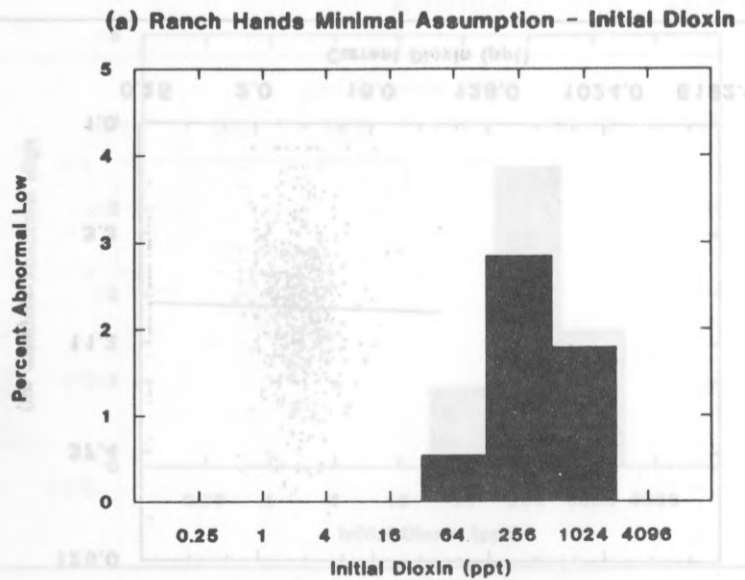


FIGURE N-1-10. FSH (Abnormal Low) versus Dioxin

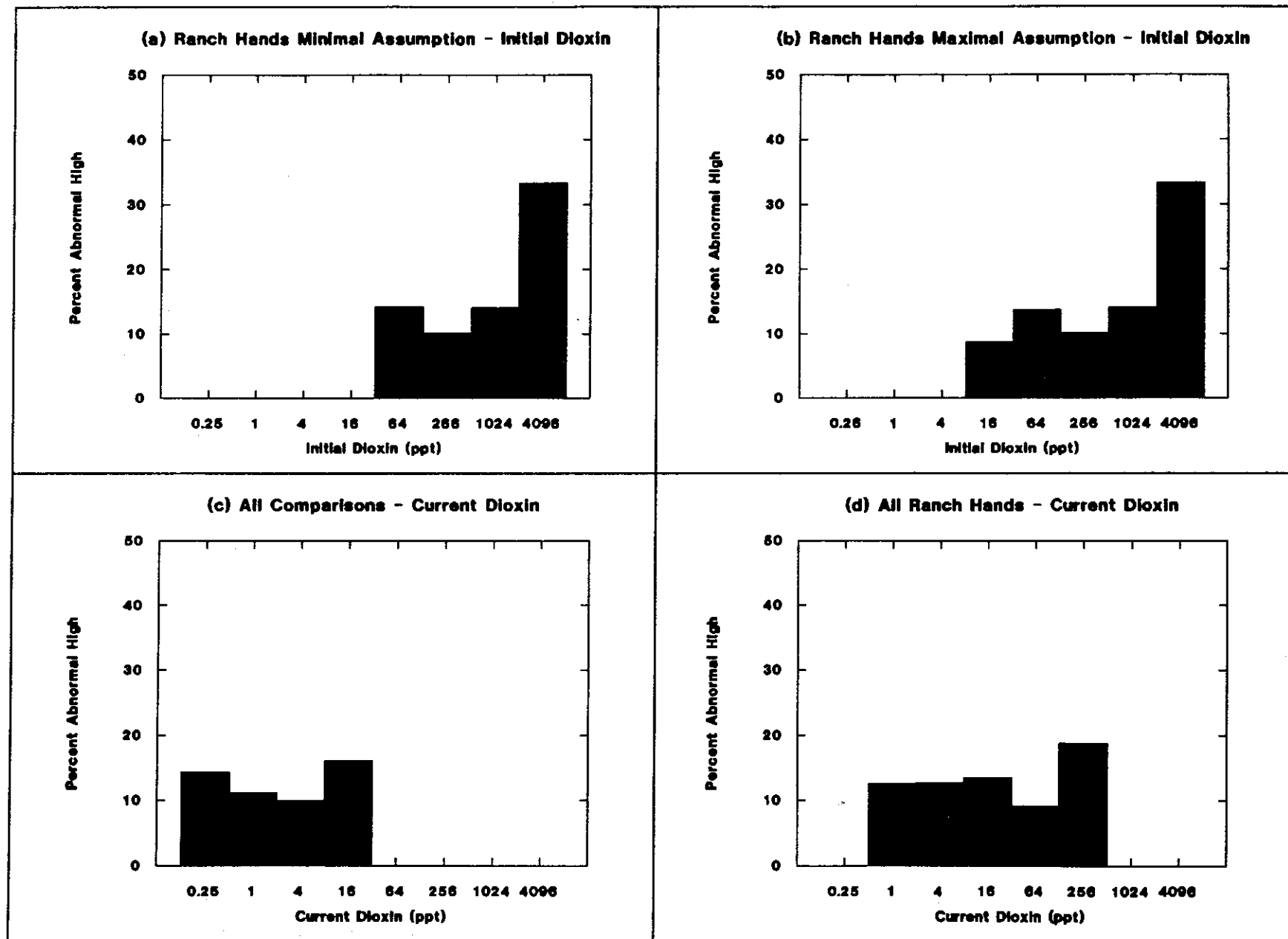


FIGURE N-1-11. FSH (Abnormal High) versus Dioxin

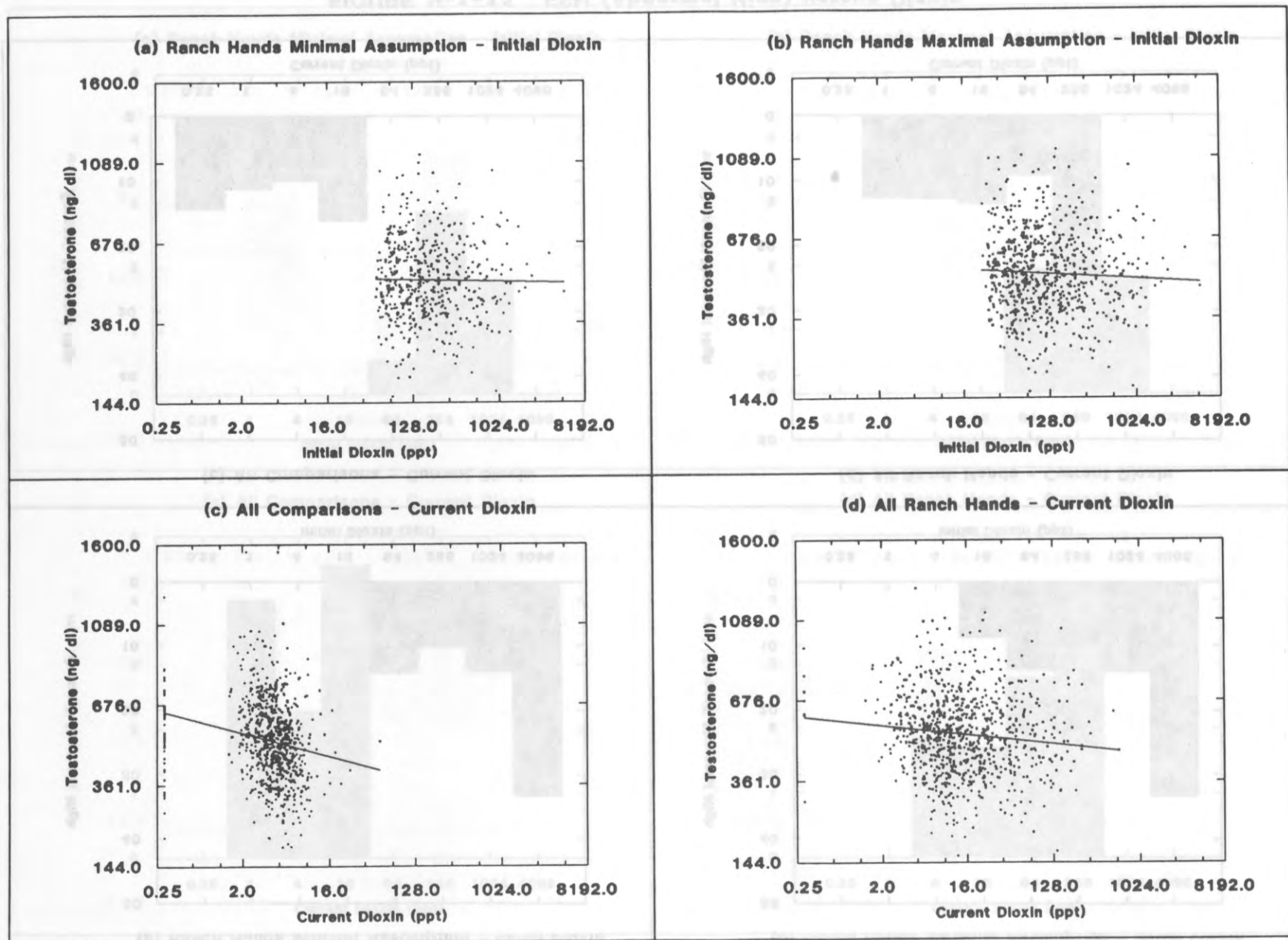


FIGURE N-1-12. Testosterone (Continuous) versus Dioxin

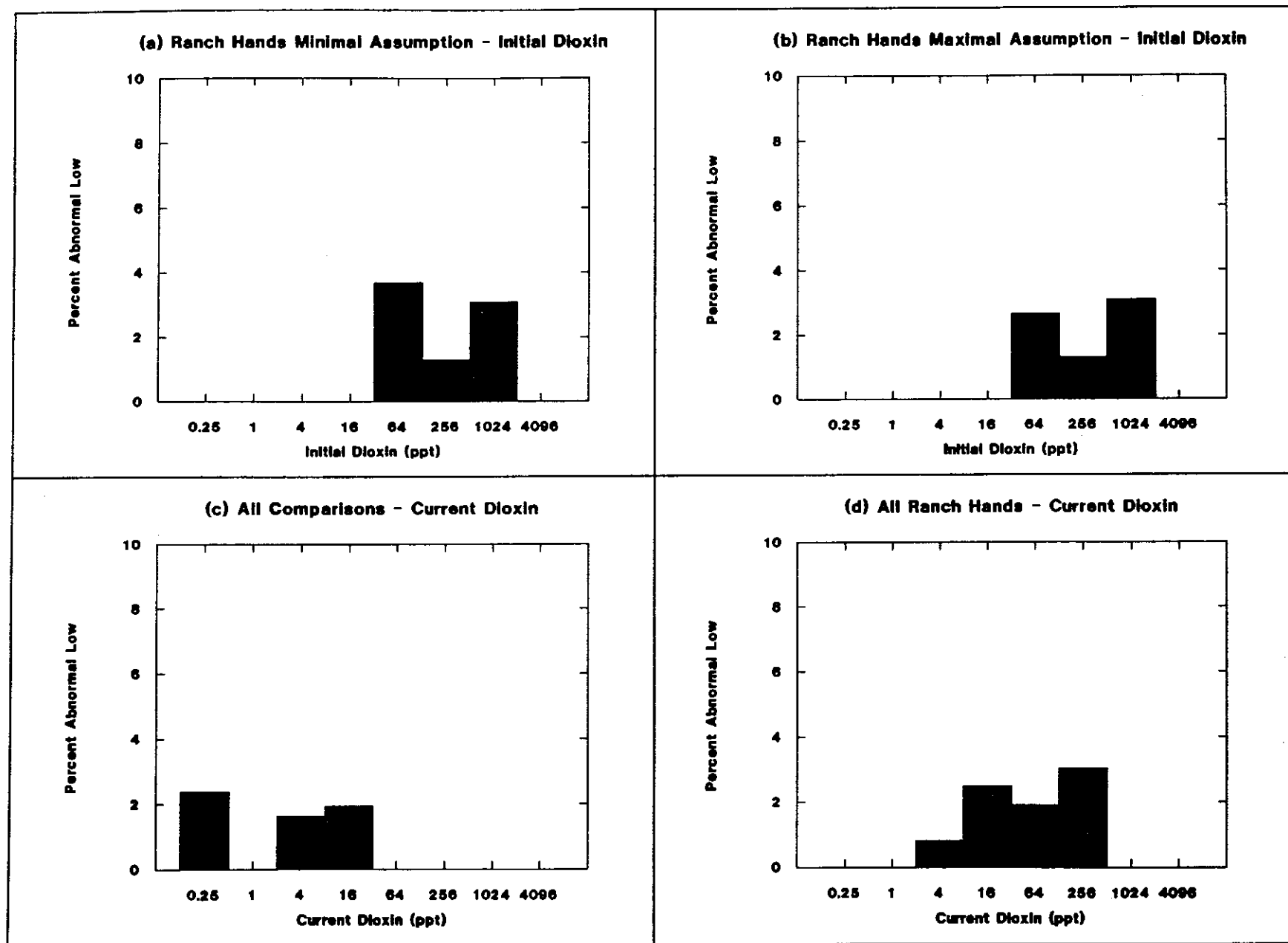


FIGURE N-1-13. Testosterone (Discrete) versus Dioxin

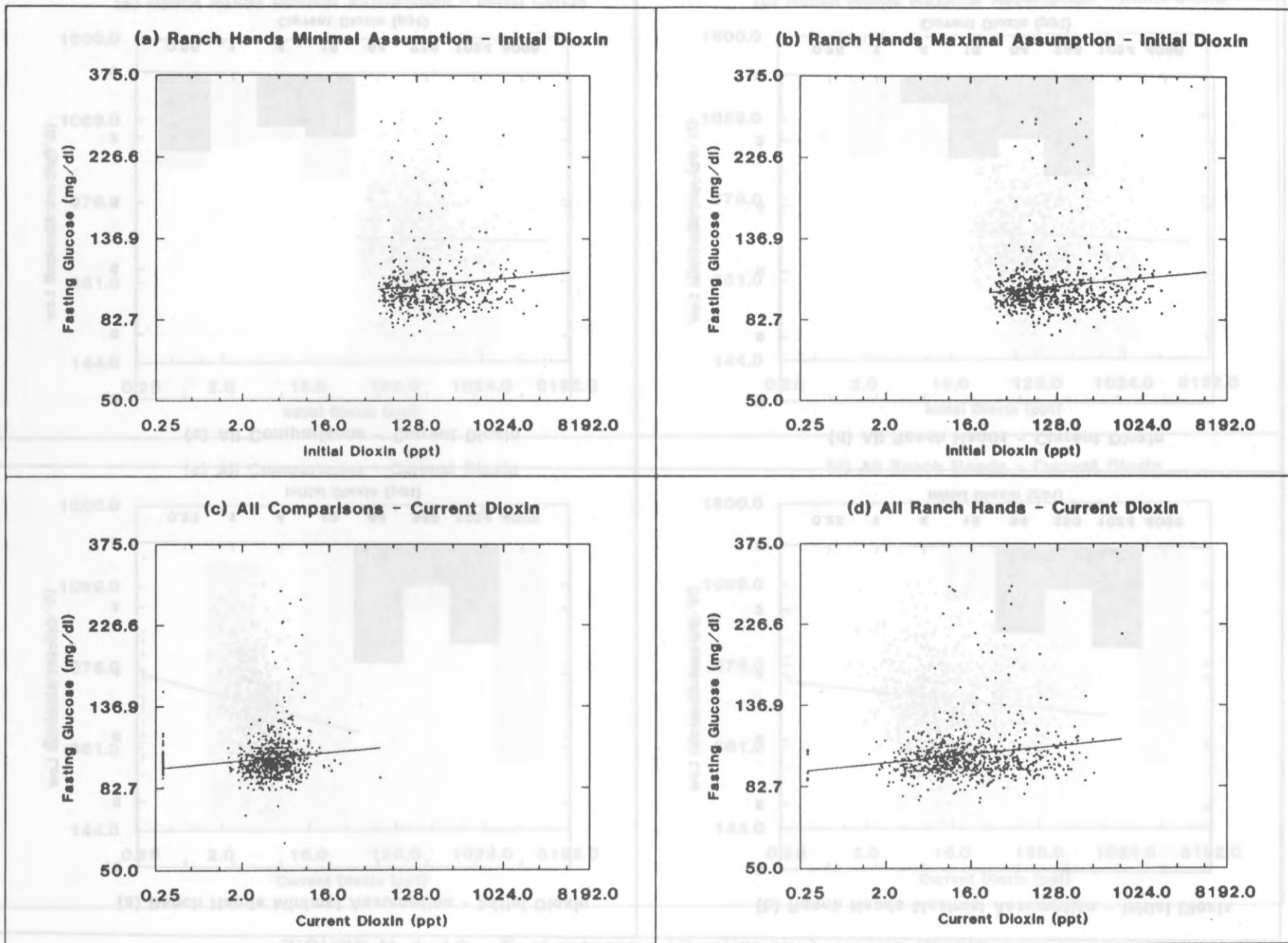


FIGURE N-1-14. Fasting Glucose (Continuous) versus Dioxin

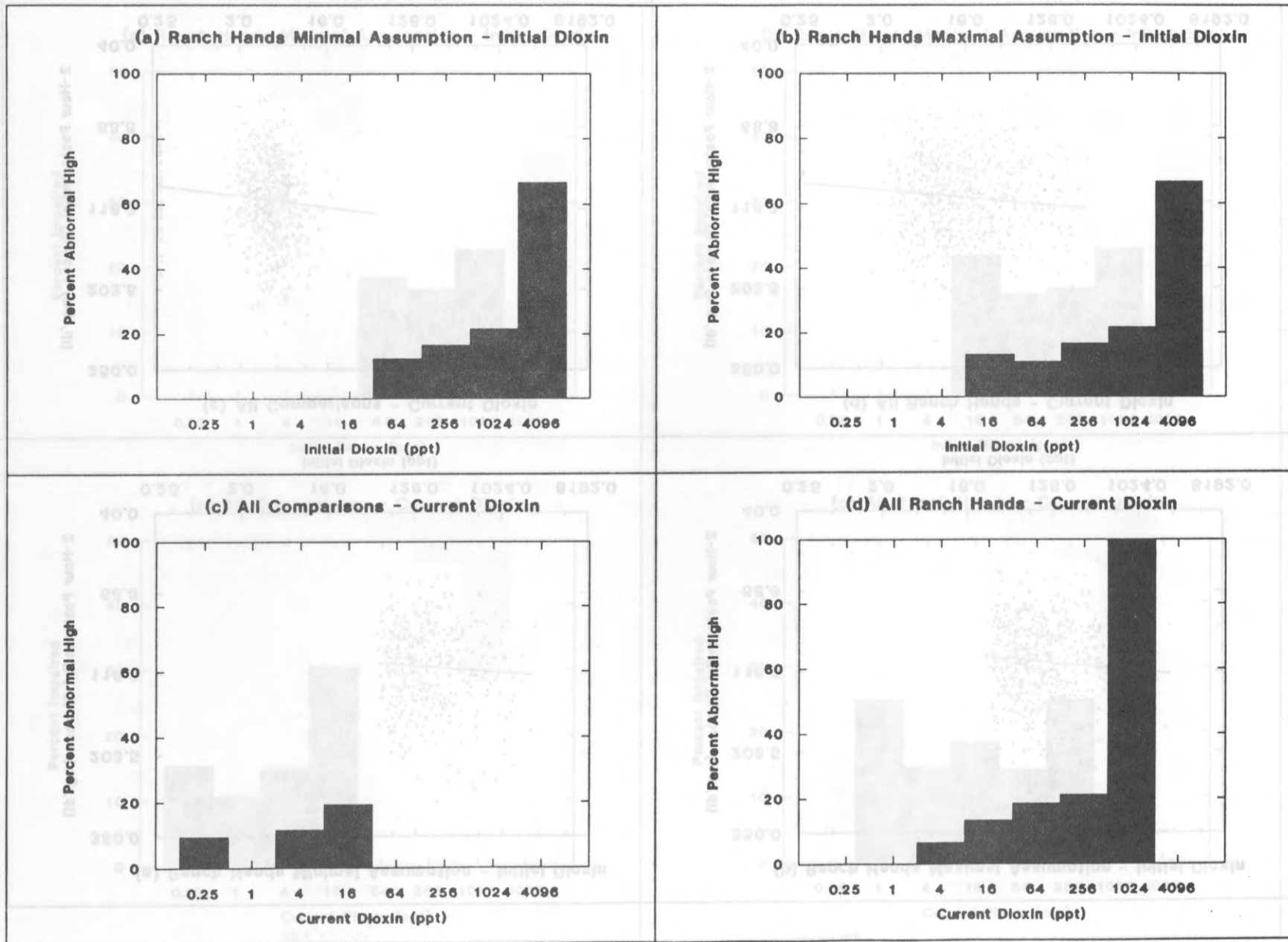


FIGURE N-1-15. Fasting Glucose (Discrete) versus Dioxin

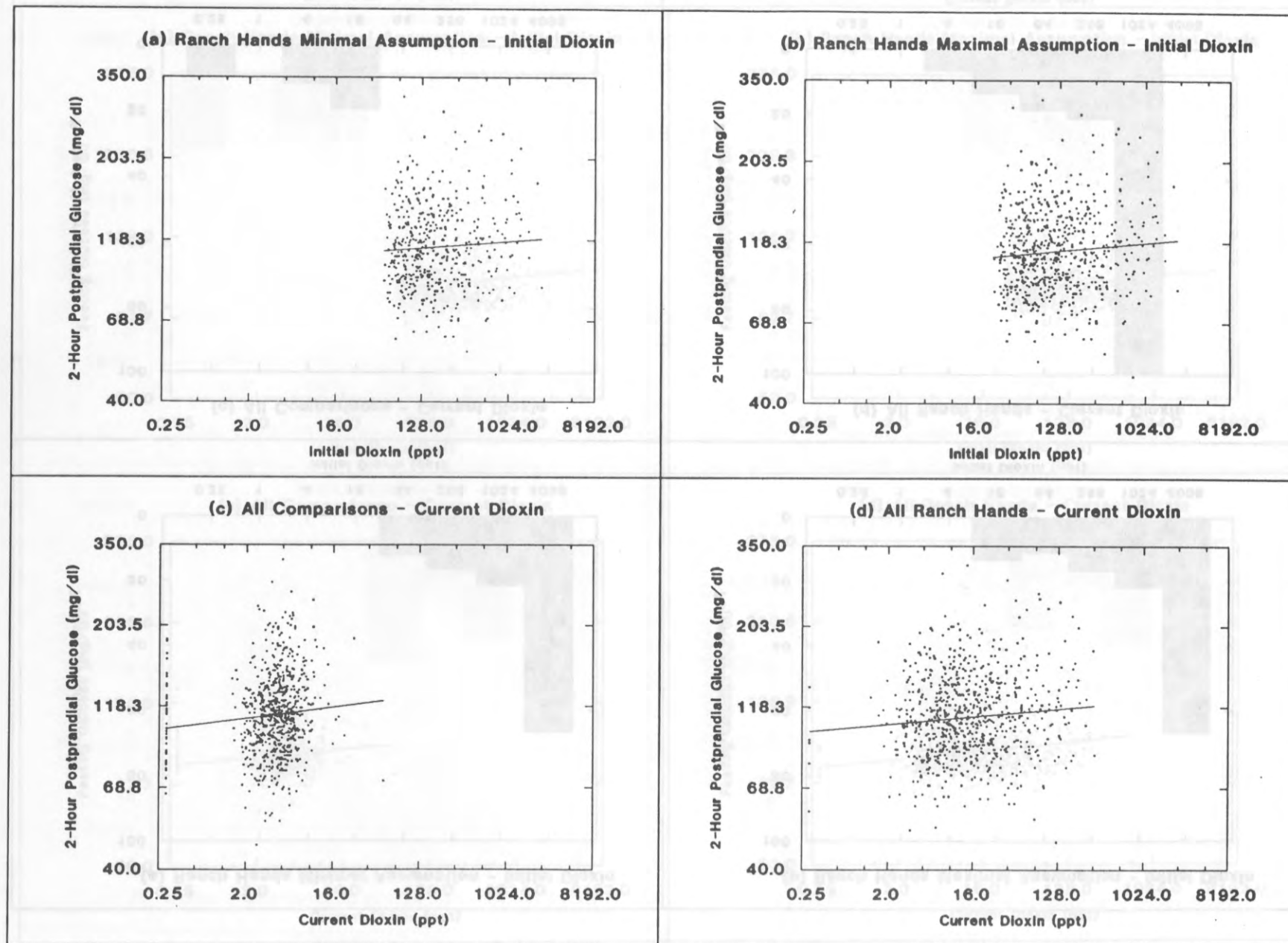


FIGURE N-1-16. 2-Hour Postprandial Glucose (Continuous) versus Dioxin

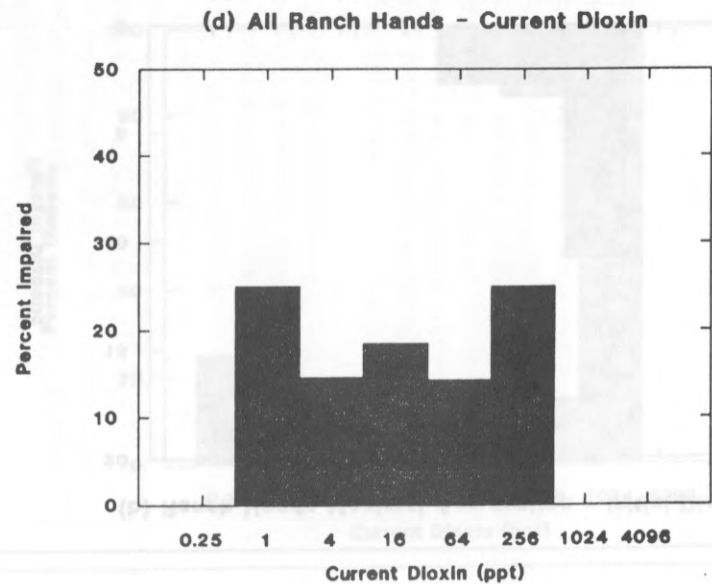
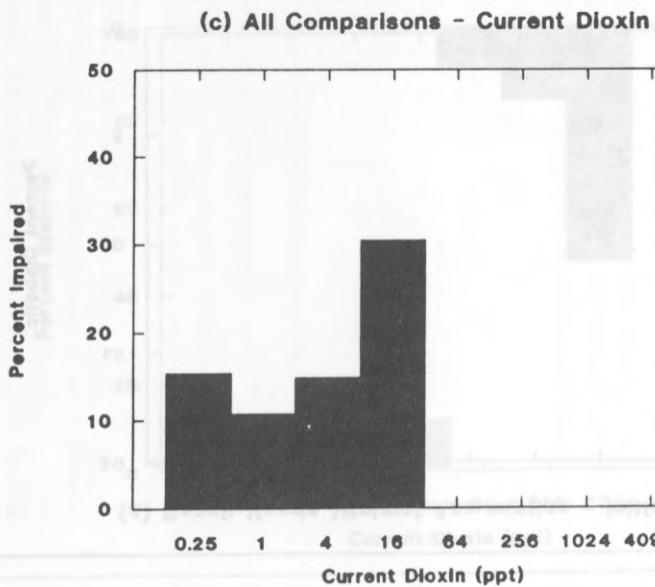
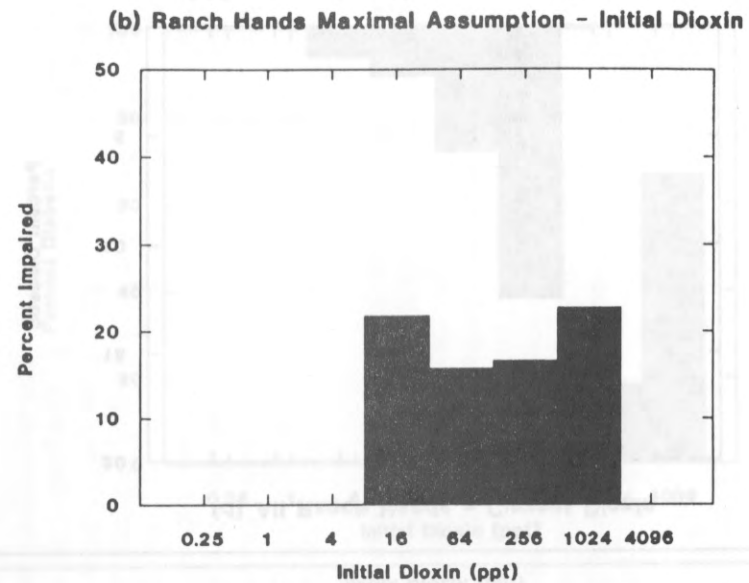
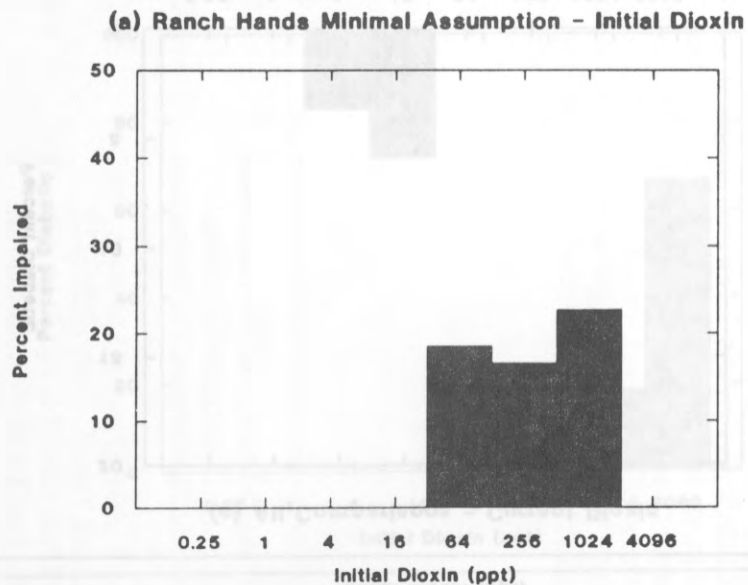


FIGURE N-1-17. 2-Hour Postprandial Glucose (Impaired) versus Dioxin

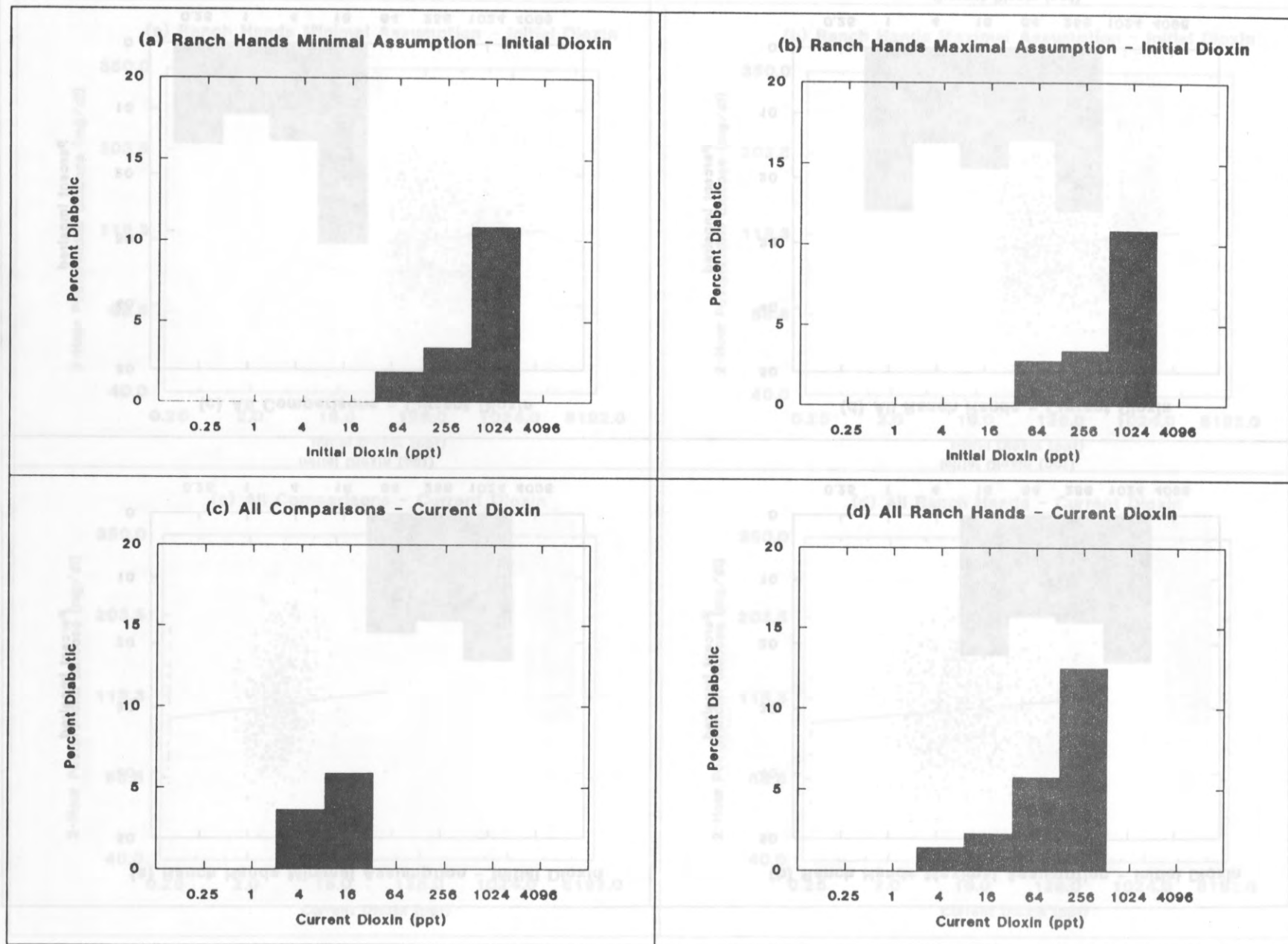


FIGURE N-1-18. 2-Hour Postprandial Glucose (Diabetic) versus Dioxin

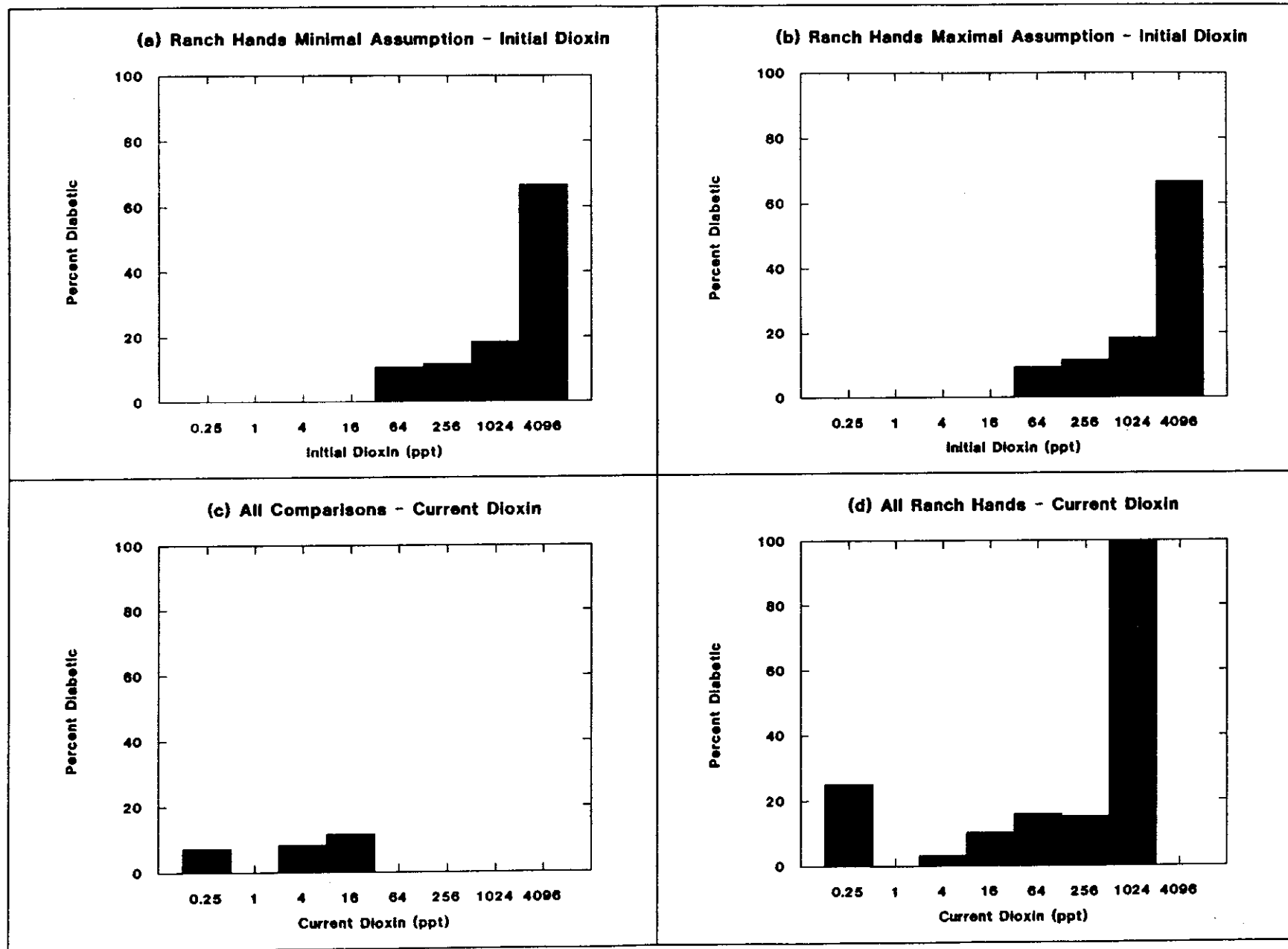


FIGURE N-1-19. Composite Diabetes Indicator versus Dioxin

APPENDIX N-2.

Interaction Displays for the Endocrine Assessment

The following figures graphically display dioxin-by-covariate interactions found in the statistical analyses of the dependent variables in the endocrine assessment. For interactions with initial dioxin in the Ranch Hands involving continuous dependent variables, bivariate plots are presented with observations in each stratum represented by different symbols. Initial dioxin is shown in original units (ppt) but spacing of intervals is based on the logarithm (base 2) scale. The dependent variable is also displayed in original units but spacing is based on the scale used for analysis, as described in the chapter. The reference lines indicate the general relationship, unadjusted for any covariates, between the (transform of the) dependent variable and $\log_2$ (initial dioxin). For each stratum, the lines span the range of initial dioxin.

In the Ranch Hands, for current dioxin-by-time-by-covariate interactions with continuous dependent variables, separate bivariate plots (dependent variable versus current dioxin) are presented for each stratum of the covariate. Different symbols represent late tours (time since tour ≤ 18.6 years) and early tours (time since tour > 18.6 years) within each plot. The spacing for current dioxin and the dependent variable follows the same conventions as described above, as do the reference lines. For current dioxin-by-time-by-covariate interactions in the Ranch Hands with discrete dependent variables, a stratum-specific percentage of participants that exhibited an abnormal condition is displayed for low, medium, and high current dioxin. Different designs represent separate time since tour categories, and covariate strata are given on separate panels. Appendix Table N-1 provides the sample sizes for each bar on the graph.

For covariate interactions with current dioxin categorized within the Ranch Hand and Comparison groups involving continuous dependent variables, adjusted means for the background category in the Comparisons, and the unknown, low, and high categories in the Ranch Hands, are shown. Appendix Table N-1 presents the definition of these categories and the sample sizes for each mean. Different symbols distinguish the covariate categories and solid line segments connect the means to display a profile of the adjusted means. For covariate interactions with current dioxin categorized within the Ranch Hand and Comparison groups involving discrete dependent variables, bars representing the percentage of participants that exhibited an abnormal condition are displayed for each of the four current dioxin categories. Different designs represent covariate categories.

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N-2-1	Interaction of Categorized Current Dioxin and Age for T3 % Uptake (Continuous)	N-2-3
N-2-2	Interaction of Categorized Current Dioxin and Age for T3 % Uptake (Discrete)	N-2-4
N-2-3	Interaction of Current Dioxin, Time, and Personality Type for TSH (Discrete - Ranch Hands, Maximal Assumption).....	N-2-5
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Figure		Page
N-2-5	Interaction of Initial Dioxin for Personality Type for Testosterone (Continuous - Ranch Hands, Maximal Assumption).....	N-2-7
N-2-6	Interaction of Categorized Current Dioxin and Personality Type for Testosterone (Discrete).....	N-2-8
N-2-7	Interaction of Current Dioxin, Time, and Age for Fasting Glucose (Continuous - Ranch Hands, Maximal Assumption).....	N-2-9
N-2-8	Interaction of Categorized Current Dioxin, Age, and Lifetime Alcohol History for Fasting Glucose (Continuous)	N-2-10
N-2-9	Interaction of Current Dioxin, Time, and Race for Fasting Glucose (Discrete - Ranch Hands, Maximal Assumption).....	N-2-11
N-2-10	Interaction of Initial Dioxin and Percent Body Fat for 2-Hour Postprandial Glucose (Continuous - Ranch Hands, Minimal Assumption).....	N-2-12
N-2-11	Interaction of Current Dioxin, Time, and Personality Type for 2-Hour Postprandial Glucose (Continuous - Ranch Hands, Minimal Assumption)	N-2-13
N-2-12	Interaction of Categorized Current Dioxin and Age for the Composite Diabetes Indicator	N-2-14

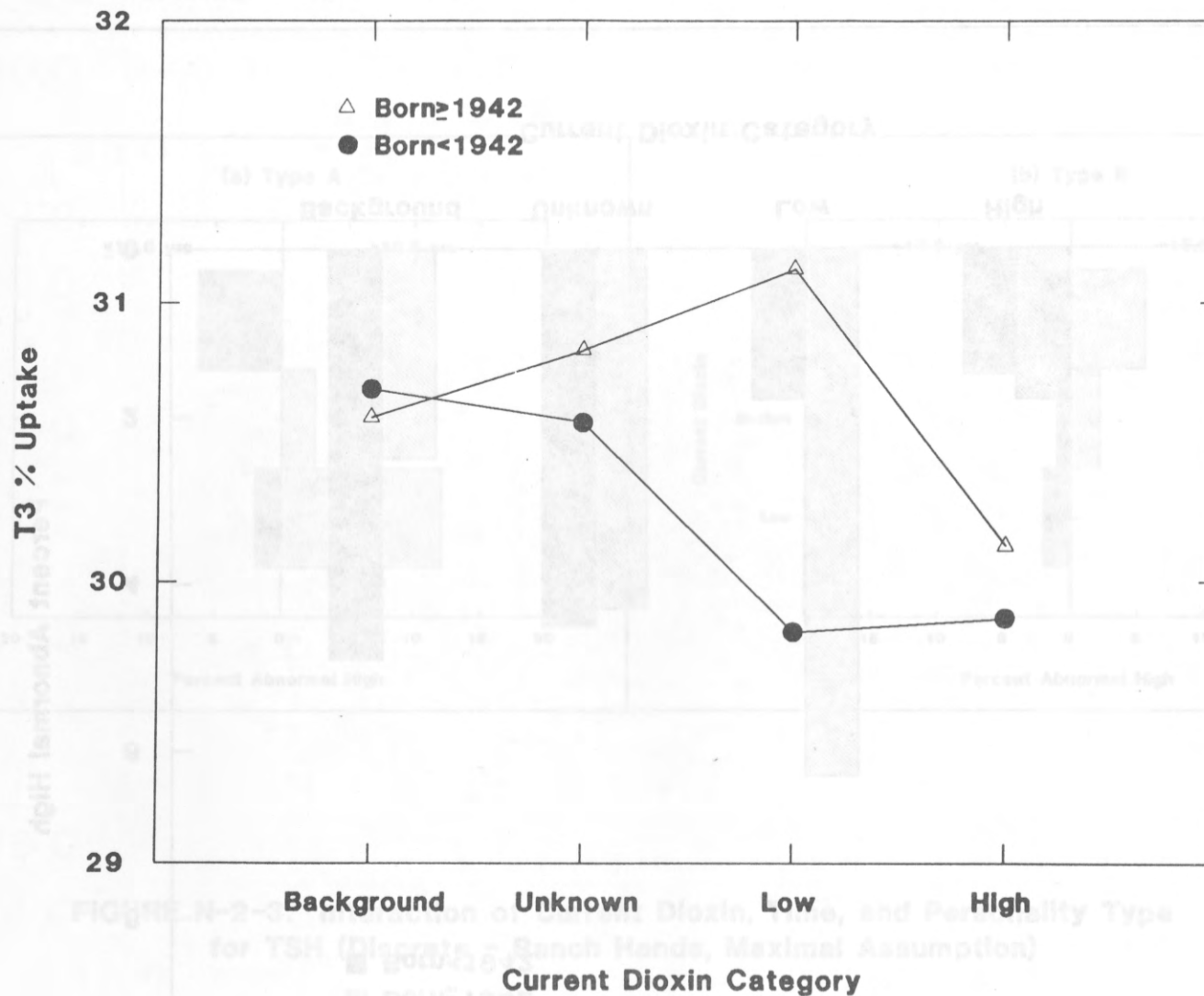


FIGURE N-2-1. Interaction of Categorized Current Dioxin and Age for T3 % Uptake (Continuous)

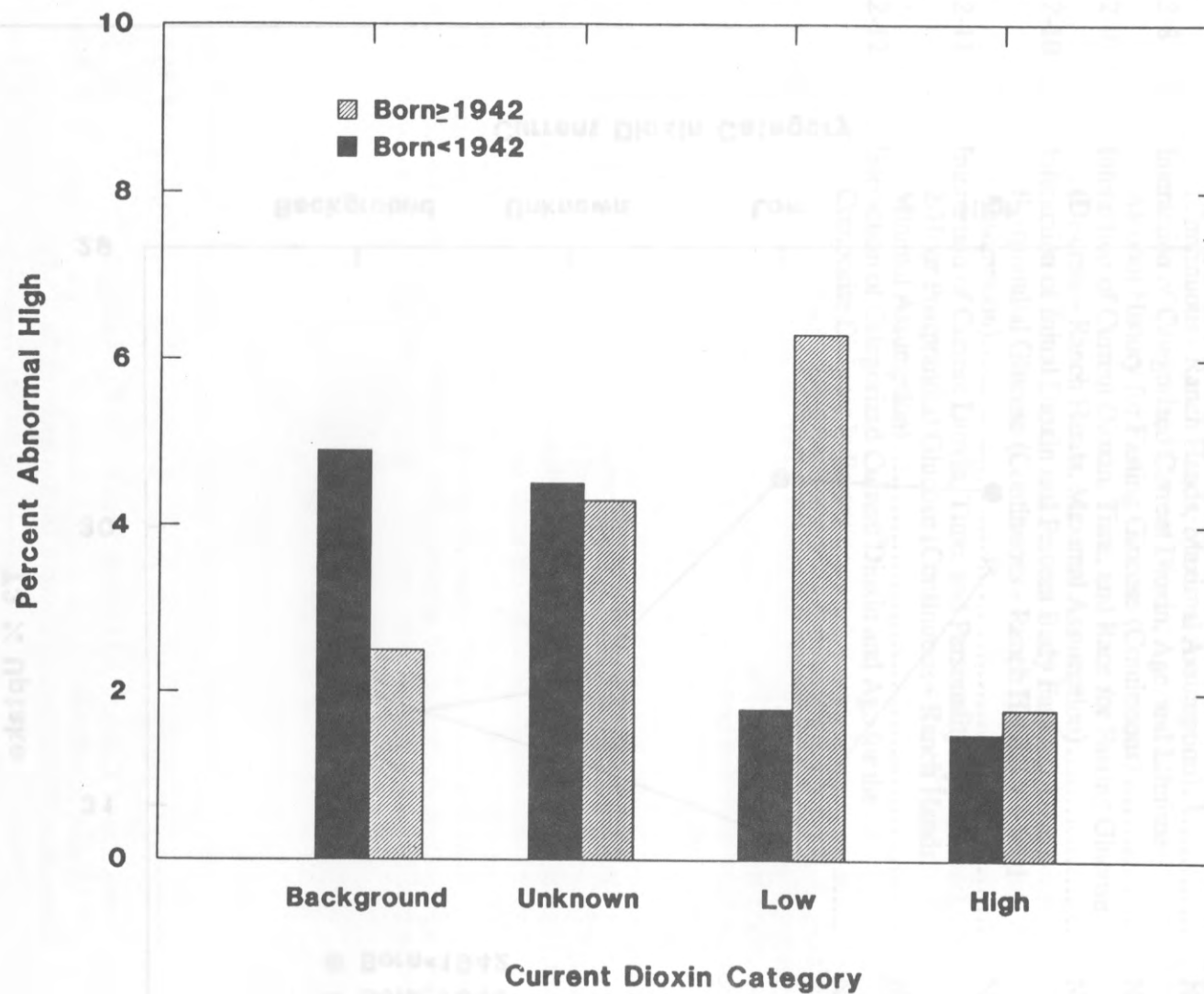


FIGURE N-2-2. Interaction of Categorized Current Dioxin and Age for T3 % Uptake (Discrete)

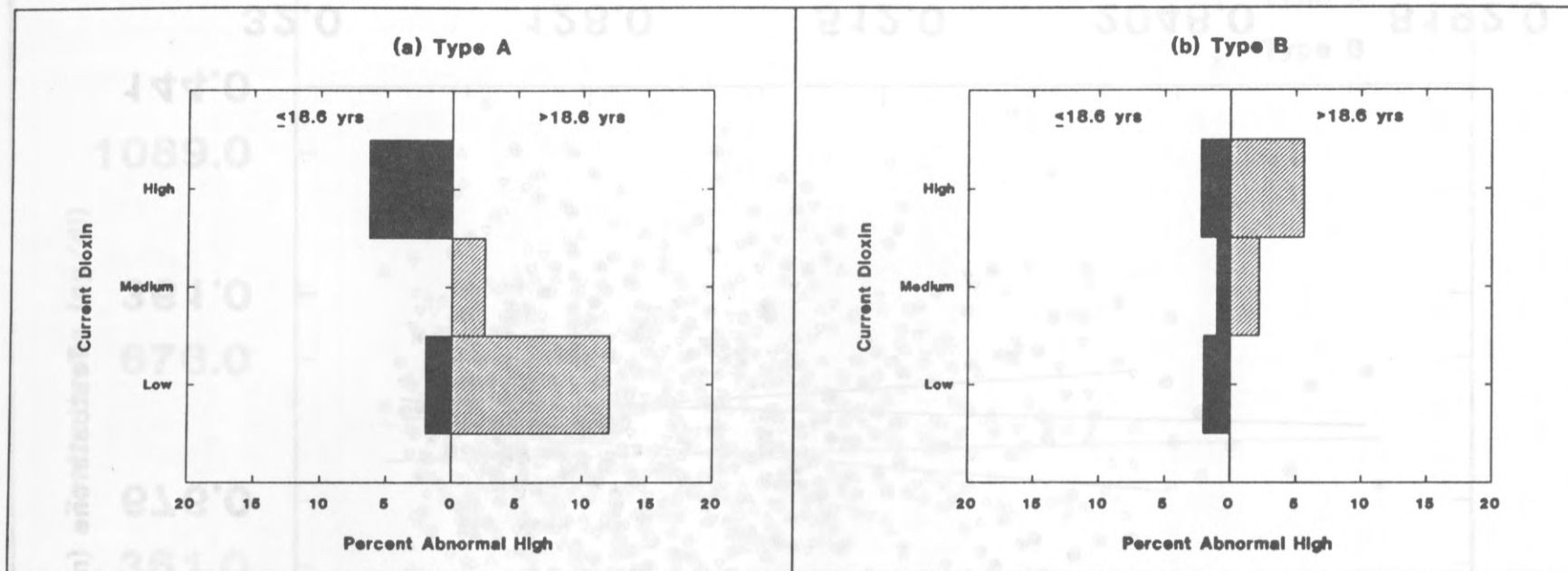


FIGURE N-2-3. Interaction of Current Dioxin, Time, and Personality Type for TSH (Discrete - Ranch Hands, Maximal Assumption)

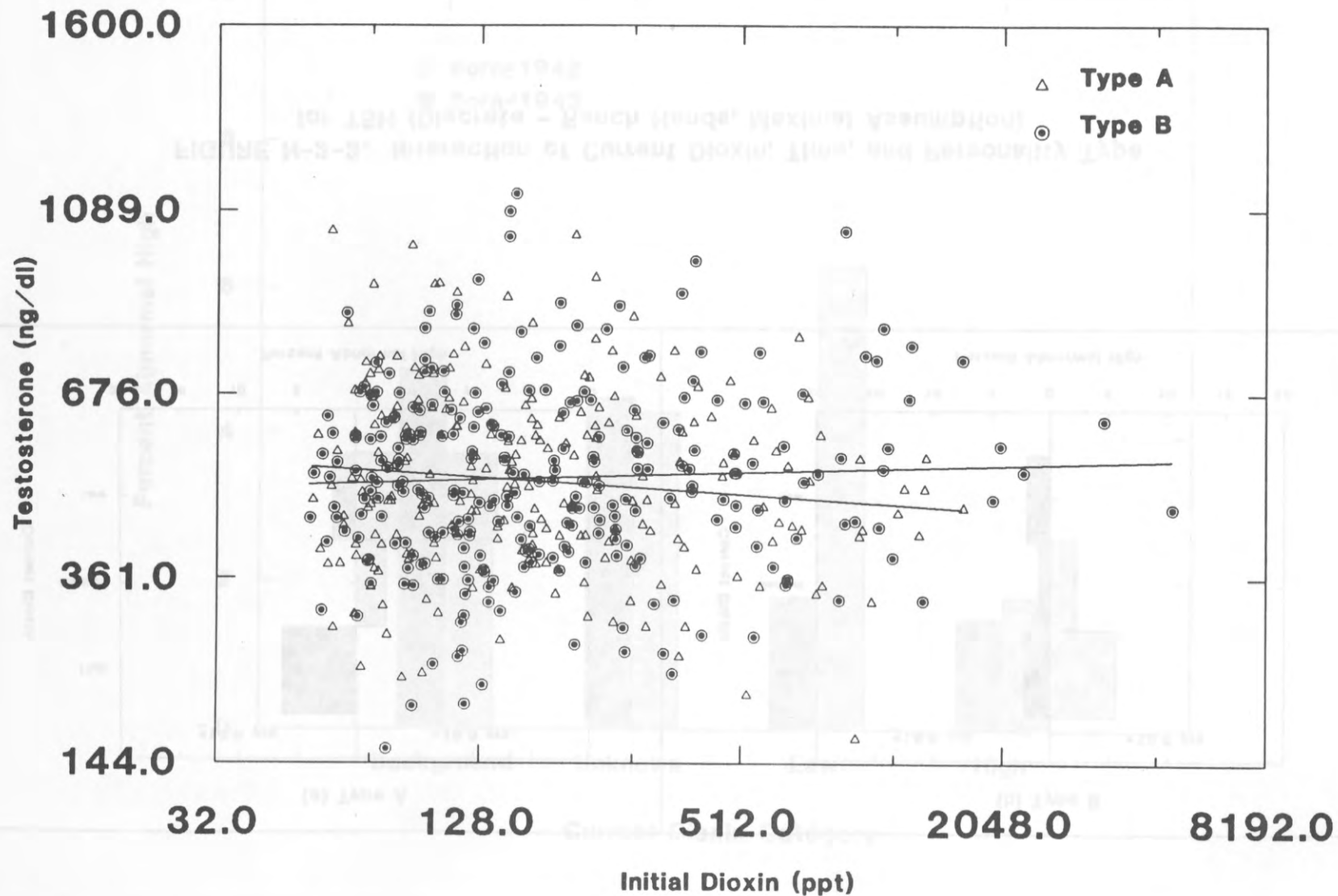


FIGURE N-2-4. Interaction of Initial Dioxin and Personality Type for Testosterone (Continuous - Ranch Hands, Minimal Assumption)

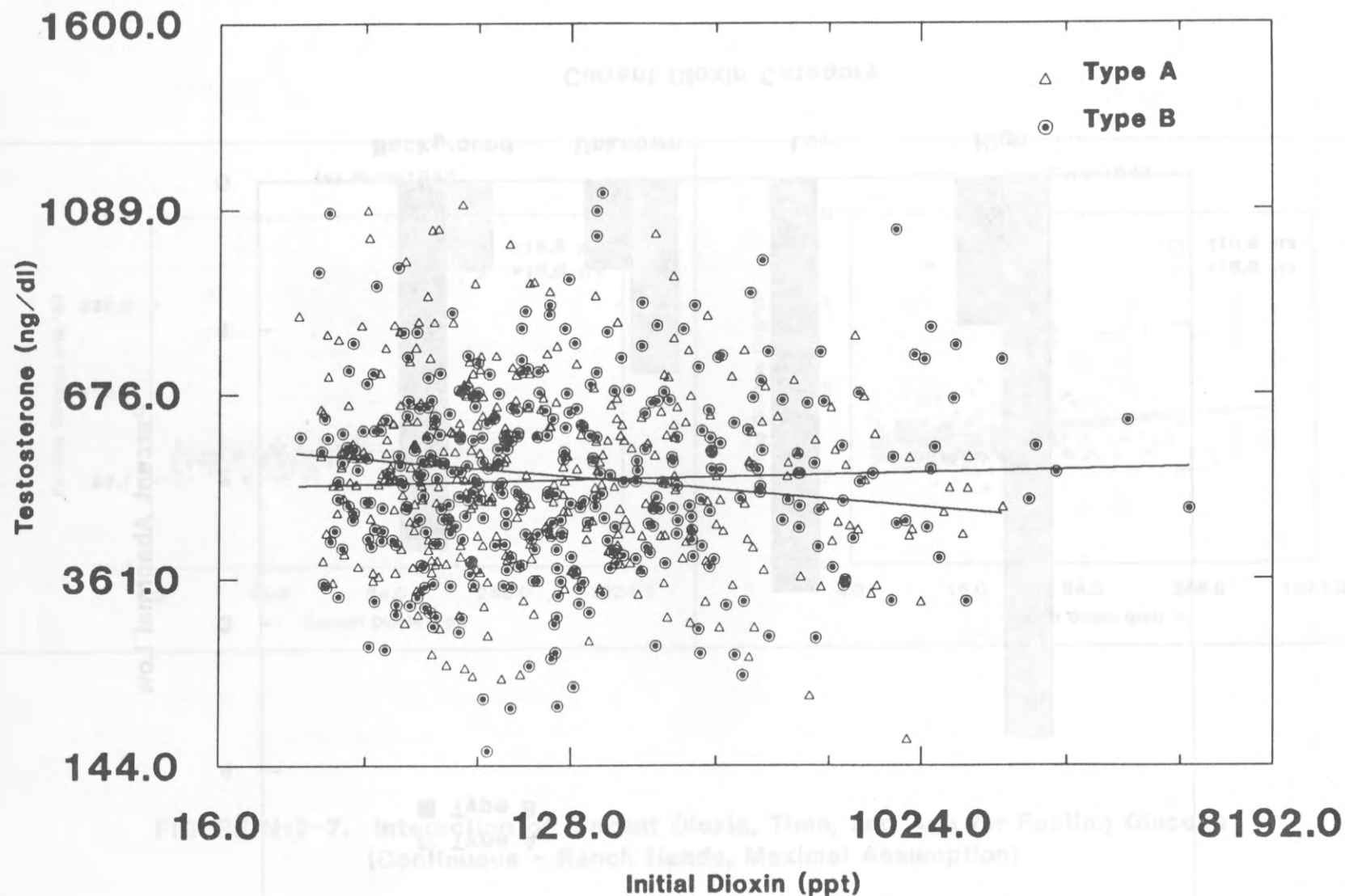


FIGURE N-2-5. Interaction of Initial Dioxin and Personality Type for Testosterone (Continuous - Ranch Hands, Maximal Assumption)

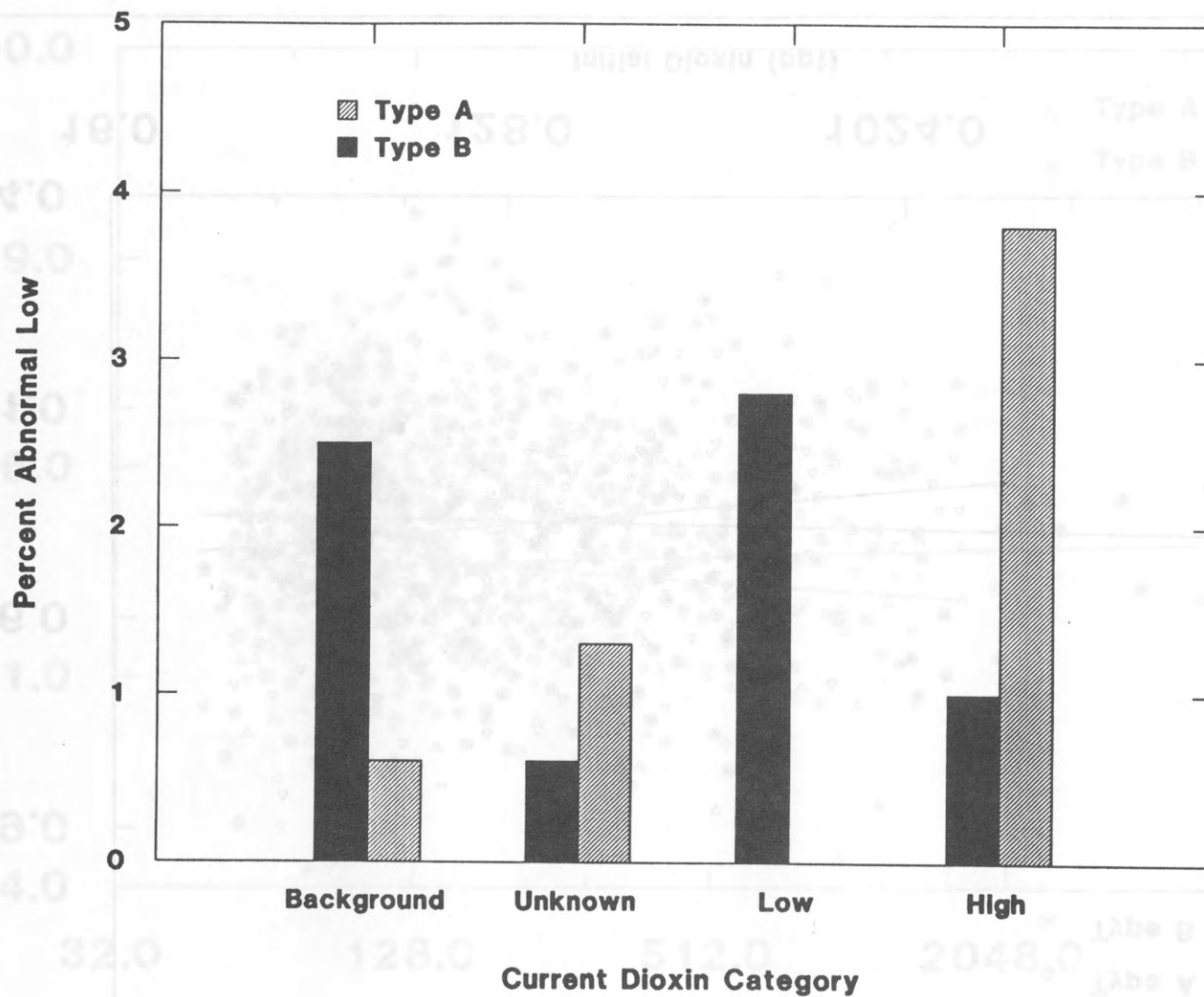


FIGURE N-2-6. Interaction of Categorized Current Dioxin and Personality Type for Testosterone (Discrete)

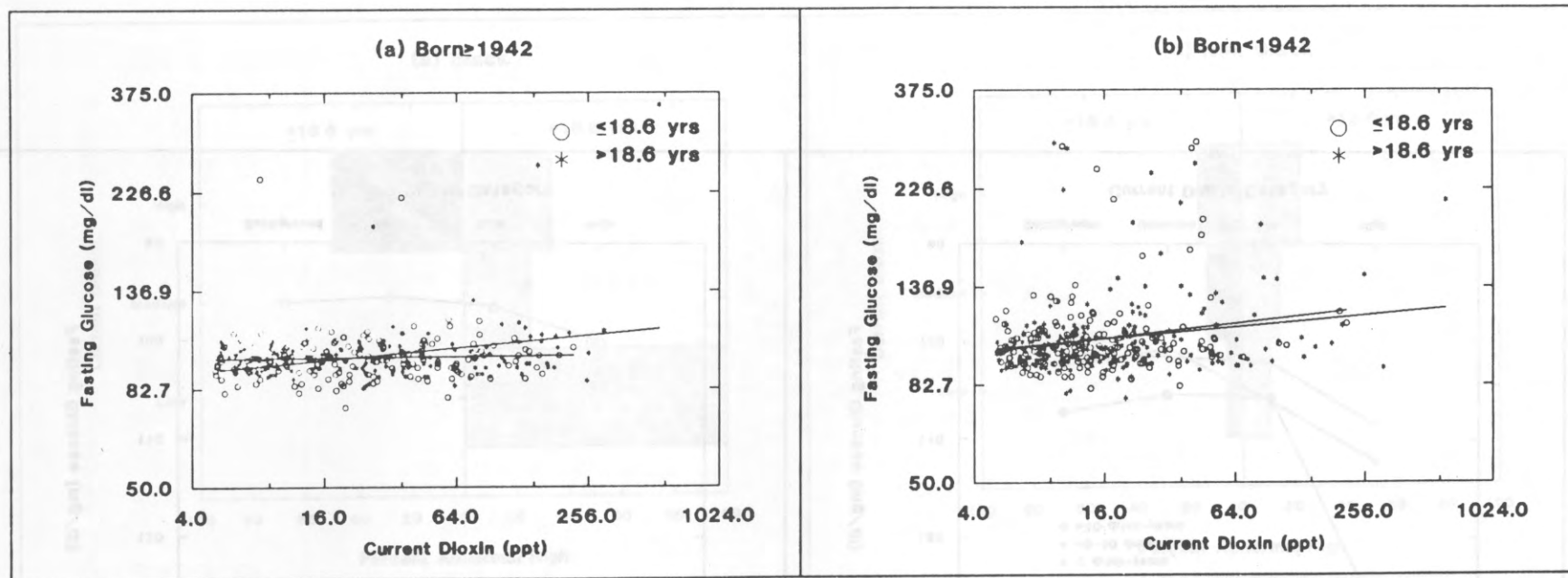


FIGURE N-2-7. Interaction of Current Dioxin, Time, and Age for Fasting Glucose (Continuous - Ranch Hands, Maximal Assumption)

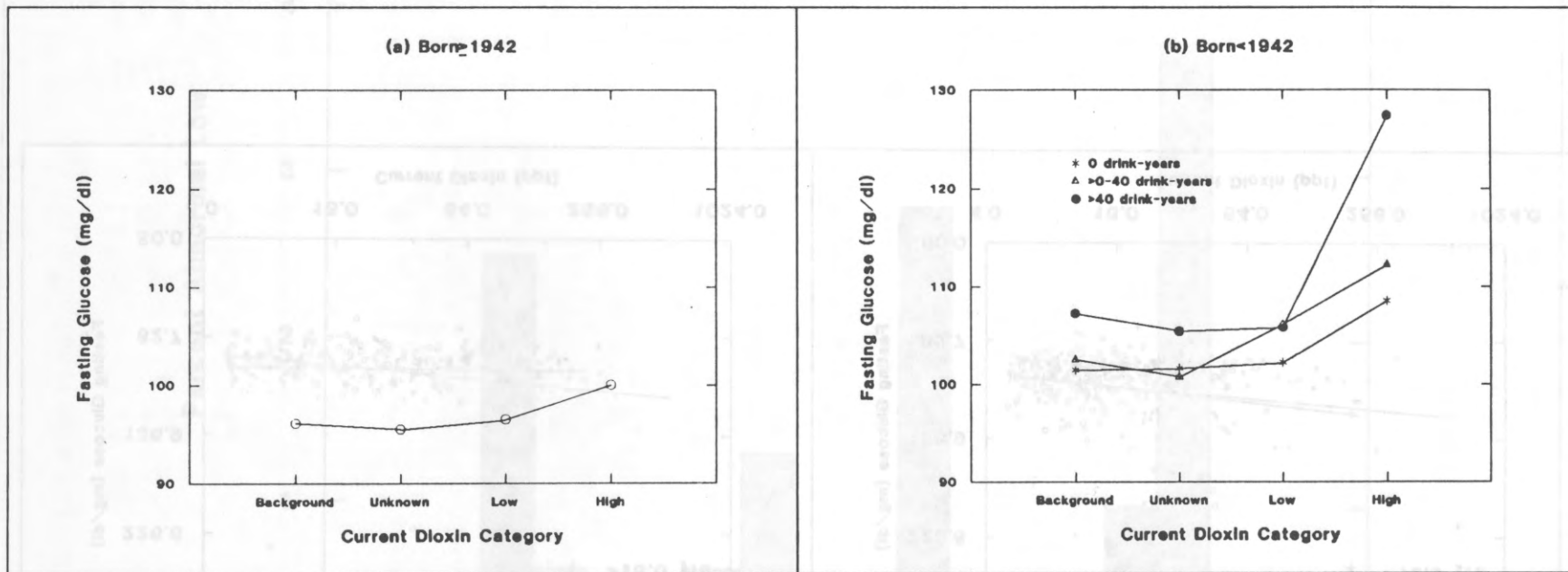
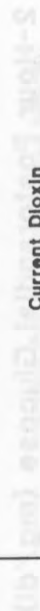


FIGURE N-2-8. Interaction of Categorized Current Dioxin, Age, and Lifetime Alcohol History for Fasting Glucose (Continuous)



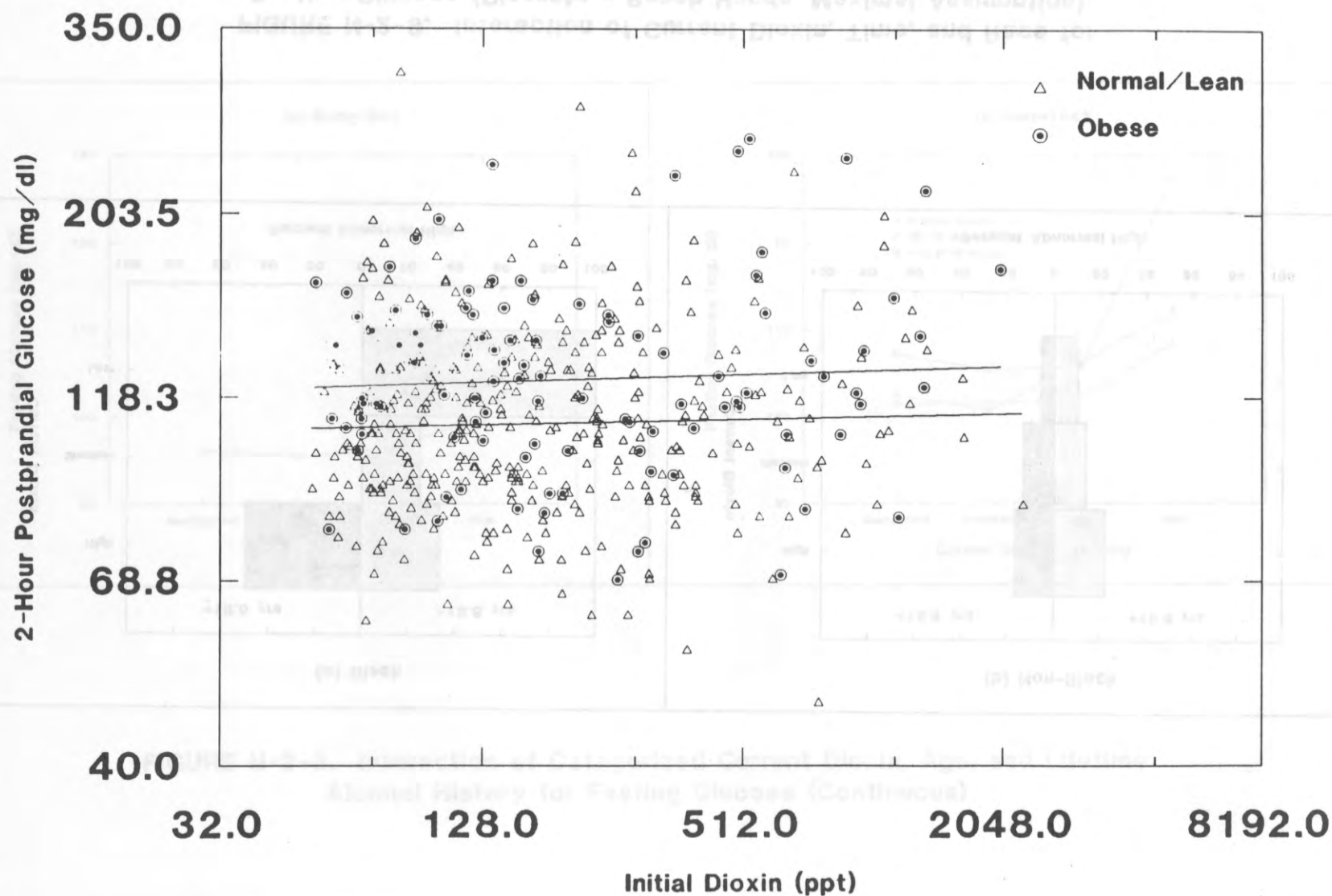


FIGURE N-2-10. Interaction of Initial Dioxin and Percent Body Fat for 2-Hour Postprandial Glucose (Continuous - Ranch Hands, Minimal Assumption)

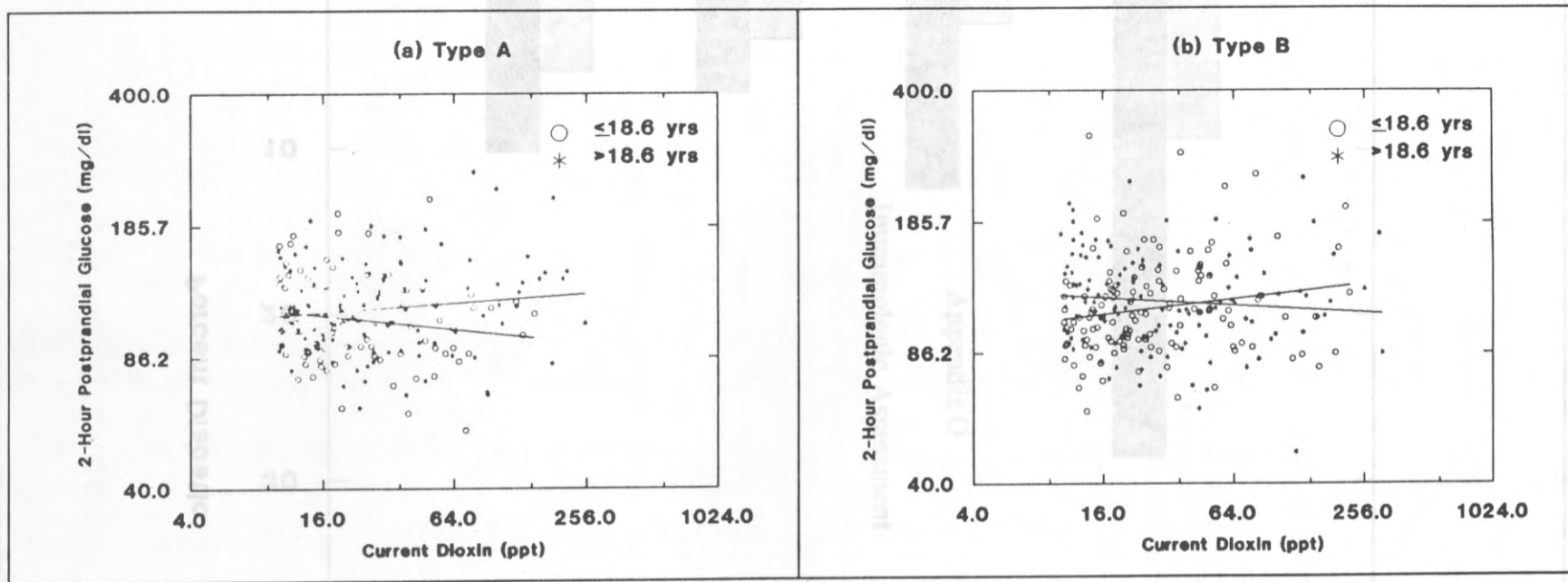


FIGURE N-2-11. Interaction of Current Dioxin, Time, and Personality Type for 2-Hour Postprandial Glucose (Continuous - Ranch Hands, Minimal Assumption)

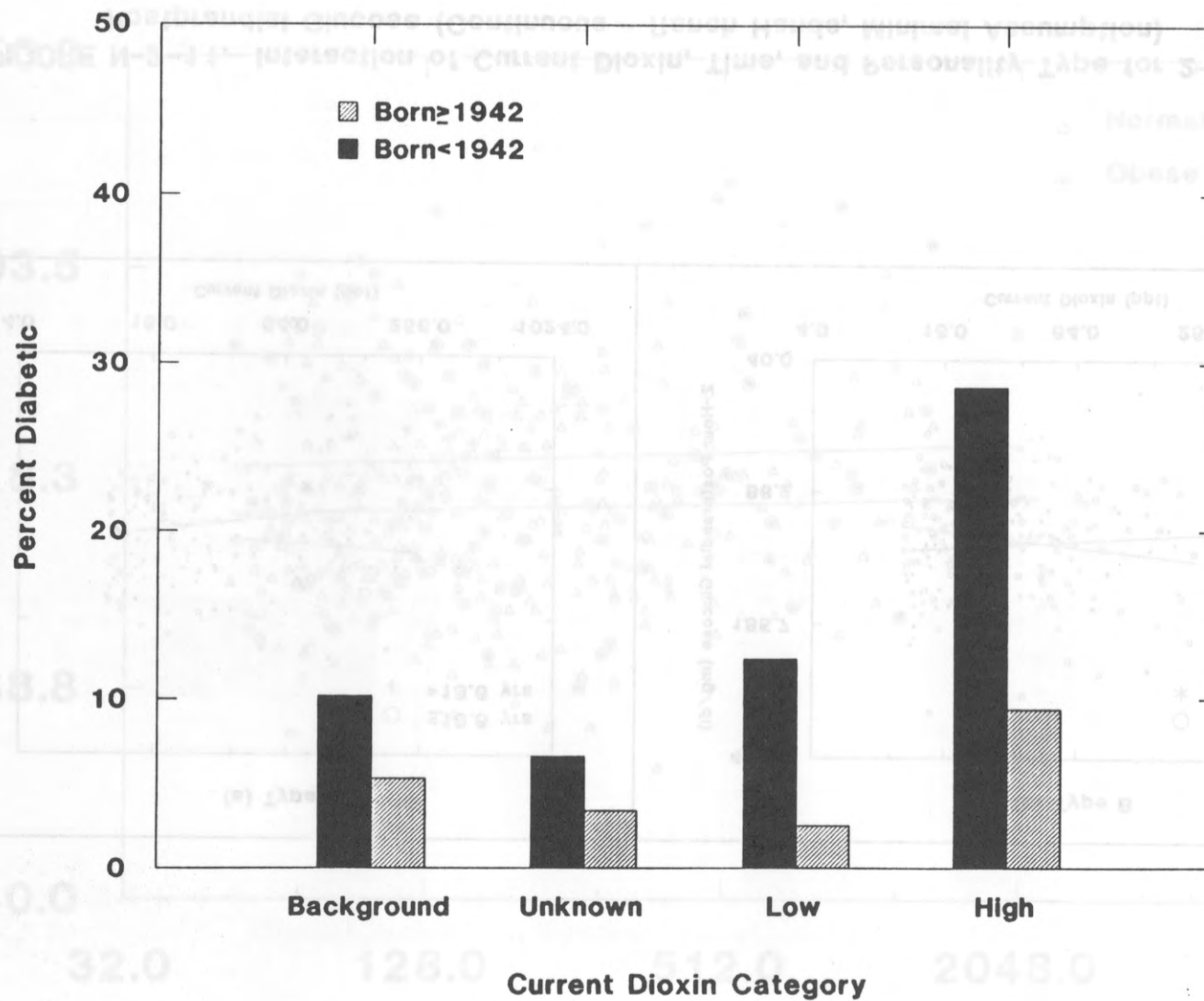


FIGURE N-2-12. Interaction of Categorized Current Dioxin and Age for the Composite Diabetes Indicator

Appendix O

Immunologic Assessment

TABLE O-1.

Summary of Dioxin-by-Covariate Interactions for Immunology Variables

Ranch Hands - Log₂ (Current Dioxin) and Time

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Percent Possibly Abnormal/(n) Current Dioxin			Adj. Relative Risk (95% C.I.) ^a	p-Value
				Low	Medium	High		
Composite Skin Test Diagnosis (Minimal-- 16-3 [g])	Current-by- Time-by-Age	Born ≥1942	≤18.6	0.0 (21)	9.4 (53)	3.5 (29)	1.01 (0.46,2.21)	0.198 ^b
			>18.6	25.0 (8)	10.5 (38)	3.3 (30)	0.45 (0.17,1.19)	0.109 ^c
		Born <1942	≤18.6	11.1 (36)	8.5 (47)	0.0 (10)	0.53 (0.20,1.40)	0.024 ^b
			>18.6	0.0 (33)	4.7 (64)	8.0 (25)	1.86 (0.87,3.93)	0.198 ^c
								0.105 ^c

Ranch Hands - Log₂ (Initial Dioxin)

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
CD2 Cells ^d (Minimal-- 16-4 [c])	Initial-by- Current Alcohol Use	0-1	Low	37	1,675.9	0.017 (0.022)	0.442
			Medium	80	1,604.4		
			High	43	1,726.6		
		>1	Low	8	1,988.2	-0.168 (0.053)	0.002
			Medium	16	1,837.7		
			High	10	1,211.5		

TABLE O-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for
Immunology Variables

Ranch Hands and Comparisons by Current Dioxin Category

Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Adj. Mean	Contrast	Difference of Adj. Means (95% C.I.) ^e	p-Value ^f
CD2 Cells ^d (16-4 [j])	Categorized Current Dioxin-by- Age	Born ≥1942 0	Background	8	1,653.3	All		0.301
			Unknown	7	1,582.0	U vs. B	-71.3 --	0.795
			Low	1	1,920.8	L vs. B	267.5 --	0.667
			High	3	1,122.2	H vs. B	-531.1 --	0.082
	Categorized Current Dioxin-by- Lifetime Alcohol History	Born ≥1942 >0-40	Background	99	1,790.4	All		0.194
			Unknown	35	1,557.7	U vs. B	-232.7 --	0.032
			Low	25	1,708.3	L vs. B	-82.1 --	0.523
			High	34	1,698.1	H vs. B	-92.3 --	0.418
		Born ≥1942 >40	Background	23	1,790.2	All		0.591
			Unknown	5	1,593.8	U vs. B	-196.4 --	0.473
			Low	4	2,084.7	L vs. B	294.5 --	0.394
			High	9	1,943.4	H vs. B	153.2 --	0.525
		Born <1942 0	Background	11	1,642.4	All		0.712
			Unknown	5	1,501.0	U vs. B	-141.4 --	0.611
			Low	5	1,777.0	L vs. B	134.6 --	0.656
			High	8	1,837.3	H vs. B	194.9 --	0.462
		Born <1942 >0-40	Background	111	1,628.3	All		0.287
			Unknown	62	1,763.6	U vs. B	135.3 --	0.126
			Low	26	1,623.3	L vs. B	-5.0 --	0.965
			High	16	1,833.1	H vs. B	204.8 --	0.177
		Born <1942 >40	Background	54	1,631.7	All		0.615
			Unknown	16	1,508.7	U vs. B	-123.0 --	0.403
			Low	12	1,781.1	L vs. B	149.4 --	0.403
			High	6	1,582.1	H vs. B	-49.6 --	0.827

TABLE O-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Immunology Variables

Ranch Hands - Log₂ (Current Dioxin) and Time								
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value
				Low	Medium	High		
CD4 Cells ^d (Minimal-- 16-5 [g])	Current-by- Time-by- Lifetime Alcohol History	0-40	≤18.6	901.3 (18)	826.9 (41)	708.0 (17)	-0.087 (0.041)	0.013 ^g 0.035 ^h
			>18.6	818.3 (15)	860.1 (36)	908.2 (23)	0.044 (0.035)	0.200 ^h
		>40	≤18.6	820.1 (4)	778.6 (7)	1079.8 (5)	0.101 (0.077)	0.054 ^g 0.191 ^h
			>18.6	976.4 (10)	1032.1 (10)	836.5 (7)	-0.099 (0.070)	0.163 ^h
		Born ≥1942	≤18.6	897.5 (13)	1044.2 (28)	930.6 (21)	0.032 (0.038)	0.753 ^g 0.411 ^h
			>18.6	702.6 (3)	952.2 (20)	959.5 (22)	0.051 (0.045)	0.265 ^h
CD4 Cells ^d (Maximal-- 16-5 [h])	Current-by- Time-by- Age	Born <1942	≤18.6	948.2 (26)	888.6 (42)	769.3 (8)	-0.069 (0.043)	0.043 ^g 0.114 ^h
			>18.6	898.9 (21)	936.1 (46)	1036.9 (21)	0.044 (0.035)	0.207 ^h

TABLE O-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Immunology Variables

Ranch Hands - Log₂ (Initial Dioxin)							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
CD8 Cells ^d (Minimal-- 16-6 [c])	Initial-by- Lifetime Alcohol History	0	Low	4	437.2	0.023 (0.074)	0.760
			Medium	7	458.3		
			High	8	490.6		
		>0-40	Low	32	505.1	-0.005 (0.037)	0.894
			Medium	67	432.4		
			High	32	488.2		
		>40	Low	9	698.0	-0.178 (0.073)	0.016
			Medium	21	582.1		
			High	13	382.5		
CD8 Cells ^d (Maximal-- 16-6 [d])	Initial-by- Current Alcohol Use	0-1	Low	48	496.1	0.005 (0.023)	0.844
			Medium	112	470.3		
			High	61	504.3		
		>1	Low	16	561.3	-0.110 (0.051)	0.033
			Medium	22	496.4		
			High	11	357.7		
CD20 Cells ^d (Minimal-- 16-7 [c])	Initial-by- Age	Born ≥1942	Low	9	199.2	-0.040 (0.070)	0.566
			Medium	44	156.0		
			High	29	161.2		
		Born <1942	Low	36	117.4	0.165 (0.053)	0.002
			Medium	52	168.6		
			High	24	189.8		