

**APPENDIX K**  
**Gastrointestinal Assessment**

## **APPENDIX K: Gastrointestinal Assessment**

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**TABLE K-1.**  
**Summary of Group-by-Covariate Interactions for Hepatic Function  
 Variables and Porphyrin Determinations Analyzed Continuously**

Variable	Interaction	Stratification	Statistic	Group		p-Value
				Ranch Hand	Comparison	
SGOT	Group-by- Current Alcohol Use (Drinks/day)	<1	n	652	843	0.889
			Mean	32.2	32.3	
			Adj. Mean	33.4	33.4	
			95% C.I.	(32.4,34.4)	(32.5,34.4)	
	1-4	>4	n	275	335	0.010
			Mean	35.3	33.4	
			Adj. Mean	36.5	34.4	
			95% C.I.	(35.1,38.0)	(33.2,35.7)	
SGPT	Group-by- Current Alcohol Use (Drinks/day)	<1	n	76	108	0.477
			Mean	37.5	38.1	
			Adj. Mean	38.2	39.4	
			95% C.I.	(35.7,40.9)	(37.2,41.8)	
	1-4	>4	n	652	843	0.011
			Mean	20.5	21.9	
			Adj. Mean	19.8	21.1	
			95% C.I.	(18.6,21.2)	(19.8,22.5)	
SGPT	Group-by- Current Alcohol Use (Drinks/day)	1-4	n	275	335	0.428
			Mean	23.4	22.6	
			Adj. Mean	22.2	21.5	
			95% C.I.	(20.2,24.3)	(19.7,23.5)	
	>4		n	76	108	0.058
			Mean	23.9	27.0	
			Adj. Mean	23.3	26.7	
			95% C.I.	(19.7,27.5)	(22.8,31.3)	

**TABLE K-1. (continued)**  
**Summary of Group-by-Covariate Interactions for Hepatic Function Variables and Porphyrin Determinations Analyzed Continuously**

Variable	Interaction	Stratification	Statistic	Group		p-Value
				Ranch Hand	Comparison	
Alkaline Phosphatase	Group-by-Industrial Chemicals	Exposed to Industrial Chemicals	n	504	681	<0.001
			Mean	94.8	89.9	
			Adj. Mean	102.4	97.2	
			95% C.I.	(97.9,107.2)	(93.1,101.5)	
	Not Exposed to Industrial Chemicals	Not Exposed to Industrial Chemicals	n	499	604	0.973
			Mean	88.9	88.7	
			Adj. Mean	88.5	88.5	
			95% C.I.	(84.9,92.1)	(85.0,92.1)	
LDH	Group-by-Age	Born ≥1942	n	408	547	0.425
			Mean	122.2	121.2	
			Adj. Mean	124.8	123.6	
			95% C.I.	(121.9,127.7)	(121.0,126.3)	
	Group-by-Age	Born 1923-1941	n	565	691	0.217
			Mean	123.8	125.3	
			Adj. Mean	127.0	128.6	
			95% C.I.	(124.5,129.7)	(126.1,131.1)	
		Born ≤1922	n	36	51	0.966
			Mean	135.1	135.5	
			Adj. Mean	138.9	139.1	
			95% C.I.	(130.8,147.5)	(132.2,146.5)	

TABLE K-1. (continued)

**Summary of Group-by-Covariate Interactions for Hepatic Function Variables and Porphyrin Determinations Analyzed Continuously**

<b>Variable</b>	<b>Interaction</b>	<b>Stratification</b>	<b>Statistic</b>	<b>Group</b>		
				<b>Ranch Hand</b>	<b>Comparison</b>	<b>p-Value</b>
Triglycerides	Group-by-Age	Born >1942	n	406	546	
			Mean	107.1	110.2	
			Adj. Mean	95.6	99.7	0.321
			95% C.I.	(88.0,103.9)	(92.5,107.4)	
	Group-by-Age	Born 1923-1941	n	561	689	
			Mean	126.0	124.5	
			Adj. Mean	116.8	115.6	0.784
			95% C.I.	(108.6,125.5)	(108.0,123.8)	
	Group-by-Age	Born <1922	n	36	51	
			Mean	139.0	105.6	
			Adj. Mean	130.7	98.3	0.039
			95% C.I.	(105.4,161.9)	(81.9,118.0)	
Uroporphyrins	Group-by-Blood Urea Nitrogen (BUN)	BUN <14	n	547	701	
			Mean	16.2	18.4	
			Adj. Mean	16.3	18.6	<0.001
			95% C.I.	(15.4,17.4)	(17.6,19.7)	
	Group-by-Blood Urea Nitrogen (BUN)	BUN >14	n	453	582	
			Mean	17.8	17.4	
			Adj. Mean	17.9	17.6	0.686
			95% C.I.	(16.8,19.2)	(16.6,18.7)	

TABLE K-2.

**Summary of Group-by-Covariate Interactions for Hepatic Function Variables  
and Porphyrin Determinations Analyzed Categorically**

Variable	Interaction	Stratification	Statistic	Group				Adj. Relative Risk (95% C.I.)	p-Value		
				Ranch Hand		Comparison					
				Number	Percent	Number	Percent				
Direct Bilirubin	Group-by-Industrial Chemicals	Exposed to Industrial Chemicals	n	507		683		1.89 (1.05,3.42)	0.035		
			High	27	5.3	20	2.9				
			Normal	480	94.7	663	97.1				
	Group-by-Industrial Chemicals	Not Exposed to Industrial Chemicals	n	496		603		0.58 (0.28,1.20)	0.143		
			High	11	2.2	23	3.8				
			Normal	485	97.8	580	96.2				
Triglycerides	Group-by-Occupation	Officer	n	376		484		1.77 (1.04,3.01)	0.035		
			High	34	9.0	26	5.4				
			Normal	342	91.0	458	94.6				
	Group-by-Occupation	Enlisted Flyer	n	177		209		1.27 (0.59,2.71)	0.539		
			High	15	8.5	14	6.7				
			Normal	162	91.5	195	93.3				
	Group-by-Occupation	Enlisted Groundcrew	n	456		596		0.63 (0.36,1.10)	0.104		
			High	19	4.2	39	6.5				
			Normal	437	95.8	557	93.5				

TABLE K-3.

## Unadjusted Categorical Exposure Index Analyses for Hepatic Function Variables by Occupation

Variable	Occupation	Statistic	Exposure Index						Contrast	Est. Relative Risk (95% C.I.)	p-Value			
			Low		Medium		High							
			Number	Percent	Number	Percent	Number	Percent						
SGOT	Officer	n	126		130		120		Overall					
		Abnormal	9	7.1	14	10.8	9	7.5	M vs. L	1.57 (0.65,3.77)	0.519			
		Normal	117	92.9	116	89.2	111	92.5	H vs. L	1.05 (0.40,2.75)	0.384			
	Enlisted	n	55		65		57		Overall					
		Abnormal	1	1.8	6	9.2	4	7.0	M vs. L	5.49 (0.64,47.09)	0.234			
		Normal	54	98.2	59	90.8	53	93.0	H vs. L	4.08 (0.44,37.67)	0.123			
	Flyer	n	154		160		142		Overall					
		Abnormal	7	4.5	13	8.1	17	12.0	M vs. L	1.86 (0.72,4.79)	0.065			
		Normal	147	95.5	147	91.9	125	88.0	H vs. L	2.86 (1.15,7.11)	0.249			
SGPT	Officer	n	126		130		120		Overall					
		Abnormal	22	17.5	20	15.4	16	13.3	M vs. L	0.86 (0.44,1.67)	0.669			
		Normal	104	82.5	110	84.6	104	86.7	H vs. L	0.73 (0.36,1.46)	0.736			
	Enlisted	n	55		65		57		Overall					
		Abnormal	2	3.6	10	15.4	6	10.5	M vs. L	4.82 (1.01,23.03)	0.105			
		Normal	53	96.4	55	84.6	51	89.5	H vs. L	3.12 (0.60,16.17)	0.037			
	Groundcrew	n	154		160		142		Overall					
		Abnormal	17	11.0	27	16.9	17	12.0	M vs. L	1.64 (0.85,3.14)	0.265			
		Normal	137	89.0	133	83.1	125	88.0	H vs. L	1.10 (0.54,2.24)	0.147			

TABLE K-3. (continued)  
Unadjusted Categorical Exposure Index Analyses for Hepatic Function Variables by Occupation

Variable	Occupation	Statistic	Exposure Index						Contrast	Est. Relative Risk (95% C.I.)	p-Value			
			Low		Medium		High							
			Number	Percent	Number	Percent	Number	Percent						
GGTP	Officer	n	126		130		120		Overall		0.859			
		Abnormal	11	8.7	9	6.9	9	7.5	M vs. L	0.78 (0.31,1.95)	0.646			
		Normal	115	91.3	121	93.1	111	92.5	H vs. L	0.73 (0.36,1.46)	0.384			
	Enlisted Flyer	n	55		65		57		Overall		0.950			
		Abnormal	5	9.1	7	10.8	6	10.5	M vs. L	1.21 (0.36,4.04)	0.999			
		Normal	50	90.9	58	89.2	51	89.5	H vs. L	1.18 (0.34,4.10)	0.999			
	Enlisted Groundcrew	n	154		160		142		Overall		0.773			
		Abnormal	16	10.4	13	8.1	14	9.9	M vs. L	0.76 (0.35,1.64)	0.561			
		Normal	138	89.6	147	91.9	128	90.1	H vs. L	0.94 (0.44,2.01)	0.999			
Alkaline Phosphatase	Officer	n	126		130		120		Overall		0.448			
		Abnormal	4	3.2	7	5.4	3	2.5	M vs. L	1.74 (0.50,6.08)	0.540			
		Normal	122	96.8	123	94.6	117	97.5	H vs. L	0.78 (0.17,3.57)	0.999			
	Enlisted Flyer	n	55		65		57		Overall		0.258			
		Abnormal	1	1.8	5	7.7	5	8.8	M vs. L	4.50 (0.51,39.74)	0.217			
		Normal	54	98.2	60	92.3	52	91.2	H vs. L	5.19 (0.59,45.96)	0.206			
	Enlisted Groundcrew	n	154		160		142		Overall		0.378			
		Abnormal	8	5.2	10	6.3	13	9.2	M vs. L	1.22 (0.47,3.17)	0.810			
		Normal	146	94.8	150	93.8	129	90.8	H vs. L	1.84 (0.74,4.58)	0.257			

**TABLE K-3. (continued)**  
**Unadjusted Categorical Exposure Index Analyses for Hepatic Function Variables by Occupation**

Variable	Occupation	Statistic	Exposure Index						Contrast	Est. Relative Risk (95% C.I.)	p-Value			
			Low		Medium		High							
			Number	Percent	Number	Percent	Number	Percent						
Total Bilirubin	Officer	n	126		130		120		Overall		0.846			
		Abnormal	3	2.4	2	1.5	3	2.5	M vs. L	0.64 (0.11,3.90)	0.680			
		Normal	123	97.6	128	98.5	117	97.5	H vs. L	1.05 (0.21,5.31)	0.999			
	Enlisted Flyer	n	55		65		57		Overall		0.353			
		Abnormal	0	0.0	1	1.5	2	3.5	M vs. L	21.58 (0.10,64.65)	0.999			
		Normal	55	100.0	64	98.5	55	96.5	H vs. L	5.00 (0.24,106.54)	0.496			
	Enlisted Groundcrew	n	154		160		142		Overall		0.374			
		Abnormal	7	4.5	3	1.9	6	4.2	M vs. L	0.40 (0.10,1.58)	0.211			
		Normal	147	95.5	157	98.1	136	95.8	H vs. L	0.93 (0.30,2.83)	0.999			
Direct Bilirubin	Officer	n	126		130		120		Overall		0.327			
		Abnormal	2	1.6	5	3.8	6	5.0	M vs. L	2.48 (0.47,13.02)	0.447			
		Normal	124	98.4	125	96.2	114	95.0	H vs. L	3.26 (0.65,16.50)	0.164			
	Enlisted Flyer	n	55		65		57		Overall		0.624			
		Abnormal	2	3.6	5	7.7	3	5.3	M vs. L	2.21 (0.41,11.86)	0.451			
		Normal	53	96.4	60	92.3	54	94.7	H vs. L	1.47 (0.24,9.17)	0.999			
	Enlisted Groundcrew	n	154		160		142		Overall		0.834			
		Abnormal	4	2.6	6	3.8	5	3.5	M vs. L	1.46 (0.40,5.28)	0.750			
		Normal	150	97.4	154	96.3	137	96.5	H vs. L	1.37 (0.36,5.20)	0.742			

TABLE K-4.

**Unadjusted Continuous Exposure Index Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Occupation**

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value	
			Low	Medium	High			
K <sub>8</sub>	SGOT	Officer	n	126	130	120	Overall	0.695
		Mean	33.3	34.5	33.8	M vs. L	0.400	
		95% C.I.	(31.5,35.3)	(32.6,36.5)	(31.9,35.8)	H vs. L	0.757	
	Enlisted Flyer	n	55	65	57	Overall	0.289	
		Mean	30.9	33.3	33.2	M vs. L	0.151	
		95% C.I.	(28.5,33.4)	(31.0,35.8)	(30.7,35.8)	H vs. L	0.192	
	Enlisted Groundcrew	n	154	160	142	Overall	0.418	
		Mean	32.9	33.2	34.4	M vs. L	0.801	
		95% C.I.	(31.4,34.5)	(31.7,34.8)	(32.8,36.1)	H vs. L	0.211	
K <sub>9</sub>	SGPT	Officer	n	126	130	120	Overall	0.712
		Mean	22.5	22.1	21.3	M vs. L	0.804	
		95% C.I.	(20.5,24.6)	(20.2,24.2)	(19.4,23.39)	H vs. L	0.421	
	Enlisted Flyer	n	55	65	57	Overall	0.061	
		Mean	18.5	21.9	22.0	M vs. L	0.037	
		95% C.I.	(16.4,20.8)	(19.7,24.5)	(19.6,24.7)	H vs. L	0.041	
	Enlisted Groundcrew	n	154	160	142	Overall	0.495	
		Mean	20.9	22.3	21.5	M vs. L	0.237	
		95% C.I.	(19.3,22.6)	(20.7,24.1)	(19.9,23.4)	H vs. L	0.595	

TABLE K-4. (continued)

**Unadjusted Continuous Exposure Index Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Occupation**

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value
			Low	Medium	High		
GGTP	Officer	n	126	130	120	Overall	0.885
		Mean	31.4	32.7	32.6		0.653
		95% C.I.	(27.8,35.5)	(29.0,36.9)	(28.7,36.9)		0.688
	Enlisted Flyer	n	55	65	57	Overall	0.243
		Mean	29.7	34.9	37.1		0.225
		95% C.I.	(24.6,35.9)	(29.3,41.5)	(30.8,44.7)		0.104
	Enlisted Groundcrew	n	154	160	142	Overall	0.412
		Mean	34.7	33.0	31.1		0.527
		95% C.I.	(31.1,38.7)	(29.6,36.7)	(27.8,34.9)		0.183
Alkaline Phosphatase	Officer	n	126	130	120	Overall	0.735
		Mean	87.2	86.8	88.9		0.893
		95% C.I.	(83.5,91.1)	(83.2,90.6)	(85.0,92.9)		0.546
	Enlisted Flyer	n	55	65	57	Overall	0.189
		Mean	88.9	96.3	95.2		0.086
		95% C.I.	(83.1,95.0)	(90.5,102.4)	(89.1,101.6)		0.153
	Enlisted Groundcrew	n	154	160	142	Overall	0.535
		Mean	93.2	95.1	96.2		0.484
		95% C.I.	(89.7,96.9)	(91.5,98.8)	(92.4,100.2)		0.270

TABLE K-4. (continued)

**Unadjusted Continuous Exposure Index Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Occupation**

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value
			Low	Medium	High		
Total Bilirubin	Officer	n	126	130	120	Overall	0.382
		Mean	0.76	0.73	0.77	M vs. L	0.324
		95% C.I.	(0.72,0.80)	(0.69,0.77)	(0.73,0.81)	H vs. L	0.722
	Enlisted Flyer	n	55	65	57	Overall	0.045
		Mean	0.66	0.73	0.76	M vs. L	0.092
		95% C.I.	(0.61,0.72)	(0.67,0.78)	(0.70,0.83)	H vs. L	0.014
	Enlisted Groundcrew	n	126	130	120	Overall	0.373
		Mean	0.74	0.75	0.78	M vs. L	0.783
		95% C.I.	(0.70,0.78)	(0.71,0.78)	(0.74,0.82)	H vs. L	0.182
Direct Bilirubin	Officer	n	126	130	120	Overall	0.606
		Mean	0.18	0.17	0.19	M vs. L	0.484
		95% C.I.	(0.17,0.21)	(0.16,0.19)	(0.17,0.21)	H vs. L	0.784
	Enlisted Flyer	n	55	65	57	Overall	0.684
		Mean	0.16	0.18	0.18	M vs. L	0.455
		95% C.I.	(0.14,0.20)	(0.15,0.21)	(0.15,0.21)	H vs. L	0.440
	Enlisted Groundcrew	n	126	130	120	Overall	0.541
		Mean	0.17	0.15	0.19	M vs. L	0.277
		95% C.I.	(0.15,0.19)	(0.17,0.20)	(0.16,0.19)	H vs. L	0.728

TABLE K-4. (continued)

**Unadjusted Continuous Exposure Index Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Occupation**

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value
			Low	Medium	High		
LDH	Officer	n	126	130	120	Overall	0.489
		Mean	125.1	124.2	121.8	M vs. L	0.742
		95% C.I.	(121.2,129.1)	(120.4,128.1)	(117.9,125.8)	H vs. L	0.246
	Enlisted Flyer	n	55	65	57	Overall	0.118
		Mean	120.2	117.6	126.2	M vs. L	0.533
		95% C.I.	(114.4,126.4)	(112.4,123.3)	(120.2,132.5)	H vs. L	0.175
	Enlisted Groundcrew	n	154	160	142	Overall	0.031
		Mean	123.1	122.3	127.9	M vs. L	0.710
		95% C.I.	(120.1,126.2)	(119.4,125.3)	(124.6,131.2)	H vs. L	0.037
Cholesterol	Officer	n	126	130	120	Overall	0.122
		Mean	220.7	211.8	210.7	M vs. L	0.093
		95% C.I.	(213.3,228.3)	(204.8,219.0)	(203.5,218.2)	H vs. L	0.063
	Enlisted Flyer	n	55	65	57	Overall	0.203
		Mean	221.1	213.9	227.7	M vs. L	0.351
		95% C.I.	(210.2,232.6)	(204.2,224.2)	(216.6,239.3)	H vs. L	0.418
	Enlisted Groundcrew	n	154	160	142	Overall	0.873
		Mean	211.4	211.1	213.3	M vs. L	0.984
		95% C.I.	(205.4,217.6)	(205.2,217.2)	(207.0,219.8)	H vs. L	0.677

TABLE K-4. (continued)

**Unadjusted Continuous Exposure Index Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Occupation**

K-12

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value
			Low	Medium	High		
Triglycerides	Officer	n	126	130	120	Overall	0.624
		Mean	114.2	117.9	125.1	M vs. L	0.728
		95% C.I.	(100.2,130.1)	(103.8,134.1)	(109.5,142.9)	H vs. L	0.338
	Enlisted Flyer	n	55	65	57	Overall	0.953
		Mean	123.8	119.9	123.1	M vs. L	0.775
		95% C.I.	(105.2,145.7)	(103.2,139.3)	(104.9,144.5)	H vs. L	0.811
	Enlisted Groundcrew	n	154	160	142	Overall	0.796
		Mean	118.7	113.8	117.9	M vs. L	0.528
		95% C.I.	(108.1,130.3)	(103.9,124.7)	(107.0,129.9)	H vs. L	0.919

TABLE K-5.

**Summary of Adjusted Exposure Index, Analyses Involving Interactions with a Continuous Covariate for Hepatic Function Variables**

Variable	Occupation	Interaction Covariate	p-Value Interaction	Exposure Index Level	Slope	p-Value on Test of Slope Against Null Hypothesis of Zero Slope
SGOT	Enlisted Flyer	Current Alcohol Use	<0.001	Low	-0.012	0.266
				Medium	0.068	0.004
				High	0.029	0.138
SGOT	Enlisted Groundcrew	Current Alcohol Use	<0.001	Low	0.004	0.628
				Medium	0.047	<0.001
				High	0.062	<0.001
SGPT	Enlisted Groundcrew	Current Alcohol Use	0.006	Low	-0.026	0.097
				Medium	0.027	0.189
				High	0.071	0.013
GGTP	Enlisted Flyer	Current Alcohol Use	0.003	Low	0.022	0.455
				Medium	0.183	<0.001
				High	0.154	0.006
GGTP	Enlisted Groundcrew	Current Alcohol Use	0.009	Low	0.035	0.129
				Medium	0.091	<0.001
				High	0.170	<0.001
Direct Bilirubin	Enlisted Flyer	Current Alcohol Use	0.017	Low	0.013	0.445
				Medium	0.097	<0.001
				High	0.065	0.090
Cholesterol	Enlisted Groundcrew	Current Alcohol Use	0.006	Low	0.003	0.591
				Medium	-0.008	0.285
				High	0.033	0.002

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**TABLE K-5. (continued)**

**Summary of Adjusted Exposure Index, Analyses Involving Interactions with a Continuous Covariate for Hepatic Function Variables**

Variable	Occupation	Interaction Covariate	p-Value Interaction	Exposure Index Level	Slope	p-Value on Test of Slope Against Null Hypothesis of Zero Slope
LDH	Enlisted Groundcrew	Current Alcohol Use	0.025	Low	-0.005	0.322
				Medium	0.016	0.020
				High	0.003	0.728
Triglycerides	Enlisted Flyer	Age	0.012	Low	0.014	0.286
				Medium	0.015	0.247
				High	0.038	0.032

TABLE K-6.

**Summary of Adjusted Exposure Index, Analyses Involving Interactions with a Categorical Covariate for Hepatic Function Variables**

Variable	Occupation	Interaction Covariate	Stratification	Exposure Index Level	Adjusted Mean (n)	Interaction p-Value
Total Bilirubin	Enlisted Groundcrew	Race	Black	Low	0.63 (14)	0.007
				Medium	0.90 (13)	
				High	0.70 (13)	
	Nonblack	Nonblack	Nonblack	Low	0.75 (138)	
				Medium	0.73 (147)	
				High	0.80 (127)	

TABLE K-7.

**Unadjusted Analyses for Baseline and  
Interval History of Liver Disease by Group  
(Verified by Medical Record Review)  
(Original Comparisons Only)**

Disease	Statistic			Group		Est. Relative Risk (95% C.I.)	p-Value		
		Ranch Hand		Comparison					
		Number	Percent	Number	Percent				
Hepatitis (Viral and Alcoholic)	n	1,016		955		1.02 (0.64,1.65)	0.999		
	Yes	37	3.6	34	3.6				
	No	979	96.4	921	96.4				
Jaundice	n	1,016		955		0.89 (0.48,1.66)	0.754		
	Yes	20	2.0	21	2.2				
	No	996	98.0	934	97.8				
Cirrhosis	n	1,016		955		2.83 (0.29,27.21)	0.625		
	Yes	3	0.5	1	0.1				
	No	1,013	99.5	954	99.9				
Enlarged Liver	n	1,016		955		1.07 (0.53,2.15)	0.999		
	Yes	17	1.7	15	1.6				
	No	999	98.3	940	98.4				
Miscel- laneous Liver Disorders	n	1,016		955		2.31 (0.95,5.58)	0.065		
	Yes	17	1.7	7	0.7				
	No	999	98.3	948	99.3				

TABLE K-8.

Unadjusted Analyses of Enlarged Livers  
Diagnosed at Physical Examination by Group\*  
(Original Comparisons Only)

Group	Enlarged Liver				Total	p-Value
	Yes	No	Number	Percent		
Ranch Hand	8	0.8	1,002	99.2	1,010	0.227
Original Comparison	3	0.3	950	99.7	953	

\*Excludes participants with positive HBsAg.

TABLE K-9.

**Unadjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group  
(Original Comparisons Only)**

Variable	Statistic	Group		Original Comparison	Est. Relative Risk (95% C.I.)	p-Value
		Ranch Band	Original Comparison			
SGOT	n	1,009		952		
	Mean	33.5		33.4		0.903
	95% C.I.	(32.9,34.1)		(32.8,34.0)		
	Number/%					
	Normal	929 92.1%		872 91.6%	0.94 (0.68,1.30)	0.701
SGPT	High	80 7.9%		80 8.4%		
	n	1,009		952		
	Mean	21.6		22.5		0.060
	95% C.I.	(21.0,22.3)		(21.8,23.2)		
	Number/%					
GGTP	Normal	872 86.4%		816 85.7%	0.94 (0.73,1.22)	0.651
	High	137 13.6%		136 14.3%		
	n	1,009		952		
	Mean	32.8		32.7		0.921
	95% C.I.	(31.4,34.3)		(31.3,34.2)		
Alkaline Phosphatase	Number/%					
	Normal	919 91.1%		862 90.6%	0.94 (0.69, 1.28)	0.682
	High	90 8.9%		90 9.4%		
	n	1,009		952		
	Mean	91.8		89.7		0.044
Alkaline Phosphatase	95% C.I.	(90.4,93.3)		(88.3,91.2)		
	Number/%					
	Normal	953 94.5%		911 95.7%	1.31 (0.87,1.97)	0.205
	High	56 5.5%		41 4.3%		

TABLE K-9. (continued)

**Unadjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group  
(Original Comparisons Only)**

Variable	Statistic	Group		Est. Relative Risk (95% C.I.)	p-Value
		Ranch Hand	Original Comparison		
Total Bilirubin	n	1,009	952	—	0.772
	Mean	0.74	0.75		
	95% C.I.	(0.73,0.76)	(0.73,0.76)		
	Number/%				
	Normal	982 97.3%	919 96.5%	0.77 (0.46, 1.28)	0.310
	High	27 2.7%	33 3.5%		
Direct Bilirubin	n	1,009	952	—	0.795
	Mean	0.28	0.28		
	95% C.I.	(0.27,0.28)	(0.27,0.28)		
	Number/%				
	Normal	971 96.2%	920 96.6%	1.13 (0.70, 1.82)	0.629
	High	38 3.8%	32 3.4%		
LDH	n	1,009	952	—	0.449
	Mean	123.5	124.3		
	95% C.I.	(122.2,124.8)	(122.8,125.7)		
	Number/%				
	Normal	999 99.0%	941 98.8%	0.86 (0.36,2.02)	0.724
	High	10 1.0%	11 1.2%		
Cholesterol	n	1,009	952	—	0.205
	Mean	214.3	216.7		
	95% C.I.	(211.8,216.8)	(214.0,219.3)		
	Number/%				
	Normal	863 85.5%	778 81.7%	0.76 (0.60,0.96)	0.023
	High	146 14.5%	174 18.3%		

TABLE K-9. (continued)

**Unadjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group  
(Original Comparisons Only)**

Variable	Statistic	Group		Original Comparison	Est. Relative Risk (95% C.I.)	p-Value
		Ranch Hand	Original Comparison			
<b>Triglycerides</b>	n	1,009	952			
	Mean	118.5	118.1			0.908
	95% C.I.	(113.8,123.3)	(113.4,122.9)			
	Number/%					
	Normal	941 93.3%	891 93.6%		1.06 (0.74,1.51)	0.767
	High	68 6.7%	61 6.4%			
<b>K-20</b> <b>Uroporphyrin</b>	n	1,006	949			
	Mean	16.9	17.7			0.176
	95% C.I.	(16.2,17.7)	(16.9,18.4)			
<b>Coproporphyrin</b>	n	1,008	950			
	Mean	119.1	115.0			0.053
	95% C.I.	(116.2,122.0)	(112.0,118.0)			

— No relative risk or confidence interval given for continuous analyses.

TABLE K-10.

Adjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group (Original Comparisons Only)

Variable	Analysis	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks*
			Ranch Hand	Original Comparison			
K21	OC	n	1,003	949			ALC*DC (p<0.001)
		Adj. Mean	34.69	34.64		0.908	AGE*ALC (p=0.033)
		95% C.I.	(33.66,35.75)	(33.61,35.70)			RACE (p=0.003)
	OD	n	1,003	949			RACE (p=0.004)
		Adj. Mean	35.97	35.99		0.974	ALC (p<0.001)
		95% C.I.	(34.82,37.17)	(34.83,37.18)			IC (p=0.032)
	DD	n	1,003	949	0.93 (0.66,1.29)	0.655	DC (p=0.044)
							AGE*ALC (p<0.001)
							OC*ALC (p<0.001)
							RACE (p=0.026)
K22	OC	n	1,003	949			ALC*DC (p=0.002)
		Adj. Mean	21.52	22.53		0.035	AGE*ALC (p=0.006)
		95% C.I.	(20.89,22.17)	(21.86,23.23)			
	OD	n	1,003	949			ALC*DC (p=0.043)
		Adj. Mean	21.49	22.52		0.032	AGE*ALC (p=0.008)
		95% C.I.	(20.21,22.86)	(21.18,23.96)			
	DD	n	1,003	949	0.91 (0.70,1.18)	0.467	AGE (p=0.008)
							ALC (p=0.003)

TABLE K-10. (continued)

Adjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group (Original Comparisons Only)

Variable	Analysis	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks*
			Ranch Hand	Original Comparison			
GGTP	CC	n	1,003	949	—	0.941	ALC*DC (p<0.001) AGE*DC (p=0.029) RACE*IC (p=0.005)
	CD	Adj. Mean	37.47	37.39			
	DD	95% C.I.	(34.93,40.20)	(34.84,40.12)			
Alkaline Phosphatase	CC	n	1,003	949	0.94 (0.68,1.28)	0.680	AGE*ALC (p=0.005) RACE (p=0.049)
	CD	Adj. Mean	42.35	42.24			
	DD	95% C.I.	(38.17,46.98)	(38.08,46.86)			
K-22	CC	n	1,003	950	—	0.020	RACE*IC (p=0.002) WINE (p<0.001) AGE (p<0.001) OCC (p<0.001)
	CD	Adj. Mean	91.5	89.1			
	DD	95% C.I.	(89.1,93.9)	(86.8, 91.5)			
	CC	n	1,003	950	—	****	GRP*IC (p=0.006) AGE*IC (p=0.040) RACE*IC (p=0.002) WINE (p<0.001) OCC (p<0.001)
	CD	Adj. Mean	****	****			
	DD	95% C.I.	****	****			
	CC	n	1,003	950	1.39 (0.91,2.12)	0.121	WINE*DC (p=0.010) AGE*IC (p=0.006) RACE*IC (p=0.004) OCC*IC (p=0.011) GRP*IC (marginal) (p=0.052)
	CD	Adj. Mean	****	****			
	DD	95% C.I.	****	****			

TABLE K-10. (continued)

**Adjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group (Original Comparisons Only)**

Variable	Analysis	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks*
			Ranch Hand	Original Comparison			
Total Bilirubin	OC	n	1,003	949			
		Adj. Mean	0.78	0.78		0.714	OC*RACE (p=0.002)
		95% C.I.	(0.75,0.81)	(0.75,0.82)			ALC*RACE (p=0.008)
	CD	n	1,003	949			AGE*DC (p=0.043)
		Adj. Mean	0.84	0.84		0.774	OC*RACE (p=0.003)
		95% C.I.	(0.80,0.88)	(0.80,0.88)			OC*ALC (p=0.047)
	DD	n	1,009	952	0.77 (0.46,1.29)	0.314	RACE (p<0.001)
		Adj. Mean	0.278	0.276		0.746	ALC (p<0.001)
		95% C.I.	(0.271,0.285)	(0.269,0.283)			
Direct Bilirubin	CD	n	1,003	949			
		Adj. Mean	0.308	0.305		0.673	IC*DC (p=0.014)
		95% C.I.	(0.291,0.325)	(0.288,0.323)			ALC*DC (p=0.012)
	DD	n	1,003	949	****	****	ALC*RACE (p=0.030)
							ALC*OC (p=0.007)
							GRP*IC (p=0.010)
							RACE (p=0.014)
							ALC (p=0.016)

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TABLE K-10. (continued)

**Adjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group (Original Comparisons Only)**

Variable	Analysis	Statistic	Group		Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks*
			Ranch Hand	Original Comparison			
K-24	OC	n	1,009	952	—	****	GRP*AGE (p=0.038) IC*RACE (p=0.029) IC*OC (p=0.049)
		Adj. Mean	*****	*****			
		95% C.I.	*****	*****			
	LDH	n	1,009	952	—	0.555	AGE (p<0.001) RACE (p=0.006)
		Adj. Mean	129.4	130.0			
		95% C.I.	(126.5,132.2)	(127.2,132.9)			
	DD	n	1,003	949	0.85 (0.36,2.01)	0.706	ALC (p=0.046)
		Adj. Mean	219.3	221.3			
		95% C.I.	(214.1,224.6)	(216.0,226.6)			
Cholesterol	OC	n	1,003	949	—	0.301	OC*RACE (p=0.003) DC*RACE (p=0.006) AGE (p<0.001) ALC (p<0.001) IC (p=0.016)
		Adj. Mean	223.7	226.0			
		95% C.I.	(217.3,230.3)	(219.6,232.5)			
	DD	n	1,003	949	0.74 (0.58,0.94)	0.015	RACE*ALC (p=0.009) AGE (p=0.020) OC (p=0.037)
		Adj. Mean	223.7	226.0			
		95% C.I.	(217.3,230.3)	(219.6,232.5)			

TABLE K-10. (continued)

Adjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group (Original Comparisons Only)

Group

Variable	Analysis	Statistic	Ranch Hand	Original Comparison	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks*
Triglycerides	OC	n	1,003	949	—	****	GRP*AGE (p=0.012) ALC (p<0.001) RACE (p<0.001) OCC (p<0.001)
		Adj. Mean	****	****			
		95% C.I.	****	****			
Uroporphyrin	OD	n	1,003	949	—	0.904	OCC (p<0.001) RACE (p<0.001) AGE (p<0.001) ALC (p=0.007)
		Adj. Mean	112.7	112.3			
		95% C.I.	(103.4,122.9)	(103.1,122.4)			
	DD	n	1,003	949	1.06 (0.74,1.51)	0.770	AGE*ALC (p=0.023) RACE (p=0.044)
		Adj. Mean	****	****	—	****	GRP*BUN (p=0.014) OCC*DC (p=0.006) ALC (p=0.048)
		95% C.I.	****	****			

TABLE K-10. (continued)

Adjusted Continuous and Categorical Analyses for Hepatic Function Variables  
and Two Porphyrin Determinations by Group (Original Comparisons Only)

Variable	Analysis	Statistic	Group		Original Comparison	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks*
			Ranch Hand					
Coproporphyrin	OC	n	1,002		947			ALC (p<0.001) BUN (p<0.001)
		Adj. Mean	119.1		115.2		—	
		95% C.I.	(116.2, 121.9)		(112.4, 118.2)		0.066	

\*Abbreviations:

GRP: group  
OCC: occupation  
ALC: current alcohol use  
WINE: wine consumption  
DC: exposure to degreasing chemicals  
IC: exposure to industrial chemicals  
BUN: blood urea nitrogen

— No relative risk or confidence interval given for continuous analyses.

\*\*\*\*Group-by-covariate interaction—adjusted mean/relative risk, confidence interval, and p-value not presented.

**TABLE K-11.**  
**Summary of Group-by-Covariate Interactions for Hepatic Function Variables**  
**(Original Comparisons Only)**

Variable	Interaction	Stratification	Statistic	Group		p-Value	
				Ranch Hand	Original Comparison		
Alkaline Phosphatase	Group-by-Industrial Chemicals	Exposed to Industrial Chemicals	n	504	506	0.001	
			Mean	94.8	90.0		
			Adj. Mean	96.9	92.1		
			95% C.I.	(93.5,100.6)	(88.8,95.5)		
	Not Exposed to Industrial Chemicals		n	499	444	0.608	
			Mean	88.9	89.5		
			Adj. Mean	92.5	93.3		
			95% C.I.	(89.3,95.8)	(90.0,96.7)		
LDH	Group-by-Age	Born $\geq$ 1942	n	408	369	0.756	
			Mean	122.2	121.7		
			Adj. Mean	124.1	123.6		
			95% C.I.	(121.1,127.1)	(120.6,126.7)		
	Born 1923-1941		n	565	538	0.295	
			Mean	123.8	125.2		
			Adj. Mean	126.4	127.8		
			95% C.I.	(123.7,129.1)	(125.1,130.5)		
	Born $\leq$ 1922		n	36	45	0.913	
			Mean	135.1	134.6		
			Adj. Mean	138.0	137.4		
			95% C.I.	(129.9,146.5)	(130.1,145.1)		

TABLE K-11.

**Summary of Group-by-Covariate Interactions for Hepatic Function Variables (continued)**  
**(Original Comparisons Only)**

Variable	Interaction	Stratification	Statistic	Group		p-Value
				Ranch Hand	Original Comparison	
Triglycerides	Group-by-Age	Born $\geq 1942$	n	406	368	0.055
			Mean	107.14	110.24	
			Adj. Mean	95.55	98.49	
			95% C.I.	(87.62,104.20)	(90.12,107.63)	
		Born 1923-1941	n	561	536	0.824
			Mean	125.98	124.23	
			Adj. Mean	116.13	115.14	
			95% C.I.	(107.59,125.35)	(106.64,124.31)	
		Born $\leq 1922$	n	36	45	0.510
			Mean	139.00	106.00	
			Adj. Mean	129.40	98.40	
			95% C.I.	(104.04,160.94)	(80.80,119.83)	
Uroporphyrin	Group-by-BUN	BUN $\leq 14$	n	547	509	0.005
			Mean	16.23	18.18	
			Adj. Mean	16.39	18.45	
			95% C.I.	(15.41,17.44)	(17.33,19.65)	
		BUN $> 14$	n	453	547	0.479
			Mean	17.79	17.15	
			Adj. Mean	18.02	17.45	
			95% C.I.	(16.85,19.27)	(16.30,18.67)	

TABLE K-12.

**Summary of Group-by-Covariate Interactions for Variables and  
and Porphyrin Determinations Analyzed Categorically  
(Original Comparisons Only)**

Variable	Interaction	Stratification	Statistic	Group				Adj. Relative Risk (95% C.I.)	p-Value		
				Ranch Hand		Comparison					
				Number	Percent	Number	Percent				
Direct Bilirubin	Group-by-Industrial Chemicals	Exposed to Industrial Chemicals	n	507		506		1.96 (1.02,3.80)	0.045		
			High	27	5.3	14	2.8				
			Normal	480	94.7	492	97.2				
	Group-by-Industrial Chemicals	Not Exposed to Industrial Chemicals	n	496		443		0.53 (0.25,1.15)	0.107		
			High	11	2.2	18	4.1				
			Normal	485	97.8	425	95.9				

TABLE K-13.

**Unadjusted Analysis for Interval History of Skin Bruises,  
Skin Patches, or Skin Sensitivity by Group  
(Original Comparisons Only)**

Group	<u>Bruises, Patches, or Sensitivity</u>				Total	p-Value
	Number	Percent	Number	Percent		
	Yes	No				
Ranch Hand	265	26.2	746	73.8	1,011	0.003
Original Comparison	195	20.5	758	79.5	953	

TABLE K-14.

**Unadjusted Analyses for Porphyrin Abnormalities by Group and Skin Patch, Bruise,  
or Sensitivity Reported at Followup Questionnaire  
(Original Comparisons Only)**

Group	Skin Patch, Bruise, or Reported Sensitivity	Abnormal Porphyrin Findings for a Participant						Total	p-Value*		
		0		1		2					
		Number	Percent	Number	Percent	Number	Percent				
Both Groups	Yes	412	89.8	45	9.8	2	0.4	459	0.754		
Both Groups	No	1,361	91.0	129	8.6	6	0.4	1496			
Ranch Hand	Yes	239	90.5	24	9.1	1	0.4	264	0.950		
Ranch Hand	No	670	90.3	70	9.4	2	0.3	742			
Original Comparison	Yes	173	88.7	21	10.8	1	0.5	195	0.419		
Original Comparison	No	691	91.6	59	7.8	4	0.5	754			

\*Chi-square test, 2 d.f.

TABLE K-15.

**Unadjusted Analyses for Uroporphyrin Abnormalities by Skin Patch, Bruise,  
or Sensitivity Reported at Followup Questionnaire and by Group  
(Original Comparisons Only)**

Variable	Stratification	Statistic	Group				Est. Relative Risk (95% C.I.)	p-Value		
			Ranch Hand		Original Comparison					
			Number	Percent	Number	Percent				
Uropor- phyrins	Skin Patch, Bruise, or Sensitivity Reported	n	264		195		0.98 (0.41,2.38)	0.999		
		Abnormal	12	4.5	9	4.6				
		Normal	252	95.5	186	95.4				
	Skin Patch, Bruise, or Sensitivity Not Reported	n	742		754		1.07 (0.69,1.67)	0.821		
		Abnormal	42	5.7	40	5.3				
		Normal	700	94.3	714	94.7				

TABLE K-16.

**Longitudinal Results for SGOT, SGPT, and GGTP:**  
**A Contrast of Baseline and First Followup**  
**Examination Test Means**  
**(Original Comparisons Only)**

Variable	Group	Total	Means		p-Value* (Equality of Difference)
			1982 Baseline	1985 Followup	
SGOT	Ranch Hand	971	32.91	33.73	0.90
	Original Comparison	872	32.93	33.69	
SGPT	Ranch Hand	971	20.08	21.82	0.86
	Original Comparison	872	20.51	22.36	
GGTP	Ranch Hand	971	39.26	33.16	0.78
	Original Comparison	872	38.76	32.56	

\*Analyzed in log units.