

**APPENDIX P**  
**Endocrine Assessment**

## **APPENDIX P: Endocrine Assessment**

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**TABLE P-1.**  
**Summary of Group-by-Covariate Interactions for Endocrinological Variables**

Variable	Interaction	Stratification	Statistic	Group		p-Value
				Ranch Hand	Comparison	
<b>Testosterone Group-by-% Body Fat</b>	<10%		n	6	4	
			Mean	522.6	1044.8	
			Adj. Mean	654.4	1042.8	0.012
			95% C.I.	(484.7,849.5)	(803.5,1313.2)	
	10-25%		n	815	1026	
			Mean	627.8	605.7	
			Adj. Mean	603.3	582.4	0.023
			95% C.I.	(583.4,623.5)	(563.9,601.3)	
	>25%		n	179	257	
			Mean	470.5	470.3	
			Adj. Mean	463.0	456.7	0.706
			95% C.I.	(435.0,491.9)	(432.9,481.2)	
<b>Differential Group-by-Cortisol Race-by-Age</b>	Nonblack Born ≥1942		n	374	500	
			Mean	2.07	2.44	
			Adj. Mean	1.58	1.97	0.156
			95% C.I.	(0.64,2.51)	(1.06,2.88)	
	Nonblack Born <1942		n	572	697	
			Mean	2.53	2.46	
			Adj. Mean	2.08	1.99	0.708
			95% C.I.	(1.18,2.97)	(1.10,2.88)	
	Black Born ≥1942		n	32	47	
			Mean	0.17	2.78	
			Adj. Mean	-0.46	2.33	0.003
			95% C.I.	(-2.11,1.18)	(0.89,3.76)	
	Black Born <1942		n	26	36	
			Mean	3.24	2.30	
			Adj. Mean	2.94	1.89	0.312
			95% C.I.	(1.22,4.67)	(0.32,3.46)	

TABLE P-2.

## Unadjusted Exposure Index Analyses for Endocrinological Variables by Occupation

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value
			Low	Medium	High		
<i>T<sub>3</sub></i> % Uptake	Officer	n	126	124	122	Overall	0.250
		Mean	28.01	28.35	27.96		0.177
		95% C.I.	(27.66,28.36)	(28.00,28.71)	(27.61,28.32)		0.857
	Enlisted Flyer	n	55	65	55	Overall	0.362
		Mean	27.31	27.59	27.83		0.411
		95% C.I.	(26.82,27.81)	(27.14,28.06)	(27.32,28.34)		0.155
	Enlisted Groundcrew	n	153	161	142	Overall	0.775
		Mean	27.68	27.65	27.53		0.865
		95% C.I.	(27.37,28.00)	(27.34,27.95)	(27.21,27.85)		0.493
TSH	Officer	n	126	124	122	Overall	0.283
		Mean	1.181	1.167	1.278		0.843
		95% C.I.	(1.089,1.286)	(1.076,1.271)	(1.173,1.397)		0.203
	Enlisted Flyer	n	55	65	55	Overall	0.181
		Mean	1.033	1.153	1.204		0.178
		95% C.I.	(0.924,1.162)	(1.035,1.292)	(1.068,1.367)		0.075
	Enlisted Groundcrew	n	153	161	142	Overall	0.738
		Mean	1.117	1.124	1.160		0.899
		95% C.I.	(1.043,1.199)	(1.051,1.204)	(1.079,1.250)		0.465

**TABLE P-2. (continued)**  
**Unadjusted Exposure Index Analyses for Endocrinological Variables by Occupation**

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value
			Low	Medium	High		
<b>Testosterone</b>	<b>Officer</b>	n	125	128	118	Overall	0.099
		Mean	599.4	547.4	558.0	M vs. L	0.041
		95% C.I.	(563.8,636.1)	(513.8,582.1)	(522.7,594.4)	H vs. L	0.112
	<b>Enlisted Flyer</b>	n	55	63	57	Overall	0.363
		Mean	588.7	637.4	584.9	M vs. L	0.244
		95% C.I.	(531.6,648.6)	(581.8,695.6)	(529.1,643.6)	H vs. L	0.929
	<b>Enlisted Groundcrew</b>	n	162	153	139	Overall	0.276
		Mean	609.3	641.4	603.4	M vs. L	0.205
		95% C.I.	(574.7,644.9)	(606.9,676.9)	(567.3,640.6)	H vs. L	0.820
<b>Initial Cortisol</b>	<b>Officer</b>	n	124	130	121	Overall	0.186
		Mean	11.97	11.43	12.28	M vs. L	0.239
		95% C.I.	(11.33,12.65)	(10.83,12.07)	(11.61,12.99)	H vs. L	0.531
	<b>Enlisted Flyer</b>	n	55	65	57	Overall	0.276
		Mean	11.97	11.08	11.13	M vs. L	0.001
		95% C.I.	(11.09,12.91)	(10.33,11.88)	(10.33,11.99)	H vs. L	0.092
	<b>Enlisted Groundcrew</b>	n	154	161	142	Overall	0.699
		Mean	11.69	11.33	11.50	M vs. L	0.397
		95% C.I.	(11.09,12.32)	(10.76,11.92)	(10.89,12.15)	H vs. L	0.678

**TABLE P-2. (continued)**  
**Unadjusted Exposure Index Analyses for Endocrinological Variables by Occupation**

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value
			Low	Medium	High		
2-Hour Cortisol	Officer	n	124	130	121	Overall	0.416
		Mean	9.27	9.16	9.69	M vs. L	0.789
		95% C.I.	(8.72, 9.86)	(8.63, 9.73)	(9.10, 10.32)	H vs. L	0.324
	Enlisted Flyer	n	55	65	57	Overall	0.200
		Mean	8.43	9.48	9.06	M vs. L	0.074
		95% C.I.	(7.67, 9.26)	(8.69, 10.34)	(8.25, 9.94)	H vs. L	0.286
	Enlisted Groundcrew	n	154	161	142	Overall	0.453
		Mean	9.64	9.29	9.17	M vs. L	0.358
		95% C.I.	(9.11, 10.19)	(8.79, 9.81)	(8.65, 9.72)	H vs. L	0.229
Differential Cortisol	Officer	n	124	130	121	Overall	0.709
		Mean	2.69	2.31	2.59	M vs. L	0.424
		95% C.I.	(2.02, 3.36)	(1.66, 2.96)	(1.91, 3.26)	H vs. L	0.829
	Enlisted Flyer	n	55	65	57	Overall	0.003
		Mean	3.43	1.20	2.30	M vs. L	<0.001
		95% C.I.	(2.50, 4.36)	(0.34, 2.06)	(1.39, 3.22)	H vs. L	0.092
	Enlisted Groundcrew	n	154	161	142	Overall	0.726
		Mean	1.96	2.12	2.37	M vs. L	0.740
		95% C.I.	(1.26, 2.66)	(1.44, 2.81)	(1.64, 3.09)	H vs. L	0.425

**TABLE P-2. (continued)**  
**Unadjusted Exposure Index Analyses for Endocrinological Variables by Occupation**

Variable	Occupation	Statistic	Exposure Index			Contrast	p-Value
			Low	Medium	High		
Officer		n	121	113	124	Overall	0.892
		Mean	109.0	107.5	107.6		M vs. L
		95% C.I.	(104.3,113.8)	(103.0,112.3)	(102.9,112.6)		H vs. L
2-Hour Post-prandial Glucose	Enlisted Flyer	n	54	62	56	Overall	0.051
		Mean	100.9	118.0	110.9		M vs. L
		95% C.I.	(92.1,110.6)	(108.3,128.5)	(101.4,121.4)		H vs. L
Enlisted Groundcrew		n	150	156	140	Overall	0.674
		Mean	105.5	106.7	109.1		M vs. L
		95% C.I.	(100.1,111.1)	(101.4,112.4)	(103.3,115.2)		H vs. L

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**TABLE P-3.**  
**Interaction Summaries of Adjusted Exposure Index Analyses for Endocrinological Variables**

Variable	Interaction (Occupation)	Stratifi- cation	Statistic	Exposure Index			Contrast	p-Value
				Low	Medium	High		
Testosterone	Exposure Index-by- % Body Fat (Enlisted Groundcrew)	<10%	n	1	2	3		
			Adj. Mean	72.7	828.8	684.5	M vs. L	≤0.001
			95% C.I.	(0.3,273.0)	(537.8,1182.5)	(465.4,945.8)	H vs. L	≤0.001
	10-25%	n	125	128	105			
		Adj. Mean	630.0	646.2	644.7	M vs. L	0.527	
		95% C.I.	(586.1,675.5)	(601.6,692.5)	(598.2,692.9)	H vs. L	0.585	
	>25%	n	27	31	29			
		Adj. Mean	501.8	503.0	467.5	M vs. L	0.980	
		95% C.I.	(433.9,574.7)	(437.6,573.0)	(400.7,539.6)	H vs. L	0.471	
2-Hour Cortisol	Exposure Index-by- % Body Fat (Officer)	10-25%	n	102	110	99		
			Adj. Mean	8.31	8.50	9.05	M vs. L	0.629
			95% C.I.	(7.20,9.58)	(7.41,9.76)	(7.86,10.43)	H vs. L	0.079
	>25%	n	22	20	20			
		Adj. Mean	10.03	7.46	8.26	M vs. L	0.006	
		95% C.I.	(8.27,12.18)	(6.12,9.10)	(6.77,10.07)	H vs. L	0.068	
2-Hour Cortisol	Exposure Index-by- Race (Enlisted Groundcrew)	Nonblack	n	138	146	129		
			Adj. Mean	9.30	9.33	9.32	M vs. L	0.921
			95% C.I.	(8.30,10.42)	(8.38,10.41)	(8.33,10.43)	H vs. L	0.961
	Black	n	16	14	11			
		Adj. Mean	12.89	9.36	8.41	M vs. L	0.013	
		95% C.I.	(10.59,15.67)	(7.61,11.52)	(7.48,10.48)	H vs. L	0.002	

TABLE P-3. (continued)  
Interaction Summaries of Adjusted Exposure Index Analyses for Endocrinological Variables

Variable	Interaction (Occupation)	Stratifi- cation	Statistic	Exposure Index			Contrast	p-Value
				Low	Medium	High		
Initial Cortisol	Exposure Index-by- % Body Fat (Officer)	10-25%	n	102	110	99		
			Adj. Mean	11.51	11.19	12.25	M vs. L	0.514
			95% C.I.	(10.13,13.08)	(9.89,12.66)	(10.80,13.91)	H vs. L	0.154
	>25%	n	22	20	20			
			Adj. Mean	12.28	9.59	10.26	M vs. L	0.010
			95% C.I.	(10.33,14.60)	(8.03,11.45)	(8.59,12.26)	M vs. L	0.060
Differential Cortisol	Exposure Index-by- Race-by- Personality Type (Enlisted Groundcrew)	Nonblack Type A	n	49	63	53		
			Adj. Mean	0.96	1.94	2.00	M vs. L	0.237
			95% C.I.	(-0.74,2.66)	(0.38,3.49)	(0.32,3.68)	H vs. L	0.223
		Nonblack Type B	n	89	83	76		
			Adj. Mean	2.29	1.36	1.64	M vs. L	0.158
			95% C.I.	(0.80,3.78)	(-0.12,2.84)	(0.14,3.14)	H vs. L	0.336
	Black Type A	Black Type A	n	8	5	4		
			Adj. Mean	-5.49	3.27	3.10	M vs. L	<0.001
			95% C.I.	(-8.70,-2.28)	(-0.71,7.25)	(-1.30,7.49)	H vs. L	0.001
Black Type B	Black Type B	n	8	9	7			
		Adj. Mean	1.16	2.99	0.48	M vs. L	0.384	
		95% C.I.	(-2.04,4.37)	(-0.07,6.05)	(-2.80,3.76)	H vs. L	0.762	

TABLE P-4.

**Unadjusted Continuous and Categorical Analyses for Laboratory Endocrinological Variables by Group  
(Original Comparisons Only)**

Variable	Statistic	Group				Contrast	Est. Relative Risk (95% C.I.)	p-Value					
		Ranch Hand	Original Comparison										
<i>T<sub>3</sub></i> , % Uptake	n	1,003	936										
	Mean	27.79	27.68										
	95% C.I.	(27.67,27.91)	(27.55,27.80)										
	Number/%												
	Low	7	0.7%	13	1.4%	Overall		0.203					
	Normal	969	96.6%	898	95.9%	Low vs. Normal							
	High	27	2.7%	25	2.7%	High vs. Normal							
						0.50 (0.20,1.26)		0.322					
						1.00 (0.58,1.74)							
						0.177							
<i>TSH</i>	n	1,003	936										
	Mean	1.16	1.11										
	95% C.I.	(1.13,1.19)	(1.08,1.14)										
	Number/%							0.040					
	Normal	996	99.3%	931	99.5%	--							
	High	7	0.7%	5	0.5%	1.31 (0.41,4.14)							
						0.775							
						0.775							
						0.999							
						0.999							
<i>Testosterone</i>	n	1,000	952										
	Mean	597.31	570.90										
	95% C.I.	(583.97,610.80)	(557.69,584.27)										
	Number/%							0.006					
	Low	38	3.8%	37	3.9%	Overall							
	Normal	949	94.9%	904	95.0%	Low vs. Normal							
	High	13	1.3%	11	1.2%	High vs. Normal							
						0.98 (0.62,1.55)							
						1.13 (0.50,2.53)							
						0.839							
<i>Initial Cortisol</i>	n	1,009	949										
	Mean	11.62	11.67										
	95% C.I.	(11.39,11.85)	(11.44,11.91)										
	Number/%							0.729					
	Low	52	5.2%	44	4.6%	Overall							
	Normal	950	94.2%	898	94.6%	Low vs. Normal							
	High	7	0.7%	7	0.7%	High vs. Normal							
						1.12 (0.74,1.69)							
						0.603							
						0.95 (0.33,2.71)							
						0.999							

TABLE P-4. (continued)

**Unadjusted Continuous and Categorical Analyses for Laboratory Endocrinological Variables by Group  
(Original Comparisons Only)**

Variable	Statistic	Group				Contrast	Est. Relative Risk (95% C.I.)	p-Value
		Ranch	Hand	Original Comparison				
2-Hour Cortisol	n	1,009		949		Overall Impaired vs. Normal Diabetic vs. Normal	1.26 (0.28,5.62)	0.999
	Mean	9.30		9.32				
	95% C.I.	(9.10,9.51)		(9.11,9.52)				
	Number/%							
	Low	0	0.0%	0	0.0%			
	Normal	1,005	99.6%	946	99.7%			
	High	4	0.4%	3	0.3%			
Differential Cortisol	n	1,009		949		Impaired vs. Normal Diabetic vs. Normal	0.69 (0.53,0.91)	0.692
	Mean	2.30		2.38				
	95% C.I.	(2.05,2.55)		(2.12,2.64)				
	Number/%							
2-Hour Post-prandial Glucose	n	976		909		Overall Impaired vs. Normal Diabetic vs. Normal	0.69 (0.53,0.91)	0.154
	Mean	107.93		110.03				
	95% C.I.	(105.90,110.01)		(108.03,112.07)				
	Number/%							
	Normal	836	85.7%	748	82.3%			
	Impaired	106	10.9%	137	15.1%			
	Diabetic	34	3.5%	24	2.6%			
Diabetes (Composite Indicator)	n	1,016		955		Diabetic vs. Normal	1.27 (0.75,2.16)	0.423
	Number/%							
	Yes	74	7.3%	67	7.0%			
	No	942	92.7%	888	93.0%			

-- No relative risk or confidence interval given for continuous analysis.

TABLE P-5.

**Adjusted Continuous and Categorical Analyses for Laboratory Endocrinological Variables by Group  
(Original Comparisons Only)**

Variable	Statistic	Group		Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
		Ranch Hand	Original Comparison				
T <sub>3</sub> % Uptake	n	998	933	Overall Low vs. Normal High vs. Normal	— 0.52 (0.45,2.36) 1.03 (0.59,1.78)	0.332 0.153 0.916	OCC (p=0.025) PERSTYPE (p=0.035)
TSH	n	1,003	936	—	—	0.020	AGE (p<0.001)
	Adj. Mean	1.16	1.11				
	95% C.I.	(1.13,1.19)	(1.08,1.14)				
				High vs. Normal	1.31 (0.41,4.14)	0.775	
Testosterone	n	1,000	951	—	—	****	RACE (p=0.015)
	Adj. Mean	****	****				AGE*BFAT (p=0.039)
	95% C.I.	****	****				GRP*BFAT (p=0.022)
	n	1,000	951	Overall Low vs. Normal High vs. Normal	— 1.01 (0.63,1.61) 1.02 (0.42,2.52)	0.998 0.980 0.958	AGE (p<0.001) ZBFAT (p<0.001)
Initial Cortisol	n	1,004	945	—	—	0.820	AGE (p<0.001)
	Adj. Mean	11.35	11.38				ZBFAT (p<0.001)
	95% C.I.	(10.49,12.27)	(10.52,12.32)				PERSTYPE (p=0.028)
							OCC*RACE (p=0.026)
Differential Cortisol	n	1,004	945	—	—	****	GRP*AGE*RACE (p=0.016)
	Adj. Mean	****	****				PERSTYPE (p=0.002)
	95% C.I.	****	****				ZBFAT (p=0.006)

TABLE P-5. (continued)

**Adjusted Continuous and Categorical Analyses for Laboratory Endocrinological Variables by Group  
(Original Comparisons Only)**

Variable	Statistic	Group		Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
		Ranch Hand	Original Comparison				
2-Hour Post-prandial Glucose	n	976	908	Overall	0.430	0.023	ZBFAT (p<0.001)
	Adj. Mean	114.8	116.0				OCC (p=0.002)
	95% C.I.	(107.2,122.9)	(108.3,124.2)				AGE*RACE (p=0.002)
				Impaired vs. Normal	0.71 (0.54,0.93)	0.014	AGE (p<0.001)
				Diabetic vs. Normal	1.29 (0.71,2.38)	0.405	RACE (p=0.027)
Diabetes (Composite Indicator)	n	1,016	954	1.13 (0.80,1.61)	0.484	0.484	ZBFAT (p<0.001)
							RACE (p=0.015)

\*\*\*\*Group-by-covariate interaction—adjusted mean/relative risk, confidence interval, and p-value are not presented.  
—No relative risk or confidence interval given for continuous analyses.

GRP: Group

OCC: Occupation

PERSTTYPE: Personality type (A or B)

ZBFAT: Percent body fat

TABLE P-6.

**Summary of Group-by-Covariate Interactions for Endocrinological Variables  
(Original Comparisons Only)**

Variable	Interaction	Stratification	Statistic	Group		p-Value
				Ranch Hand	Original Comparison	
Testosterone Group-by-% Body Fat	<10%	10-25%	n	6	3	
			Mean	522.6	1173.8	
			Adj. Mean	640.1	1074.7	0.014
			95% C.I.	(472.2,833.5)	(794.4,1397.2)	
	10-25%	>25%	n	815	757	
			Mean	627.8	595.9	
			Adj. Mean	602.3	577.7	0.013
			95% C.I.	(581.2,623.7)	(556.7,599.1)	
	>25%		n	179	191	
			Mean	470.5	470.7	
			Adj. Mean	461.5	459.1	0.891
			95% C.I.	(432.9,491.1)	(431.8,487.2)	
Differential Group-by-Cortisol Race-by-Age	Nonblack Born ≥1942	Nonblack Born <1942	n	374	342	
			Mean	2.07	2.34	
			Adj. Mean	1.36	1.65	0.331
			95% C.I.	(0.38,2.34)	(0.67,2.64)	
	Black Born ≥1942	Black Born <1942	n	572	545	
			Mean	2.53	2.36	
			Adj. Mean	1.85	1.66	0.419
			95% C.I.	(0.92,2.79)	(0.71,2.60)	
	Black Born <1942		n	32	27	
			Mean	0.17	3.05	
			Adj. Mean	-0.68	2.41	0.004
			95% C.I.	(-2.35,0.99)	(0.64,4.17)	