

**APPENDIX N**  
**Hematological Evaluation**

## **APPENDIX N: Hematological Evaluation**

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**TABLE N-1.**  
**Summary Statistics for Hematological Covariates by Group**

Covariate	Covariate Category	Group			p-Value
		Ranch Hand Percent	Comparison Percent		
Race	Black	5.9	6.4	0.679	
	Nonblack	94.1	93.6		
Occupation	Officer	37.4	37.5	0.724	
	Enlisted Flyer	17.5	16.2		
	Enlisted Groundcrew	45.2	46.3		
		<u>Mean±SE</u>		<u>Mean±SE</u>	
Age (At Baseline)	--	43.94±0.24	43.86±0.22	0.804	
Current Smoking*	--	10.75±0.48	9.13±0.40	0.010	
Smoking History (Pack-Years)	--	13.24±0.52	12.98±0.47	0.708	

\*Equivalent cigarettes per day.

--Covariate not categorized for these results.

TABLE N-2.

**Summary of Group-by-Covariate  
Interactions for Hematological Variables**

Variable	Interaction Covariates	Stratification	Ranch Hand-Comparison Group Difference $\pm$ SE	p-Value	Direction of Result*
RBC	Occupation	<u>Officer</u>			
		<u>Nonsmoker</u>	-0.009 $\pm$ 0.030	0.775	
		30 Pack-Years	-0.014 $\pm$ 0.035	0.686	
		<u>Enlisted Flyer</u>			
		<u>Nonsmoker</u>	-0.066 $\pm$ 0.053	0.212	
	Smoking History	30 Pack-Years	-0.001 $\pm$ 0.046	0.975	
		<u>Enlisted Groundcrew</u>			
		<u>Nonsmoker</u>	-0.010 $\pm$ 0.029	0.736	
		30 Pack-Years	-0.093 $\pm$ 0.036	0.010	C>RH
WBC <sup>a</sup>	Race	<u>Nonblack</u>			
		<u>Nonsmoker</u>			
		35	-0.010 $\pm$ 0.020	0.609	
		53	0.002 $\pm$ 0.021	0.942	
	Occupation	<u>30 Pack-Years</u>			
		35	0.115 $\pm$ 0.031	<0.001	RH>C
		53	-0.017 $\pm$ 0.019	0.369	
	Age (At Baseline)	<u>Black</u>			
		<u>Officer</u>			
		35	-0.550 $\pm$ 0.184	0.003	C>RH
		53	-0.143 $\pm$ 0.186	0.446	
	Smoking History	<u>Enlisted Flyer</u>			
		35	-0.341 $\pm$ 0.172	0.050	C>RH
		53	0.067 $\pm$ 0.134	0.618	
	Occupation	<u>Enlisted Groundcrew</u>			
		35	-0.121 $\pm$ 0.074	0.104	
		53	0.286 $\pm$ 0.149	0.057	RH>C

**TABLE N-2. (continued)**  
**Summary of Group-by-Covariate**  
**Interactions for Hematological Variables**

Variable	Interaction Covariates	Stratification	Ranch Hand-Comparison Group Difference $\pm$ SE	p-Value	Direction of Result*
PLT*	Race	<u>Nonblack</u>			
		<u>Nonsmoker</u>	0.003 $\pm$ 0.012	0.789	
	Smoking (Smoking History and Current Smoking)	30 Pack-Years, Currently 1 Pack/Day	0.103 $\pm$ 0.042	0.014	RH>C
		<u>Black</u>			
		<u>Nonsmoker</u>	-0.050 $\pm$ 0.050	0.317	
		30 Pack-Years, Currently 1 Pack/Day	0.258 $\pm$ 0.096	0.007	RH>C

\*RH>C: Variable mean in Ranch Hand group greater than variable mean in Comparison group.  
 C>RH: Variable mean in Comparison group greater than variable mean in Ranch Hand group.

\*Units are on log scale.

**TABLE N-3.**  
**Interaction Summaries for Adjusted Continuous Exposure  
 Index Analyses for Hematological Variables**

Variable	Interaction (Occupation)	Stratification	Contrast	Exposure Index Level Difference $\pm$ SE	p-Value	Direction of Result*
RBC	Exposure Index- by-Race (Officer)	Nonblack	M vs. L	0.014 $\pm$ 0.295	0.962	
			H vs. L	-0.180 $\pm$ 0.372	0.630	
		Black	M vs. L	-0.047 $\pm$ 0.402	0.908	
			H vs. L	0.516 $\pm$ 0.502	0.304	
RBC	Exposure Index- by-Age (At Baseline) (Enlisted Flyer)	35	M vs. L	-0.119 $\pm$ 0.128	0.356	
			H vs. L	0.261 $\pm$ 0.151	0.086	H > L
		53	M vs. L	0.033 $\pm$ 0.102	0.748	
			H vs. L	-0.172 $\pm$ 0.102	0.093	L > H
HGB	Exposure Index- by-Race (Officer)	Nonblack	M vs. L	-0.007 $\pm$ 0.122	0.955	
			H vs. L	0.060 $\pm$ 0.123	0.626	
		Black	M vs. L	0.089 $\pm$ 0.874	0.919	
			H vs. L	2.227 $\pm$ 0.960	0.021	H > L
HGB	Exposure Index- by-Age (At Baseline) (Enlisted Flyer)	35	M vs. L	-0.854 $\pm$ 0.389	0.029	
			H vs. L	0.626 $\pm$ 0.457	0.172	
		53	M vs. L	0.425 $\pm$ 0.308	0.169	
			H vs. L	-0.339 $\pm$ 0.308	0.272	
HCT	Exposure Index- by-Race (Officer)	Nonblack	M vs. L	-0.093 $\pm$ 0.359	0.795	
			H vs. L	0.206 $\pm$ 0.362	0.569	
		Black	M vs. L	-0.849 $\pm$ 2.569	0.741	
			H vs. L	5.611 $\pm$ 2.823	0.048	H > L

TABLE N-3. (continued)

**Interaction Summaries for Adjusted Continuous Exposure Index Analyses for Hematological Variables**

Variable	Interaction (Occupation)	Stratification	Contrast	Exposure Index Level Difference $\pm$ SE	p-Value	Direction of Result*
HCT	Exposure Index by-Age (At Baseline) (Enlisted Flyer)	35	M vs. L	-2.332 $\pm$ 1.141	0.042	L > M
			H vs. L	1.921 $\pm$ 1.341	0.154	
	(Packs per Day) (Enlisted Flyer)	53	M vs. L	1.074 $\pm$ 0.904	0.236	M > L
			H vs. L	-0.887 $\pm$ 0.904	0.328	
PLT <sup>a</sup>	Exposure Index- by-Current Smoking	0	M vs. L	0.097 $\pm$ 0.054	0.075	M > L
			H vs. L	-0.005 $\pm$ 0.053	0.932	
	(Enlisted Flyer)	1	M vs. L	-0.015 $\pm$ 0.042	0.710	M > L
			H vs. L	-0.062 $\pm$ 0.045	0.169	
	Exposure Index- by-Race	2	M vs. L	-0.128 $\pm$ 0.068	0.064	L > M
			H vs. L	-0.118 $\pm$ 0.078	0.132	
PLT <sup>a</sup>	(Enlisted Groundcrew)	Nonblack	M vs. L	-0.015 $\pm$ 0.025	0.557	M > L
			H vs. L	-0.004 $\pm$ 0.026	0.885	
	Black	M vs. L	0.156 $\pm$ 0.079	0.049	M > L	
			H vs. L	-0.036 $\pm$ 0.081	0.659	

\*H > L: Variable mean in high exposure index category greater than variable mean in low exposure index category.  
 L > H: Variable mean in low exposure index category greater than variable mean in high exposure index category.  
 L > M: Variable mean in low exposure index category greater than variable mean in medium exposure index category.  
 M > L: Variable mean in medium exposure index category greater than variable mean in low exposure index category.  
<sup>a</sup>Units are in log scale.

TABLE N-4.

**Unadjusted Categorical Analyses for  
Hematological Variables by Group  
(Original Comparisons Only)**

Variable	Group	<u>Abnormally Low</u>		<u>Normal</u>		<u>Abnormally High</u>		Total	p-Value*
		Number	Percent	Number	Percent	Number	Percent		
RBC	Ranch Hand	30	3.0	976	96.2	8	0.8	1,014	0.598
	Original Comparison	36	3.8	910	95.4	8	0.8	954	
WBC	Ranch Hand	45	4.4	906	89.4	62	6.1	1,013	0.631
	Original Comparison	47	4.9	857	89.8	50	5.2	954	
HGB	Ranch Hand	39	3.8	752	74.2	223	22.0	1,014	0.867
	Original Comparison	34	3.6	717	75.2	203	21.3	954	
HCT	Ranch Hand	11	1.1	1,001	98.7	2	0.2	1,014	0.722
	Original Comparison	13	1.4	938	98.3	3	0.3	954	
MCV	Ranch Hand	10	1.0	857	84.5	147	14.5	1,014	0.904
	Original Comparison	11	1.2	809	84.8	134	14.0	954	
MCH	Ranch Hand	7	0.7	943	93.0	64	6.3	1,014	0.947
	Original Comparison	7	0.7	890	93.3	57	6.0	954	
MCHC	Ranch Hand	1	0.1	1,013	99.9	0	0.0	1,014	—
	Original Comparison	0	0.0	954	100.0	0	0.0	954	
PLT	Ranch Hand	5	0.5	987	97.4	21	2.1	1,013	0.760
	Original Comparison	2	0.2	935	98.0	17	1.8	954	

\*Chi-square test, 2 d.f., except for HCT and PLT, which were obtained from continuity adjusted chi-square tests on 1 d.f. (Abnormally high category pooled with normal, and abnormally low category pooled with normal for HCT and PLT, respectively.)

—Only one abnormal MCHC value; p-value not given.

TABLE N-5.

**Unadjusted Continuous Analyses for  
Hematological Variables (Contrast of Group Means)  
(Original Comparisons Only)**

Variable	Group Mean $\pm$ SE		Difference $\pm$ SE	t-Statistic	p-Value
	Ranch Hand	Original Comparison			
RBC	4.964 $\pm$ 0.012	4.974 $\pm$ 0.012	-0.010 $\pm$ 0.017	-0.61	0.540
WBC <sup>1</sup>	7.003	6.844	--	1.78	0.076
HGB	15.624 $\pm$ 0.033	15.600 $\pm$ 0.034	0.024 $\pm$ 0.047	0.50	0.619
HCT	45.904 $\pm$ 0.097	45.874 $\pm$ 0.097	0.030 $\pm$ 0.137	0.22	0.827
MCV	92.596 $\pm$ 0.150	92.355 $\pm$ 0.157	0.241 $\pm$ 0.217	1.11	0.268
MCH	31.544 $\pm$ 0.055	31.435 $\pm$ 0.058	0.108 $\pm$ 0.080	1.35	0.177
MCHC	34.040 $\pm$ 0.021	34.009 $\pm$ 0.613	0.030 $\pm$ 0.029	1.06	0.291
PLT <sup>1</sup>	265.2	261.7	--	1.39	0.165

<sup>1</sup>Means transformed from log scale.

--Difference and standard errors (SE) not presented, since variables were analyzed on logarithmic scale.

TABLE N-6.

**Adjusted Categorical Analyses for Hematological Variables  
(Abnormal Versus Normal, Adjusted for Age, Race, Occupation, and Smoking)  
(Original Comparisons Only)**

Variable	<u>Abnormally Low vs. Normal</u>		<u>Abnormally High vs. Normal</u>	
	Adj. Relative Risk (95% C.I.)	p-Value	Adj. Relative Risk (95% C.I.)	p-Value
RBC	0.81 (0.51,1.30)	0.380	0.95 (0.41,2.17)	0.898
WBC	0.95 (0.63,1.43)	0.730	1.16 (0.80,1.70)	0.431
HGB	1.10 (0.70,1.72)	0.692	1.05 (0.85,1.30)	0.662
HCT	0.84 (0.41,1.71) <sup>a</sup>	0.628 <sup>a</sup>	Sparse Data	
MCV				
Nonblack	1.92 (0.64,5.76)	0.242	1.09 (0.84,1.42)	0.503
Black	0.32 (0.09,1.11)	0.072	0.41 (0.12,1.34)	0.139
MCH	0.96 (0.40,2.30)	0.920	1.06 (0.74,1.52)	0.734
PLT	Sparse Data		1.13 (0.63,2.05) <sup>b</sup>	0.682 <sup>b</sup>

<sup>a</sup>Abnormally low versus normal/abnormally high.

<sup>b</sup>Abnormally high versus normal/abnormally low.

TABLE N-7.

**Adjusted Continuous Analyses for Hematological Variables  
(Ranch Hand-Original Comparison Group Differences)  
(Original Comparisons Only)**

Variable	Ranch Hand-Original Comparison Group Difference ±SE	p-Value	Covariate Remarks*
RBC	-0.018 ± 0.017	0.278	AGE (p<0.001) CSMOK (p=0.001) OCC*PACKYR (p=0.043)
WBC	****	****	GRP*RACE*OCC (p<0.001) GRP*AGE*RACE (p=0.013) GRP*AGE*PACKYR (p=0.013) GRP*RACE*PACKYR (p=0.022) PACKYR*CSMOK (p<0.001)
HGB	****	****	GRP*RACE*AGE (p=0.030) GRP*RACE*OCC (p=0.020) OCC*PACKYR (p=0.023) CSMOK (p<0.001)
HCT	****	****	GRP*RACE*AGE (p=0.026) GRP*RACE*OCC (p=0.011) AGE*OCC (p=0.009) CSMOK (p<0.001)
MCV	****	****	GRP*AGE*PACKYR (p=0.041) GRP*AGE*CSMOK (p=0.012) RACE*OCC (p=0.021) AGE*RACE (p<0.001)
MCH	****	****	GRP*AGE*CSMOK (p=0.026) AGE*RACE (p=0.001) OCC (p=0.001)
MCHC	0.030 ± 0.028	0.296	RACE (p<0.001)
PLT	****	****	GRP*RACE*PACKYR (p=0.011) GRP*AGE (p=0.040) OCC (p=0.005)

\*CSMOK: current level of smoking (cigarettes per day)

PACKYR: smoking history (pack years)

OCC: occupation

GRP: group

\*\*\*\*Group-by-covariate interaction--group difference, standard error (SE), and p-value not presented.

TABLE N-8.

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

Variable	Interaction Covariates	Stratification	Ranch Hand-Original Comparison Group Difference $\pm$ SE	p-Value	Direction of Result*
VBC <sup>a</sup>	Race	<u>Nonblack</u>			
		<u>Nonsmoker</u>			
	Smoking History	35			
		53	-0.014 $\pm$ 0.021	0.511	
	Age (At Baseline)	30 Pack-Years	0.014 $\pm$ 0.022	0.508	
		35	0.107 $\pm$ 0.033	0.001	RH>OC
		53	-0.011 $\pm$ 0.019	0.551	
	Black		-0.053 $\pm$ 0.058	0.364	
	(No significant interactions)				

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TABLE N-8. (continued)

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

Variable	Interaction Covariates	Stratification	Ranch Hand-Original Comparison Group Difference $\pm$ SE	p-Value	Direction of Result*
HGB	Race	<u>Nonblack</u> <u>Officer</u>			
	Occupation	35	0.151 $\pm$ 0.113	0.181	
		53	-0.035 $\pm$ 0.082	0.667	
	Age (At Baseline)	<u>Enlisted Flyer</u>			
		35	0.087 $\pm$ 0.132	0.509	
		53	-0.100 $\pm$ 0.121	0.410	
		<u>Enlisted Groundcrew</u>			
		35	0.026 $\pm$ 0.080	0.744	
		53	-0.161 $\pm$ 0.107	0.134	
		<u>Black</u> <u>Officer</u>			
		35	-1.034 $\pm$ 0.627	0.099	OC>RH
		53	0.209 $\pm$ 0.629	0.740	
		<u>Enlisted Flyer</u>			
		35	-1.398 $\pm$ 0.613	0.023	OC>RH
		53	-0.155 $\pm$ 0.481	0.747	
		<u>Enlisted Groundcrew</u>			
		35	-0.014 $\pm$ 0.283	0.962	
		53	1.230 $\pm$ 0.526	0.020	RH>OC

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TABLE N-8. (continued)

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

Variable	Interaction Covariates	Stratification	Ranch Hand-Original Comparison Group Difference $\pm$ SE	p-Value	Direction of Result*
HCT	Race	<u>Nonblack</u>			
		<u>Officer</u>			
		35	0.506 $\pm$ 0.325	0.120	
		53	-0.174 $\pm$ 0.237	0.462	
		<u>Enlisted Flyer</u>			
		35	0.390 $\pm$ 0.377	0.301	
		53	-0.291 $\pm$ 0.347	0.403	
		<u>Enlisted Groundcrew</u>			
		35	0.063 $\pm$ 0.230	0.783	
		53	-0.617 $\pm$ 0.307	0.045	OC>RH
		<u>Black</u>			
		<u>Officer</u>			
		35	-2.662 $\pm$ 1.801	0.140	
		53	0.825 $\pm$ 1.805	0.648	
		<u>Enlisted Flyer</u>			
		35	-4.365 $\pm$ 1.753	0.013	OC>RH
		53	-0.878 $\pm$ 1.378	0.524	
		<u>Enlisted Groundcrew</u>			
		35	-0.050 $\pm$ 0.806	0.950	
		53	3.436 $\pm$ 1.497	0.022	RH>OC

TABLE N-8. (continued)

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

Variable	Interaction Covariates	Stratification	Ranch Hand-Original Comparison Group Difference $\pm$ SE	p-Value	Direction of Result*
MCV	Smoking (Smoking History and Current Smoking)	<u>Nonsmoker</u>			
		35	0.692 $\pm$ 0.418	0.098	
	Age (At Baseline)	53	-0.136 $\pm$ 0.417	0.743	
		<u>30 Pack-Years, Currently 1 Pack/Day</u>			
		35	0.057 $\pm$ 0.635	0.928	
		53	-0.582 $\pm$ 0.412	0.158	
MCH	Current Smoking	<u>Nonsmoker</u>			
		35	0.126 $\pm$ 0.141	0.373	
	Age (At Baseline)	53	0.158 $\pm$ 0.132	0.232	
		<u>1 Pack/Day</u>			
		35	0.254 $\pm$ 0.144	0.079	
		53	-0.275 $\pm$ 0.149	0.066	RH>OC OC>RH
	<u>2 Pack/Day</u>	35	0.381 $\pm$ 0.273	0.162	
		53	-0.707 $\pm$ 0.281	0.012	OC>RH

TABLE N-8. (continued)

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

Variable	Interaction Covariates	Stratification	Ranch Hand-Original Comparison Group Difference $\pm$ SE	p-Value	Direction of Result*
PLT <sup>a</sup>	Race	<u>Nonblack</u>			
		<u>Nonsmoker</u>			
		35	0.030 $\pm$ 0.016	0.061	RH>OC
		53	-0.017 $\pm$ 0.018	0.354	
		<u>30 Pack-Years</u>			
		35	0.050 $\pm$ 0.020	0.012	RH>OC
		53	0.003 $\pm$ 0.016	0.858	
	Black	<u>Nonsmoker</u>			
		35	-0.082 $\pm$ 0.051	0.111	OC>RH
		53	-0.129 $\pm$ 0.054	0.016	
		<u>30 Pack-Years</u>			
		35	0.261 $\pm$ 0.103	0.011	RH>OC
		53	0.214 $\pm$ 0.102	0.036	RH>OC

\*RH>OC: Variable mean in Ranch Hand group greater than variable mean in Original Comparison group.  
OC>RH: Variable mean in Original Comparison group greater than variable mean in Ranch Hand group.

<sup>a</sup>Units are on log scale.

TABLE N-9.

**Longitudinal Analyses for  
MCV, MCH, and PLT: A Contrast of  
Baseline and First Followup Examination Test Means  
(Original Comparisons Only)**

Variable	Group	Total	<u>Means</u>		Difference (Followup-Baseline)	Error*	p-Value (Equality of Difference)
			Baseline	Followup			
MCV	Ranch Hand	971	88.89	92.60	+3.71	2.808	0.65
	Original Comparison	872	88.56	92.35	+3.79		
MCH	Ranch Hand	971	30.81	31.55	+0.74	0.873	0.21
	Original Comparison	872	30.63	31.44	+0.81		
PLT	Ranch Hand	971	276.90	271.50	-5.4	35.50	0.80
	Original Comparison	872	272.10	267.30	-4.8		

\*Error =  $\sqrt{\text{Subj} * \text{Time}/\text{Group mean squares}}$ .