

# **Investigating Variations in Be-LPT Results in the National Supplemental Screening Program (NSSP): An Exploratory Analysis**

**ORAU**

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# National Supplemental Screening Program (NSSP)

- Under the NSSP, the U.S. Department of Energy offers free customized medical screenings to former energy workers who may have been exposed to hazardous substances on the job site.
- Public Law 102-484, Section 3162
- Over 2,000 former workers screened nationwide, each year
- Over 1,000 variables collected for each participant: clinical and medical history



Clinic Sites Where NSSP Participants are Seen

# The Problem

- Some kinds of uninterpretable BeLPTs seem to repeat in individuals, making it difficult to get a good result for these people
  - Overproliferation (OP) of cells: the cells grow very rapidly in the media and sometimes consume all the growth nutrients in the culture
  - Poor proliferation (PG) of cells: the cells grow very slowly in the media



# Well Counts Illustrative of Each Type of Outcome: Measure of Cell Proliferation

Type of Outcome				
Over proliferation	5973	16233	8089	8762
	6939	14611	11496	14838
	13051	8980	8052	16284
Normal	185	243	243	172
	190	174	198	165
	247	190	185	244
Poor proliferation	37	70	30	80
	58	47	41	37
	46	53	66	114



# The Investigation

- Look at personal characteristics of people in each category and compare them with people who had normal test results to find:
  - Diseases that correlate with the uninterpretable results
  - Blood results that correlate with the uninterpretable results



## Physical Exam Variables

Pulmonary	Cardiovascular	Gastrointestinal	Neurological	Circulatory Tests	Kidney Tests	Liver Tests	Pancreas Tests
Definite Emphysema	Abnormality of cardiac size and shape	Occult blood	Sharp touch non-focal	Hematocrit	Blood urea nitrogen	ALK	Glucose
Effusion*	Cor pulmonale	Abdominal findings	Sharp touch stocking and/or glove-like pattern	Hemoglobin	Creatinine	ALT	Urine glucose
Mass*	Pedal edema left/right #	Ascities	Peripheral neuropathy	Iron	Beta 2 Creat	AST	Urine ketone
Calcified granuloma	Categorical blood pressure	Enlarged liver		Lymphocyte count	Urine Protein	GGT	
Apical pleural thickening				Lymphocyte percent		LDH	
Pleural abnormalities				White blood cells count		Total bilirubin	
Plate atelectasis							
Parenchymal abnormalities							
Profusion							



## Participant-Reported Variables

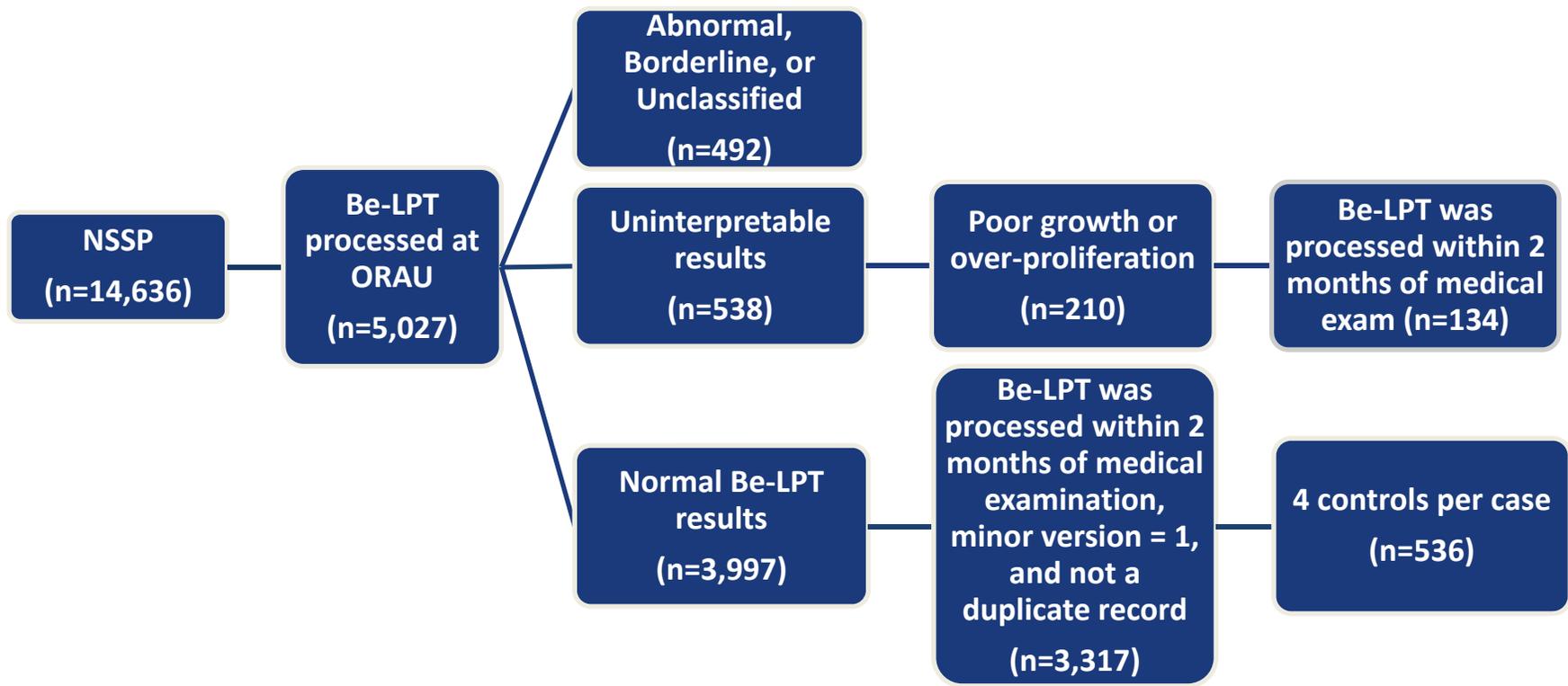
Demographics	Pulmonary	Cardiovascular	Gastrointestinal	Pancreas	Kidney	Circulatory Disorders	Occupational Exposures
Age	Past/Current Smoking History	Heart Attack	Ulcerative Colitis	Diabetes	Reported Kidney Problems	Anemia	Asbestos
Gender	Asbestosis	Coronary Artery Disease	Irritable Bowel Syndrome	Use of Injections		Thrombocytopenia	Beryllium
Years Worked	Black Lung	Hypertension	Crohn's Disease	Pancreatitis		Chronic Leukemia	Plutonium
Region	Silicosis	Congestive Heart Failure	Acid Reflux			Acute Leukemia	
Season Be-LPT was Taken	CBD	Rheumatic Fever	Ulcer			Hodgkin's Lymphoma	
BMI	Asthma		Stomach Cancer			Other Lymphoma	
	Allergies		Colon/Intestine Cancer				
	Pneumonia						
	Tuberculosis						
	COPD						
	Pleural Plaques						
	Lung Cancer						
	Mesothelioma						
Lung Fibrosis							

# Case-Control Study: Statistical Analyses

- Separate analyses were completed for OP and PG
- Descriptive analyses
  - Chi-Square
  - T-test or Wilcoxon
- Univariate logistic regression
- Stepwise Multivariable Logistic Regression



# Cases and Controls



# Over-Proliferation of Lymphocytes: Results

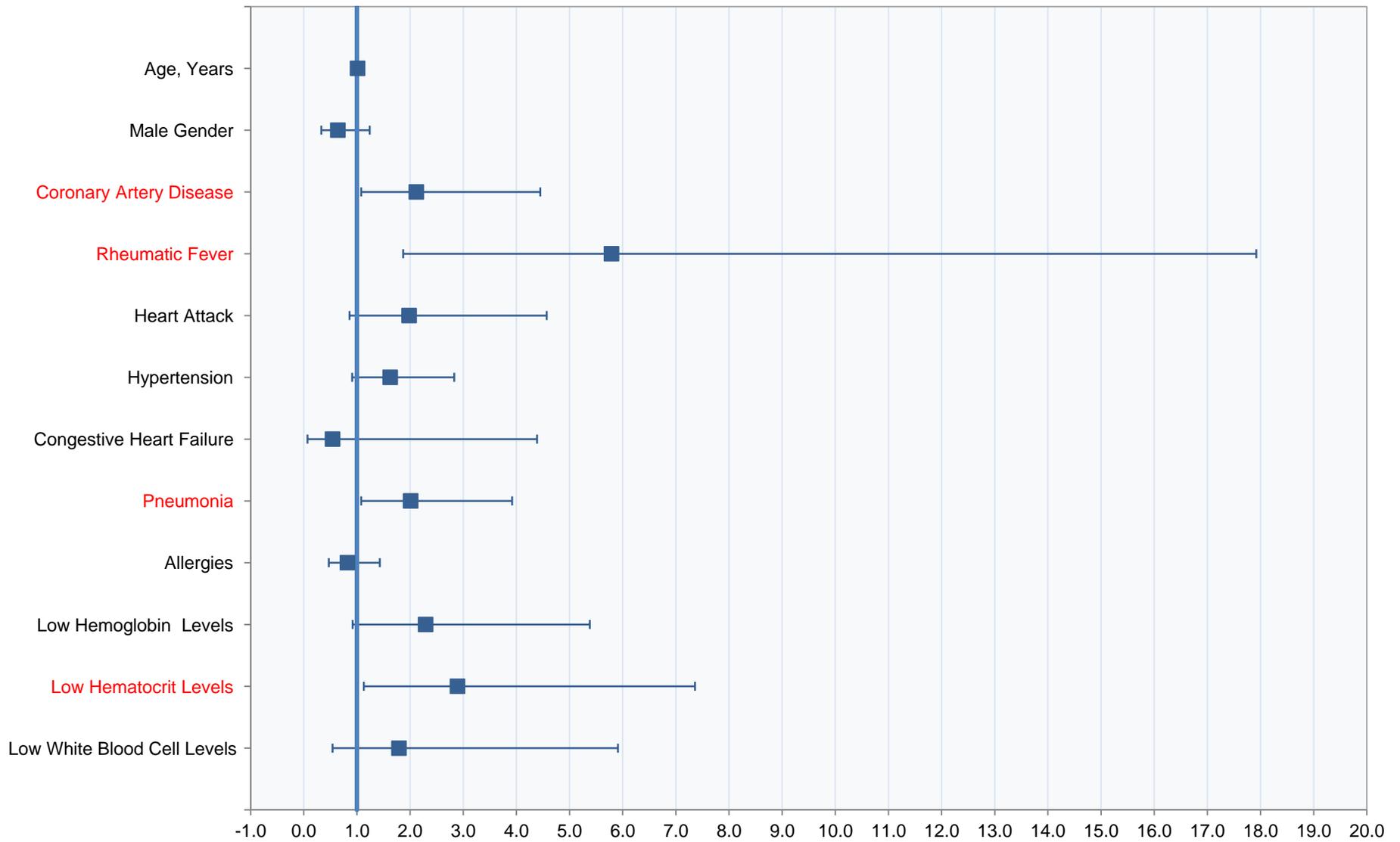


**Over-proliferation of Lymphocytes:  
Demographic Characteristics by Cases and Controls**

<b>Continuous Variables</b>	<b>Controls (n=276) Mean (SD)</b>	<b>Cases (n=69) Mean(SD)</b>	<b>P (t Test)</b>
Age, years	63.5 (10.8)	64.1 (10.2)	0.69
Years Worked	11.3 (11.3)	13.0 (12.3)	0.28
Body Mass Index	29.5 (6.6)	29.4 (5.3)	0.86
<b>Categorical Variables</b>	<b>Controls (n=276) n (%)</b>	<b>Cases (n=69) n (%)</b>	<b>P (χ<sup>2</sup>)</b>
Male Sex	201 (73)	56 (81)	0.18
Current Smoker	24 (9)	4 (6)	0.43
Past Smoker	115 (42)	29 (42)	0.96
Region			0.45
Midwest	82 (30)	18 (26)	
Northeast	6 (2)	3 (4)	
South	116 (42)	34 (49)	
West	72 (26)	14 (20)	
BeLPT Season Taken			0.93
Fall	64 (23)	18 (26)	
Spring	77 (28)	18 (26)	
Summer	80 (29)	21 (30)	
Winter	55 (20)	12 (17)	



# Odds Ratios of Risk Factors for OVER-PROLIFERATION of Lymphocytes



# Stepwise Logistic Regression of Potential Risk Factors for Over-proliferation of Lymphocytes in a Be-LPT Result

Variable	Chi Square P Value	Odds Ratio	95% Confidence Limits
Rheumatic Fever	0.003	5.71	1.76, 18.56
Low Hematocrit Count	0.001	4.57	1.70, 12.25
<b>Model P Value 0.003</b>			



# Poor Growth of Lymphocytes: Results

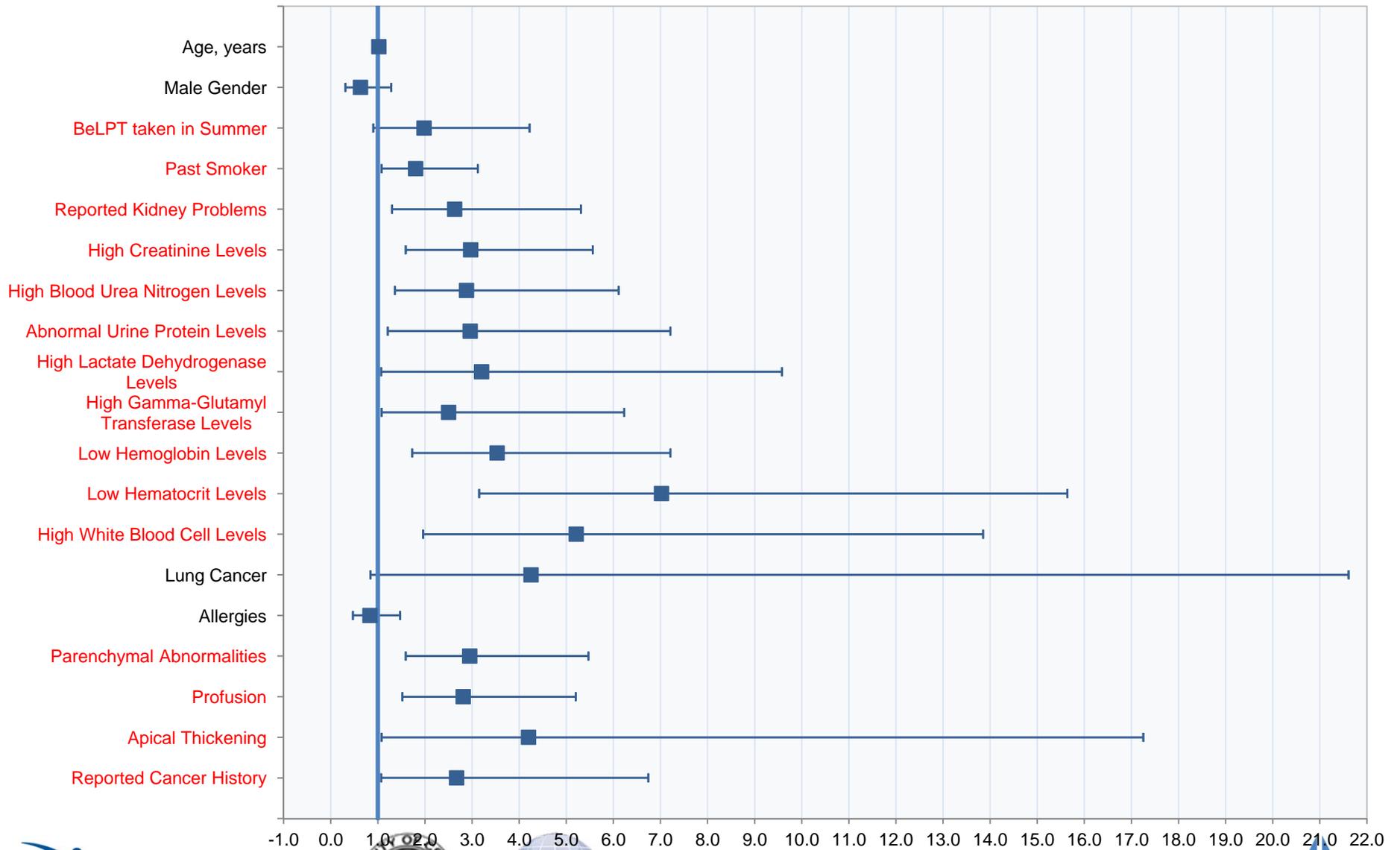


**Poor Lymphocyte Growth :  
Demographic Characteristics by Cases and Controls**

<b>Continuous Variables</b>	<b>Controls (n=260) Mean (SD)</b>	<b>Cases (n=65) Mean (SD)</b>	<b>p-value</b>
Age, years	65.3 (11.5)	68.0 (12.7)	0.09
Years Worked	10.5 (11.81)	11.1 (11.56)	0.72
Body Mass Index	29.2 (5.9)	29.4 (7.3)	0.83
<b>Categorical Variables</b>	<b>Controls (n=260) n (%)</b>	<b>Cases (n=65) n (%)</b>	<b>p-value (<math>\chi^2</math>)</b>
Male Sex	194 (75)	53 (83)	0.2
Current Smoker	17 (7)	3 (5)	0.56
Past Smoker	110 (42)	37 (57)	0.03*
Region			0.36
Midwest	72 (28)	12 (18)	
Northeast	8 (3)	2 (2)	
South	94 (36)	23 (35)	
West	86 (33)	28 (43)	
Season BeLPT given			0.05*
Fall	67 (26)	18 (28)	
Spring	58 (22)	7 (11)	
Summer	73 (28)	28 (43)	
Winter	62 (24)	12 (18)	



# Odds Ratios of Risk Factors for POOR-PROLIFERATION of Lymphocytes



# Stepwise Logistic Regression of Potential Risk Factors for Poor Lymphocyte Growth in a Be-LPT Result

Variable	Chi Square P Value	Odds Ratio	95% Confidence Limits
Low Hematocrit Levels	0.0001	4.81	1.84, 12.59
High Creatinine Levels	0.005	2.71	1.26, 5.80
High White Blood Cell Levels	0.02	4.85	1.61, 14.56
Apical Thickening	0.03	5.52	1.04, 29.42
Model P Value		<0.0001	



# Over-Proliferation of Lymphocytes: Potential Hypotheses

- Low hematocrit levels may indicate an increase in the proliferation of lymphocytes due to:
  - Long-term illness
  - Infection
  - Leukemia or Lymphoma
- Associations between heart conditions (i.e., rheumatic fever) and over-proliferation of lymphocytes
  - Medication use
  - Biological processes of these conditions
  - Surgeries or other treatments



# Poor Lymphocyte Growth: Potential Hypotheses

- Sufficient evidence to suggest that kidney problems should be considered as risk factors for poor lymphocyte growth
- Prior lung exposures and infections could be influencing poor lymphocyte growth
- Low hematocrit count due to underlying condition, which influences PG
- High white blood cell count could indicate infection, immune disorders, or diseases of the bone marrow
- In the lab, smoking history, cancer history, and Be-LPT season have been observed to be associated with PG



# Questions?

