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# The Level of Physical Activity Before and After Lymphoma Diagnosis Impacts Overall and Lymphoma-Specific Survival

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# INTRODUCTION

## Background

- Increased physical activity (PA) is associated with improved quality of life in cancer survivors\*
- Knowledge about the impact of PA on survival in lymphoma patients is limited\*\*
  - Boyle et al. from the BCCA reported a significant association of pre-diagnosis PA with survival (OS, LSS and PFS) in 238 cases of DLBCL
  - PA was not associated with survival in 175 cases of FL

\*Courneya, et al: JCO 2009 \*\*Boyle, et: al: BJH, 2017

# INTRODUCTION

## Study Questions

- i. Does the level of pre-diagnosis PA affect survival in all lymphoma patients?
- ii. Does the level of PA after lymphoma diagnosis influence survival?
- iii. Does a change (i.e. increase or decrease) from pre-diagnosis level of PA impact survival after lymphoma diagnosis?

# METHODS

## Study Cohort

- Patients at the Mayo Clinic enrolled in the Mayo Clinic/ University of Iowa Lymphoma SPORE Molecular Epidemiology Resource (MER)\*
- Patients were prospectively enrolled within 9 months of lymphoma diagnosis and followed systematically
- PA data was collected through surveys at baseline and every 3 years

\*Cerhan, et al: International Journal of Epidemiology, 2017

# METHODS

## Study Aims



To evaluate the association of overall and lymphoma-specific survival with

- i. The level of PA during adult life prior to lymphoma diagnosis
- ii. The level of PA at 3 years after lymphoma diagnosis
- iii. Change in level of PA at 3 years after lymphoma diagnosis

# METHODS

## Baseline Data

Patients reported their usual level of PA during most of their adult life\*

- Mild
- Moderate
- Strenuous

16. During most of your adult life, how often did you usually do *strenuous or very hard exercise*? (Exercise where you work up a sweat and your heart beats fast, e.g., aerobics, aerobic dancing, jogging, tennis, swimming laps, or vigorous yard or housework.) (Exclude walking outside of your home and any physical activity associated with any jobs you had.)

1  Rarely or never

2  1 to 3 days per month

3  1 day per week

4  2 days per week

5  3 to 4 days per week

6  5 or more days per week

How many minutes did you usually exercise like this at one time?

— — — Minutes

\*Cerhan, et.al: Cancer Causes Control, 2005

# METHODS

## FU3 Data

- Godin Leisure-Time Exercise Questionnaire\*
- Self-perceived change in level of PA since lymphoma diagnosis

18. During a typical 7-day period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time (write on each line the appropriate number).

- |   |                      |
|---|----------------------|
| a. STRENUOUS EXERCISE (HEART BEATS RAPIDLY)<br>(e.g. running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long-distance bicycling) | __ __ Times per week |
| b. MODERATE EXERCISE (NOT EXHAUSTING)<br>(e.g. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)   | __ __ Times per week |
| c. MILD EXERCISE (MINIMAL EFFORT)<br>(e.g. yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking)   | __ __ Times per week |

20. How has your level of physical activity changed since your diagnosis of lymphoma or leukemia?

- 1  No change    2  Decreased level of activity    3  Increased level of activity

\*Amireault, et al: BMC Med Res Method, 2015

# METHODS

## Statistics

- We used the data to calculate the Leisure Score Index (LSI)\*

$$\text{Weekly LSI} = (9 \times \text{Strenuous}) + (5 \times \text{Moderate}) + (3 \times \text{Light})$$

- Although the Godin questionnaire was not used at baseline, we used the frequencies of exercise available to calculate the LSI
- LSI was modeled as
  - Continuous score (per 10-point change)
  - Tertiles

\*Amireault, et al: BMC Med Res Method, 2015



# METHODS

## Statistics

- Survival was measured as time from diagnosis (for baseline PA) and time from FU3 (for FU3 PA) until death
  - Overall Survival (OS)
  - Lymphoma-Specific Survival (LSS)
- Association of PA with survival was analyzed using
  - Kaplan-Meier curves
  - Cox models [hazard ratios (HRs) and 95% confidence intervals (CI)]
    - Stratified by lymphoma subtype
    - Adjusted for age and sex
    - Change in PA was adjusted for baseline PA



# RESULTS

# RESULTS

## Patients and Events

|   |                    |
|---|--------------------|
| Total patients enrolled in the MER at the Mayo Clinic 2002-2012 | 4,087              |
| Median follow-up from diagnosis (inter-quartile range)          | 84 (59-119) months |
| Evaluable for LSI   |                    |
| At baseline   | 3,060              |
| At FU3  | 1,370              |
| Median LSI (range)  |                    |
| At baseline   | 28 (0-57)          |
| At FU3  | 25 (0-67)          |
| Median change in LSI at FU3 from baseline (range)               | -2 (-57 to 61)     |
| Deaths due to lymphoma/ due to all causes                       |                    |
| From baseline   | 423 / 806          |
| Beyond FU3  | 104 / 271          |

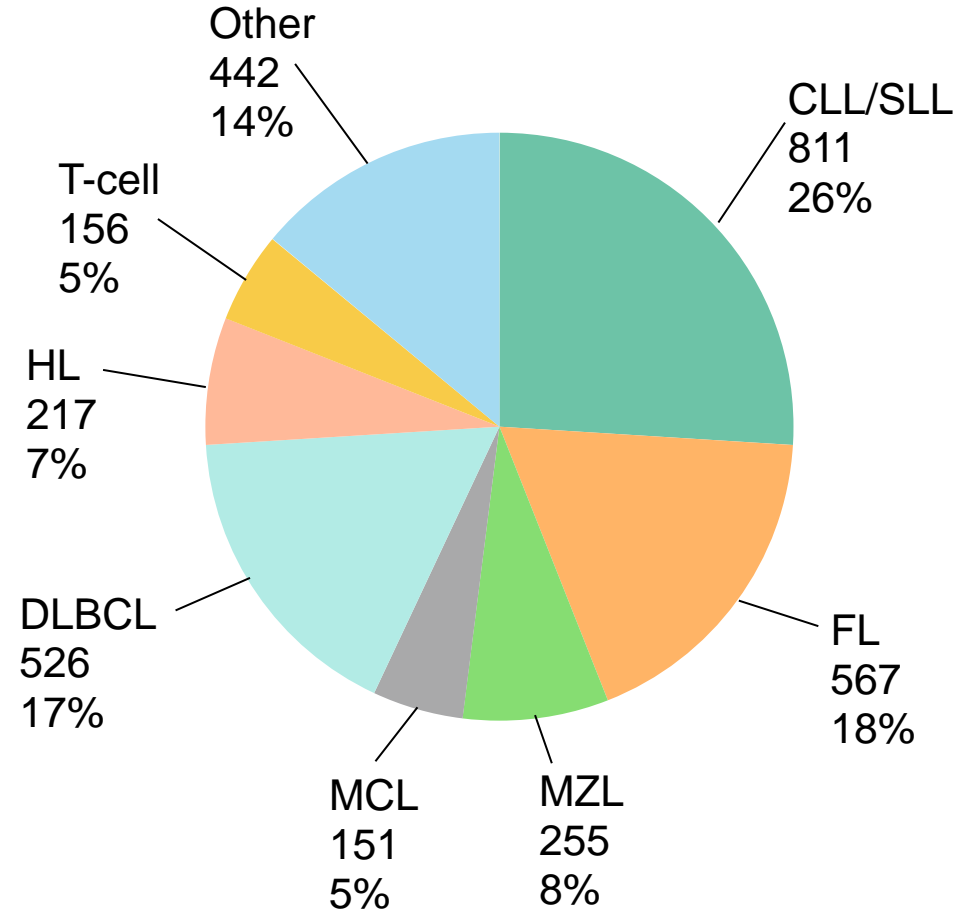
# RESULTS

## Baseline Patient Characteristics

|                                 |             |
|---------------------------------|-------------|
| Median age at diagnosis (range) | 62 (18-92)  |
| Male                            | 1,808 (58%) |
| Ann Arbor Stage                 |             |
| Missing                         | 732         |
| I-II                            | 887 (37%)   |
| III-IV                          | 1,510 (63%) |
| B-symptoms                      |             |
| Missing                         | 209         |
| Yes                             | 416 (14%)   |
| No                              | 2,504 (86%) |
| ECOG performance status         |             |
| Missing                         | 13          |
| <2                              | 2,960 (95%) |
| ≥2                              | 156 (5%)    |

# Results

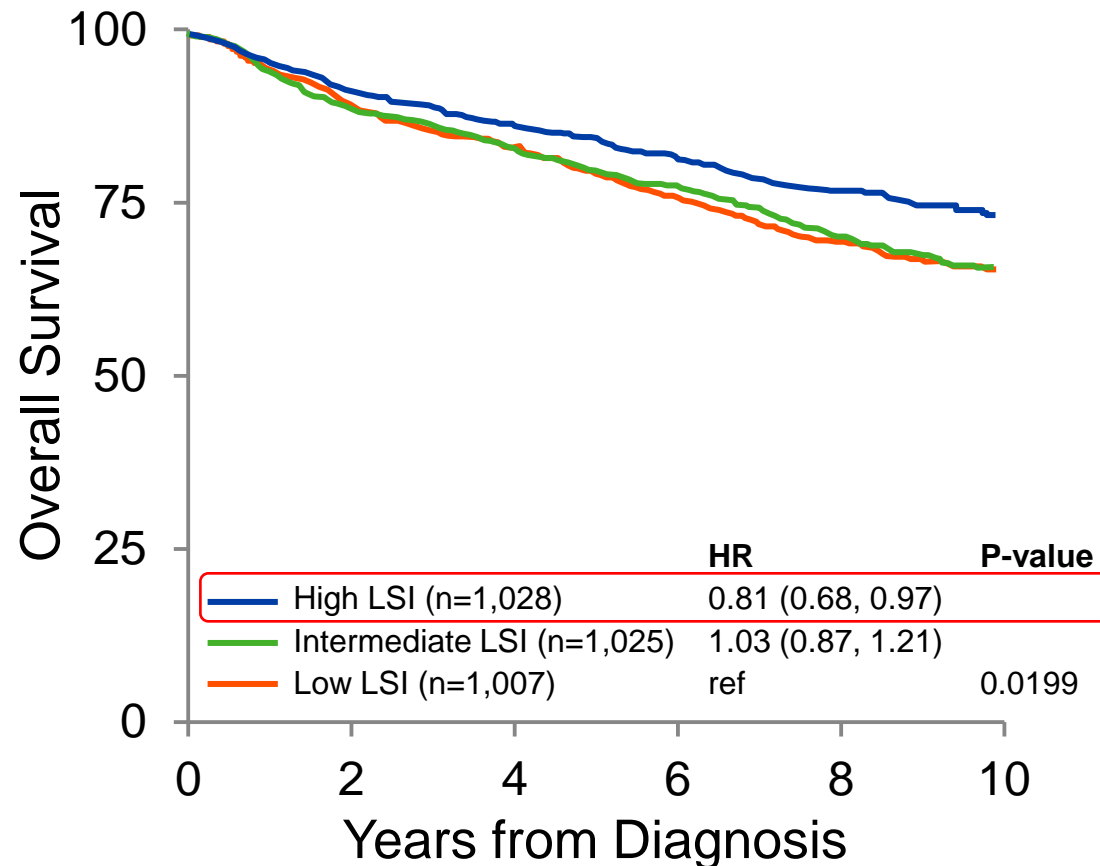
## Lymphoma Subtypes



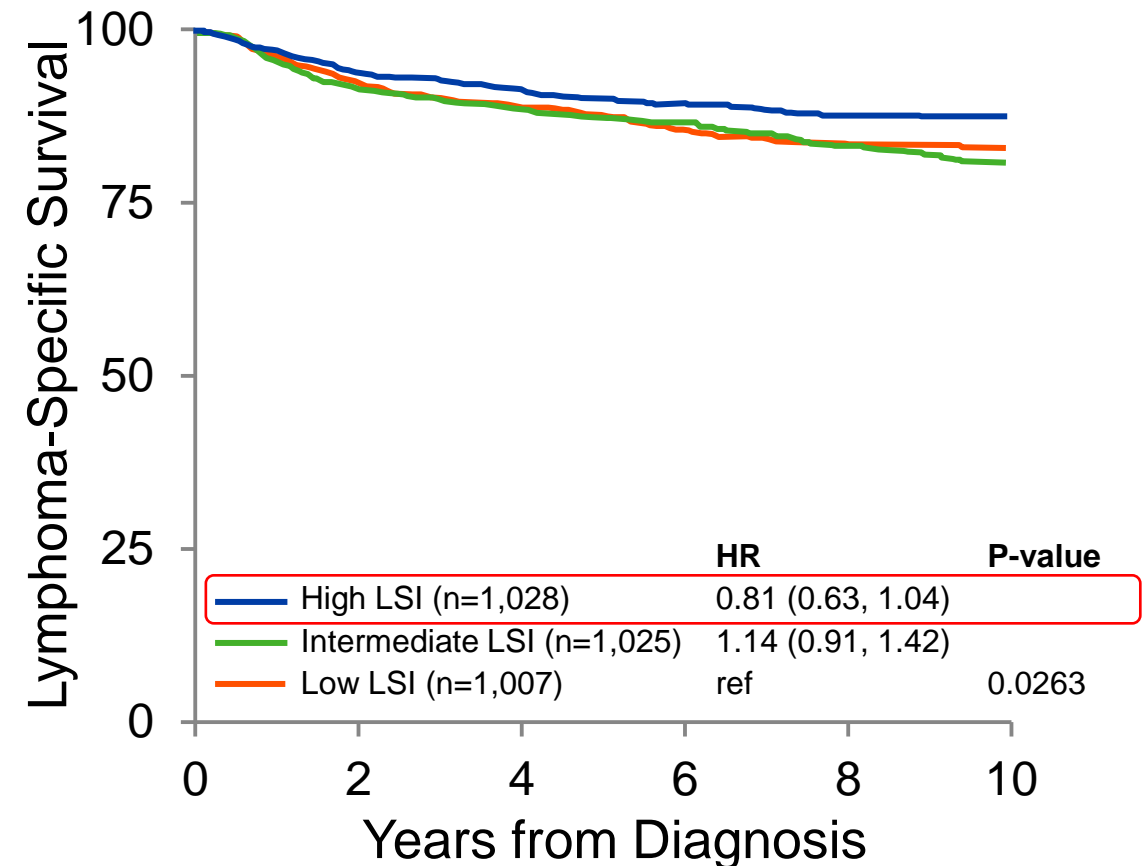
# RESULTS

## Baseline LSI & Survival

### OS from Baseline by LSI Tertiles



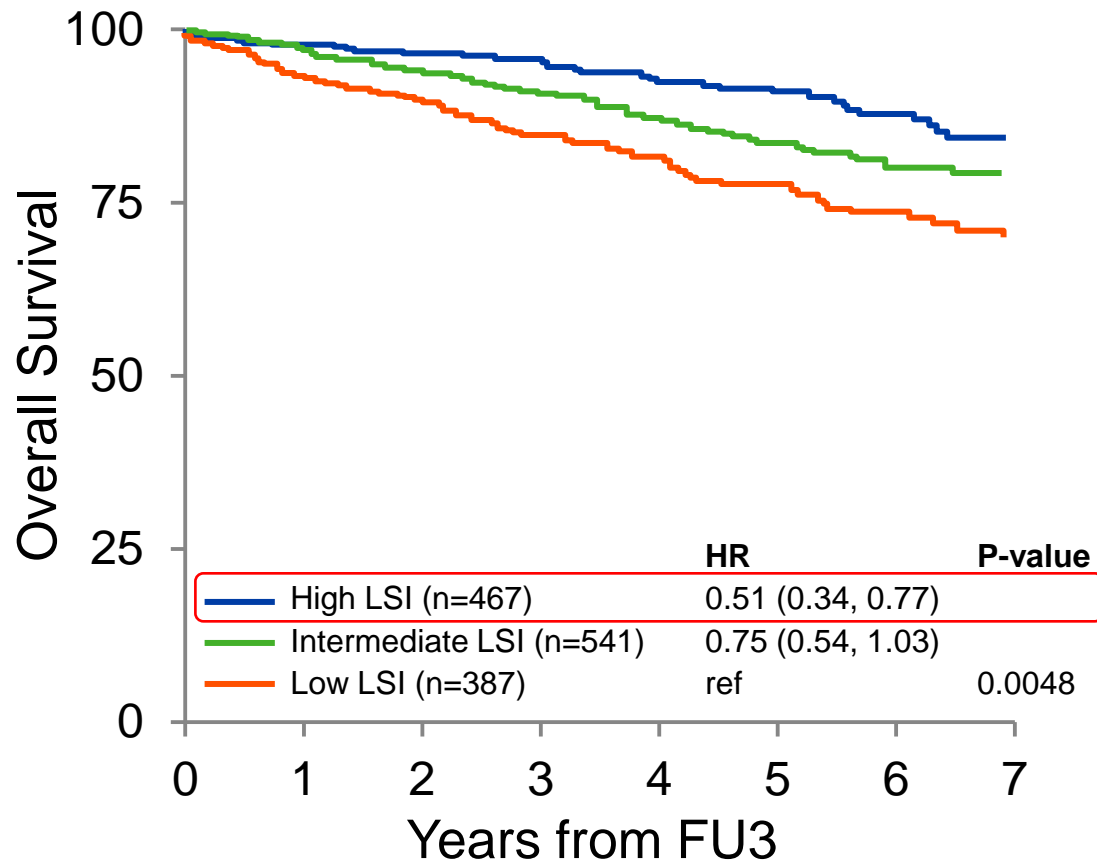
### LSS from Baseline by LSI Tertiles



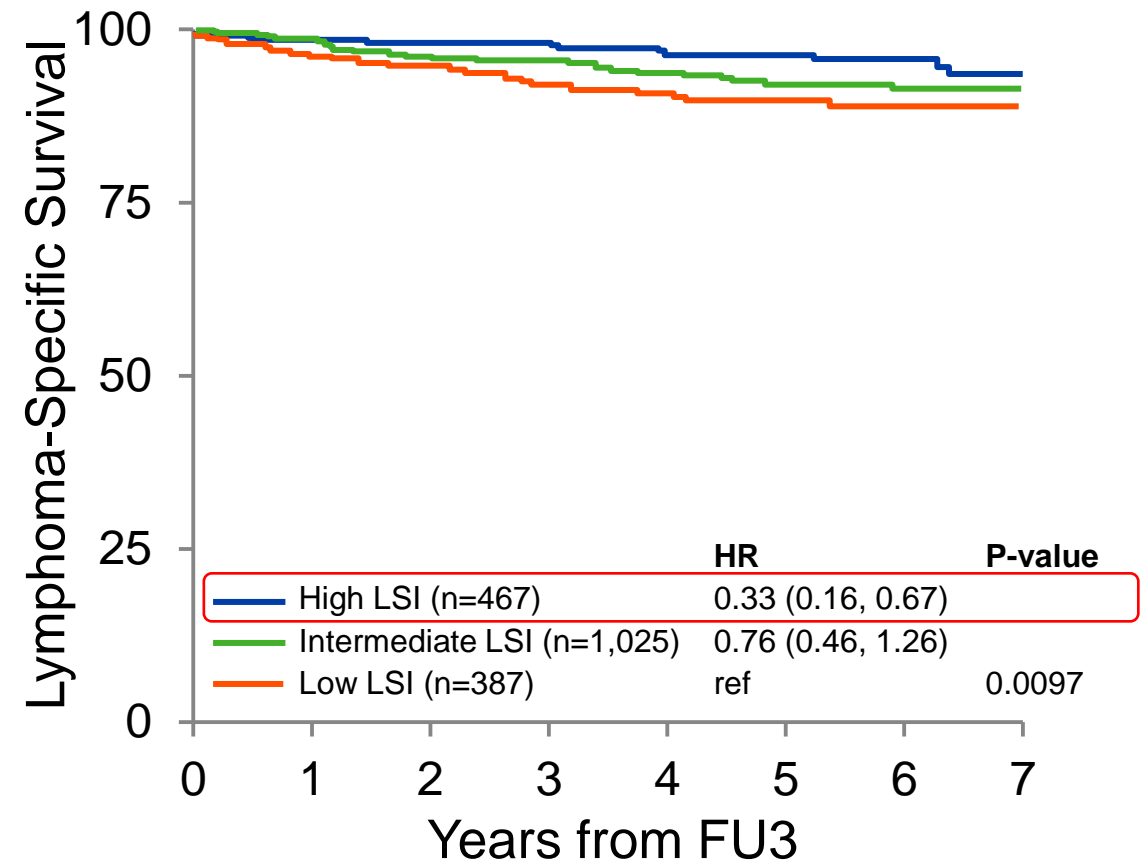
# RESULTS

## FU3 LSI & Survival

### OS from 3-Year Landmark by LSI Tertiles



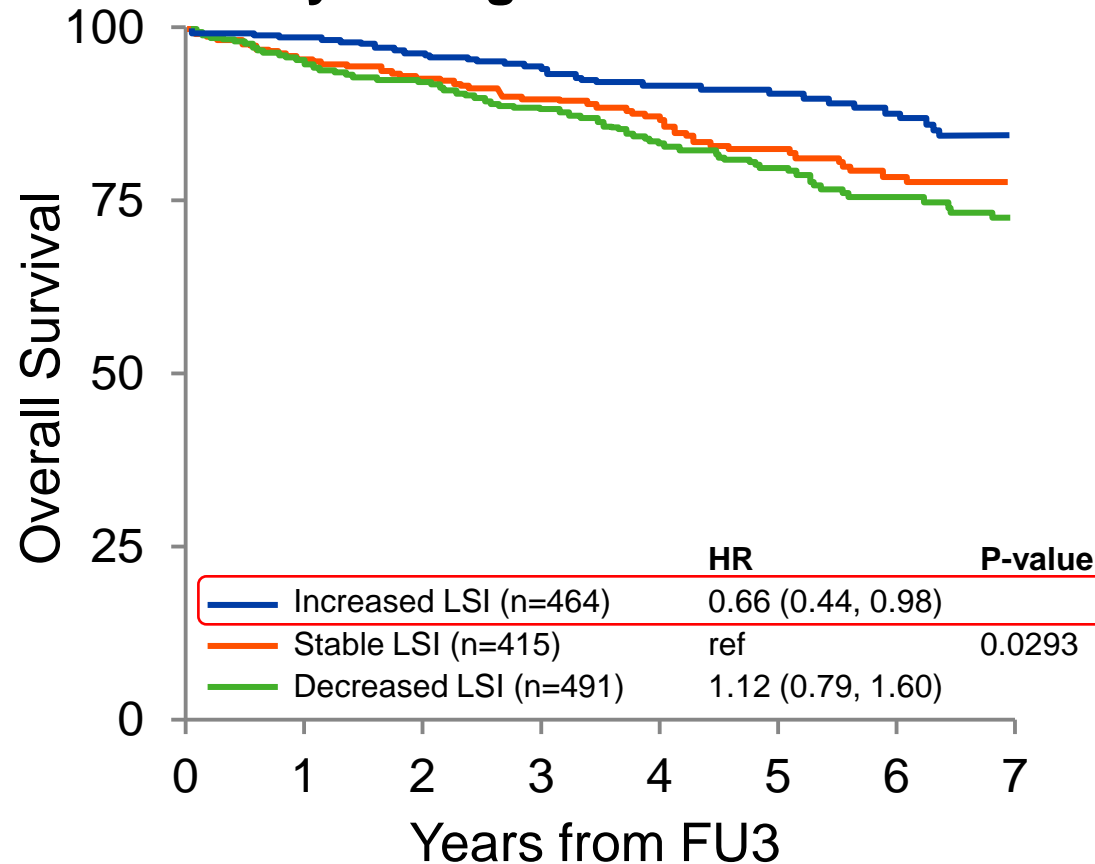
### LSS from 3-Year Landmark by LSI Tertiles



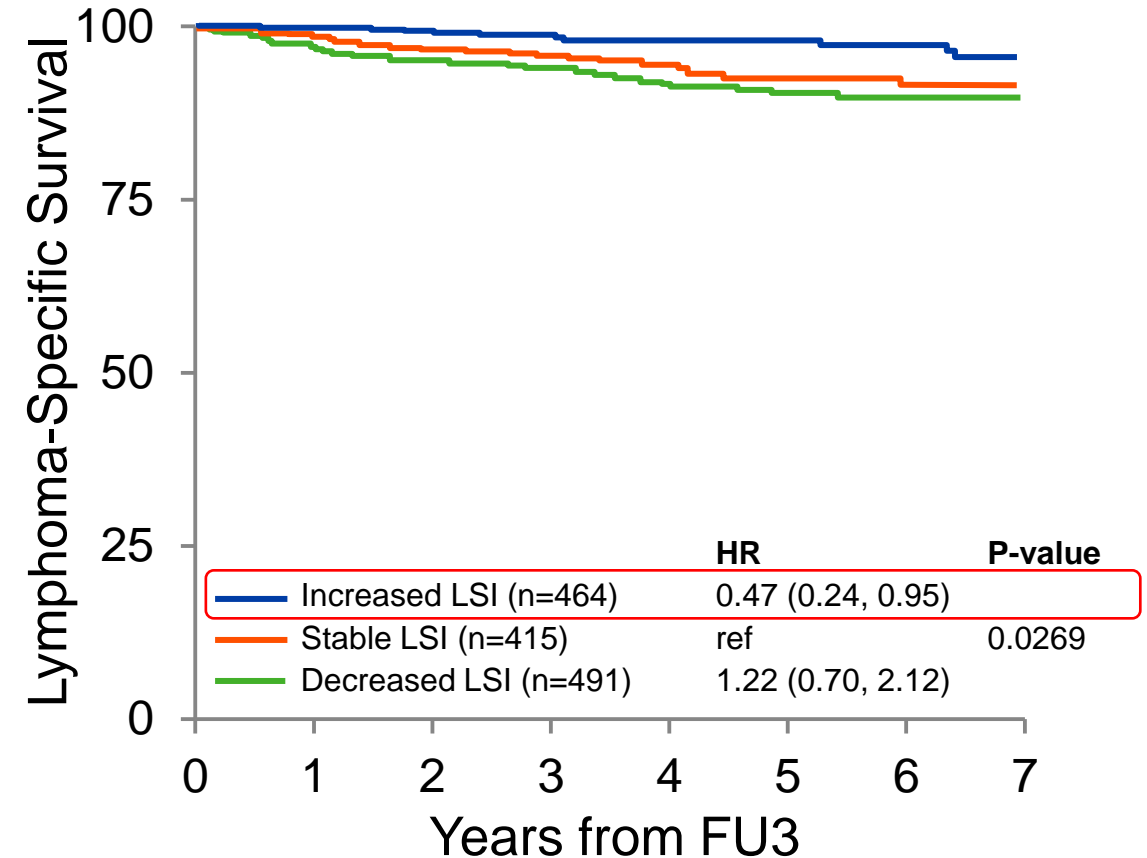
# RESULTS

## Change in LSI & Survival

**OS from 3-Year Landmark by Change in LSI Tertiles**



**LSS from 3-Year Landmark by Change in LSI Tertiles**

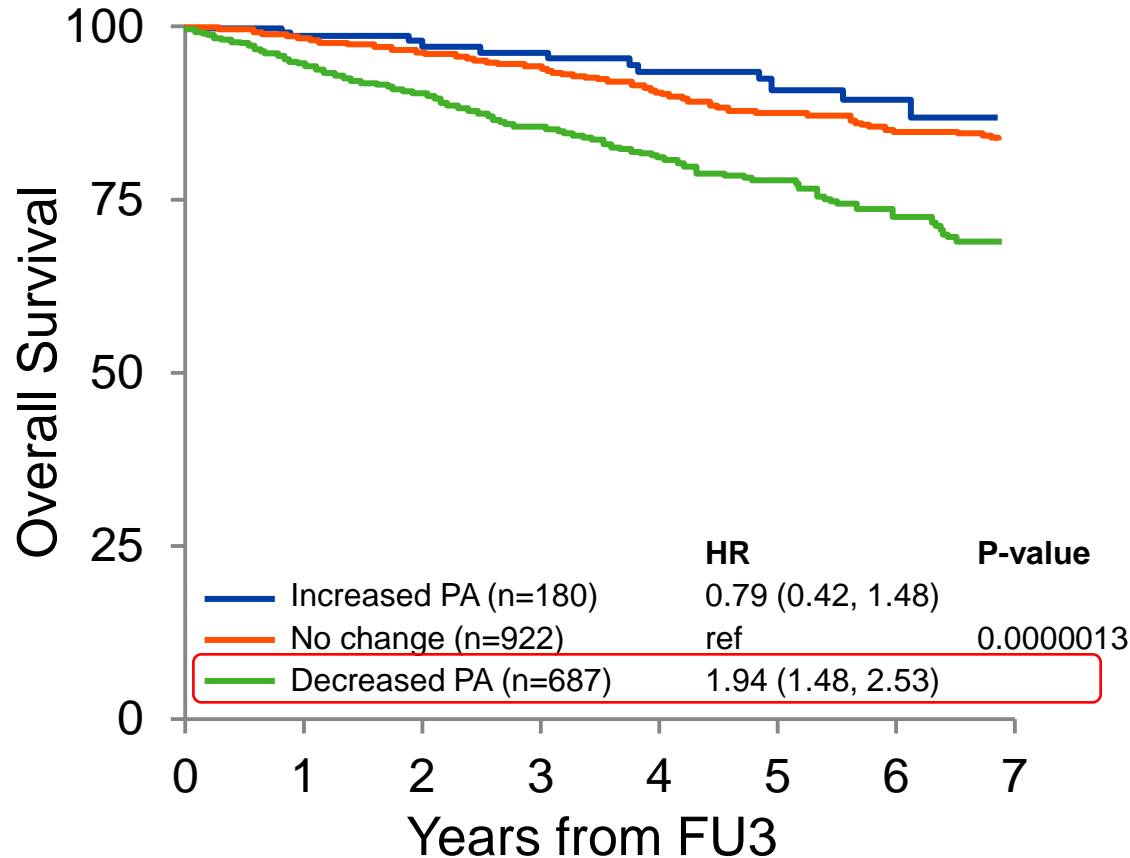




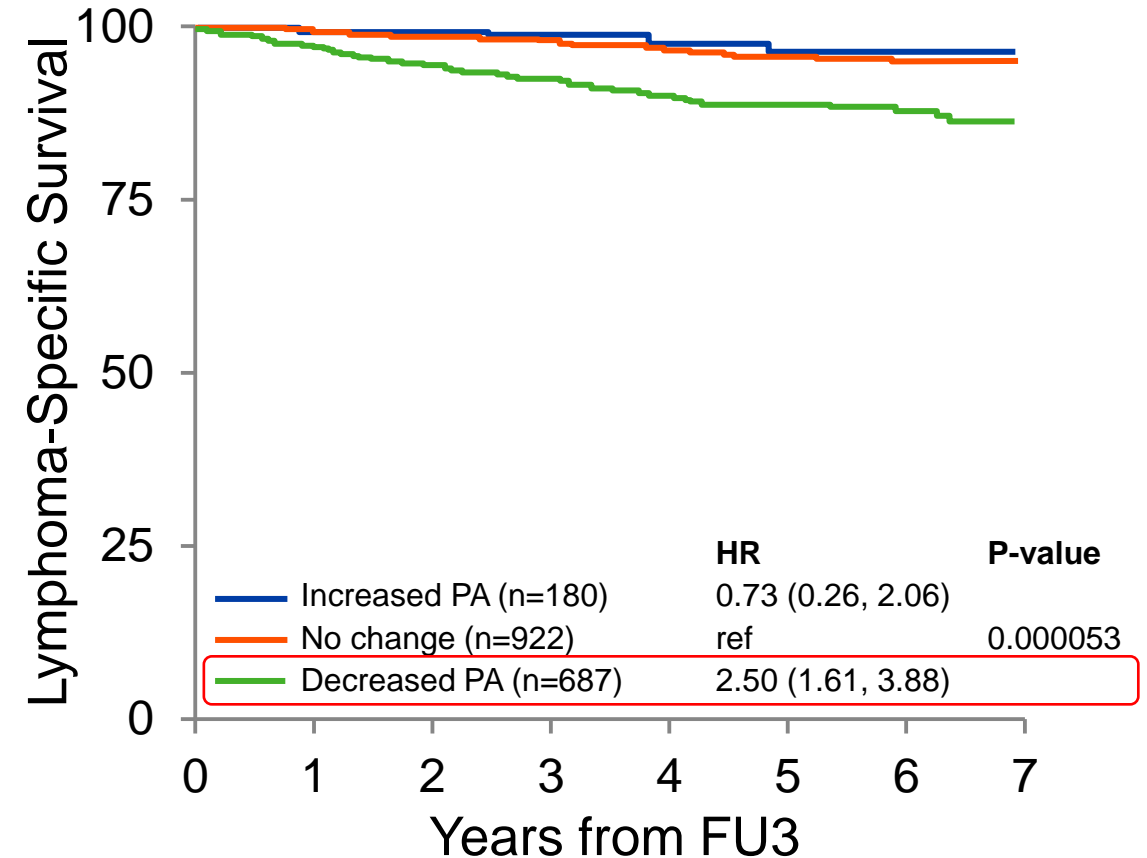
# RESULTS

## Perceived PA Change & Survival

**OS from 3-Year Landmark  
by Self Perceived Change in PA**



**LSS from 3-Year Landmark  
by Self Perceived Change in PA**



# RESULTS

## Sensitivity Analysis EFS36

Including only patients reaching FU3 without any events (relapse/progression)  
n=1,104

|  | OS               |        |
|--|------------------|--------|
|  | HR (95% CI)      | P      |
| <b>Change in LSI at FU3 compared to baseline</b> |                  |        |
| Stable LSI (n=334)                               | ref              | 0.23   |
| Decreased LSI (n=367)                            | 1.14 (0.73-1.78) |        |
| Increased LSI (n=374)                            | 0.74 (0.46-1.19) |        |
| <b>Self-perceived change in PA</b>               |                  |        |
| No change (n=778)                                | ref              | 0.0007 |
| Decreased PA (n=488)                             | 1.87 (1.35-2.59) |        |
| Increased PA (n=153)                             | 1.01 (0.52-1.97) |        |

# RESULTS

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# Conclusions

- Patients with a higher level of usual PA during adult life have significantly better OS and LSS after diagnosis compared to those who are less physically active
- Higher PA in 3-year survivors is also associated with improved survival beyond 3 years
- A change in the level of PA after lymphoma diagnosis affects survival; in particular, a decrease in PA is associated with worse outcomes

# Conclusions

- These data suggest that physical activity behaviors can impact lymphoma outcomes
- Patients (especially survivors) should be counseled on the importance of PA
- Next steps: These data provide a strong rationale for designing a PA intervention trial in lymphoma patients

# Acknowledgements

- Mayo Clinic/University of Iowa Lymphoma SPORE  
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- Patients



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# QUESTIONS & DISCUSSION

THANK YOU!

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