Health outcomes associated with excessive lung function decline and respiratory symptoms in a community cohort

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The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

Presenter Disclosures

- Penelope Baughman
  - The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:
    - No relationships to disclose

Introduction

- Occupational respiratory health monitoring in at-risk populations
  - Periodic spirometry testing
  - Respiratory symptom questionnaires

- *What are the relative contributions of each in predicting adverse health outcomes?*

Study Objectives

- Aim: Study the risk of morbidity and mortality associated with excessive lung function decline, respiratory symptoms, and asthma in an aging community-based cohort

    1. Evaluate the usefulness of the level of lung function and various measures of lung function decline in predicting morbidity and mortality

    2. Investigate the level at which lung function decline becomes a significant predictor of morbidity and mortality

    3. Assess the usefulness of respiratory symptoms and asthma in predicting morbidity and mortality relative to lung function level and decline

Study Population

- Copenhagen City Heart Study
  - Cardiovascular health of 23,000 adults
    - Age-stratified random sample from Copenhagen Population Register
  - 4 examinations: spirometry testing and respiratory symptom questionnaire
    - 28-year period (1976-78, 1981-83, 1991-94, and 2001-03)
  - Morbidity and mortality follow-up
    - Danish National Patient Register
    - Danish Register of Causes of Death and Civil Registration System

Our Study Design

- *Longitudinal*
  - Investigate associations of morbidity and mortality from examination two through 2007 with:
    - FEV_1 lung function measurements
      - Level of lung function at examination two (1981–83)
      - Lung function decline over the first two examinations (1976–78 and 1981–83)
    - Respiratory symptoms and asthma (1981–83)
  - Stratification by gender and for never smokers

Health Outcomes of Interest

- Chronic obstructive pulmonary disease (COPD)
  - Initial hospital diagnosis of COPD
    - ICD-8 491–492, ICD-10 J41–J44
- COPD or coronary heart disease (CHD) mortality
  - Underlying or contributing cause of death
    - ICD-8 410–414, ICD-10 I20–I25
- All-cause mortality

Statistical Method

- Cox proportional hazards model
  - Relate the incidence of morbidity and mortality to lung function, respiratory symptoms, and asthma
  - Penalized splines identified the rate of decline where risk began to increase
    - Time to event
      - Morbidity: Exam date until initial COPD diagnosis, death, or the end of the follow-up
      - Mortality: Exam date until death or the end of the follow-up

Level of Lung Function

- Quartiles of height-adjusted lung function level ($FEV_1/Height^2$)
  - Reference: quartile with the highest level of lung function
  - Models adjusted for age

Lung Function Decline

1. Quartiles of FEV_1 slope (ml/yr)
   - *Reference: quartile with the lowest rate of decline*
2. Relative Limit of Longitudinal Decline (LLD_r)
   - *Accounts for an average within-person variability in FEV_1*
   - *Approximates a 15% annual decline in FEV_1, the approach recommended by the American College of Occupational and Environmental Medicine*
3. FEV_1 decline of 90 ml/yr or more
4. Continuous FEV_1 slope (ml/yr) in the models using a spline
   - Models adjusted for age, height-adjusted baseline lung function level (FEV_{1b}/Height^2), and height

Respiratory Symptoms and Asthma

- First examination: asthma and chronic bronchitis
  - Do you suffer from asthma?
  - Do you bring up phlegm (in the morning or during the day) for as long as three months each year?
- Second examination: shortness of breath added
  - Do you feel out of breath?

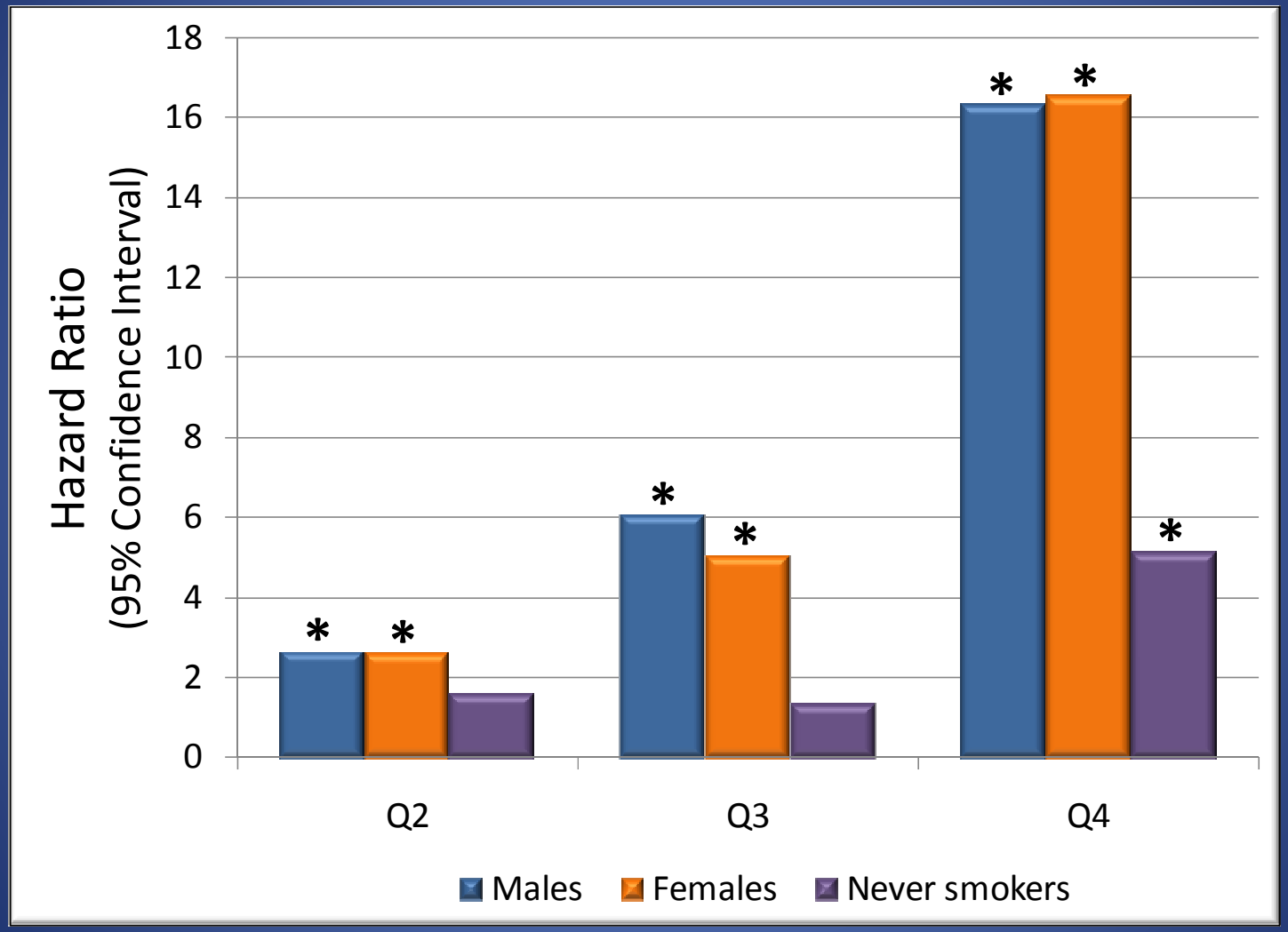
Characteristics of Subjects Present for Both Examinations 1 and 2

- 9,679 subjects
  - 56% female
  - 19% never smokers
  - Average baseline age of 53 years

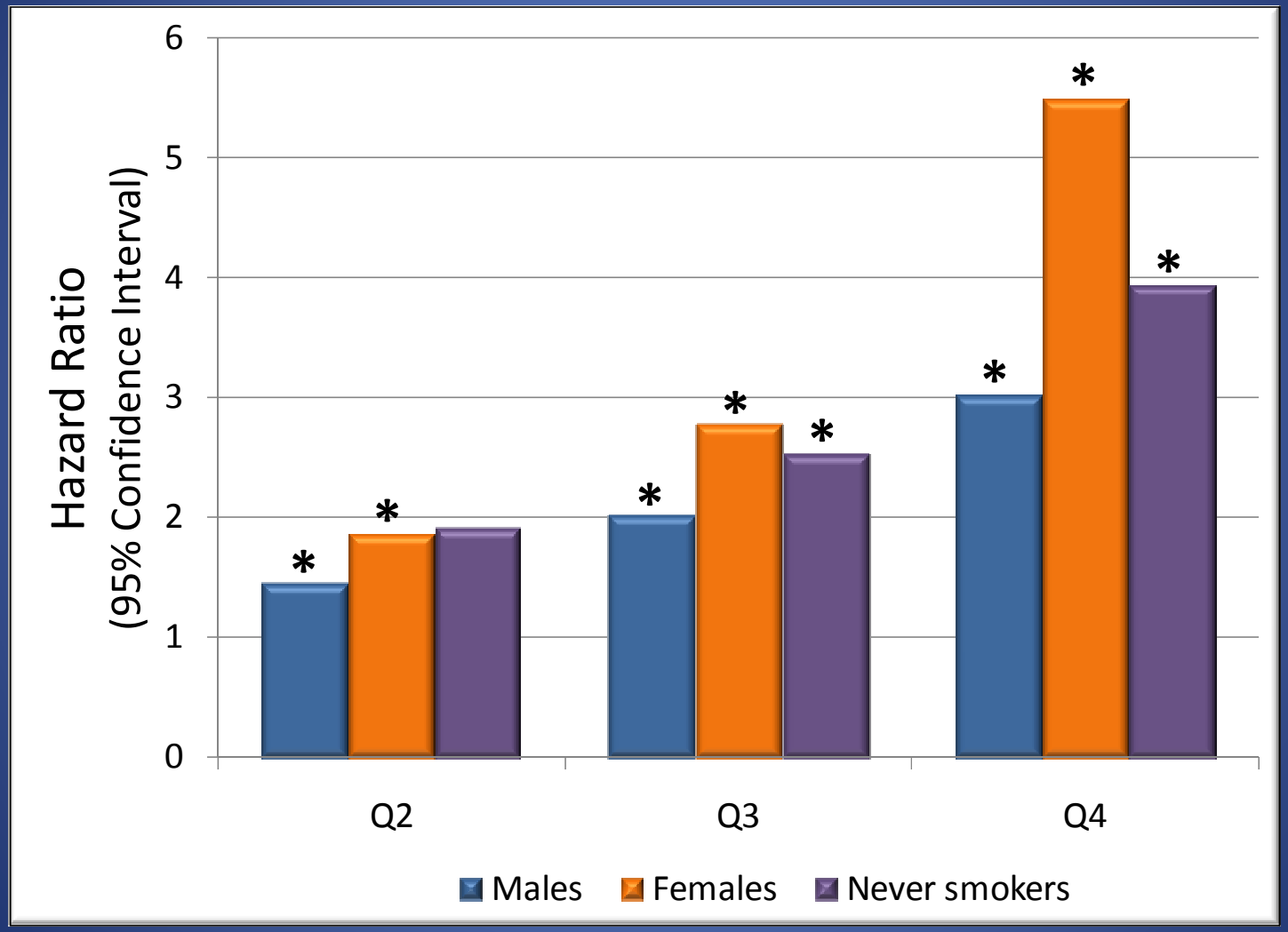
  - Health outcomes:
    - 10% COPD morbidity
    - 18% COPD or CHD mortality
    - 60% All-cause mortality

Objective 1: Evaluate the usefulness of the level of lung function and various measures of lung function decline in predicting morbidity and mortality

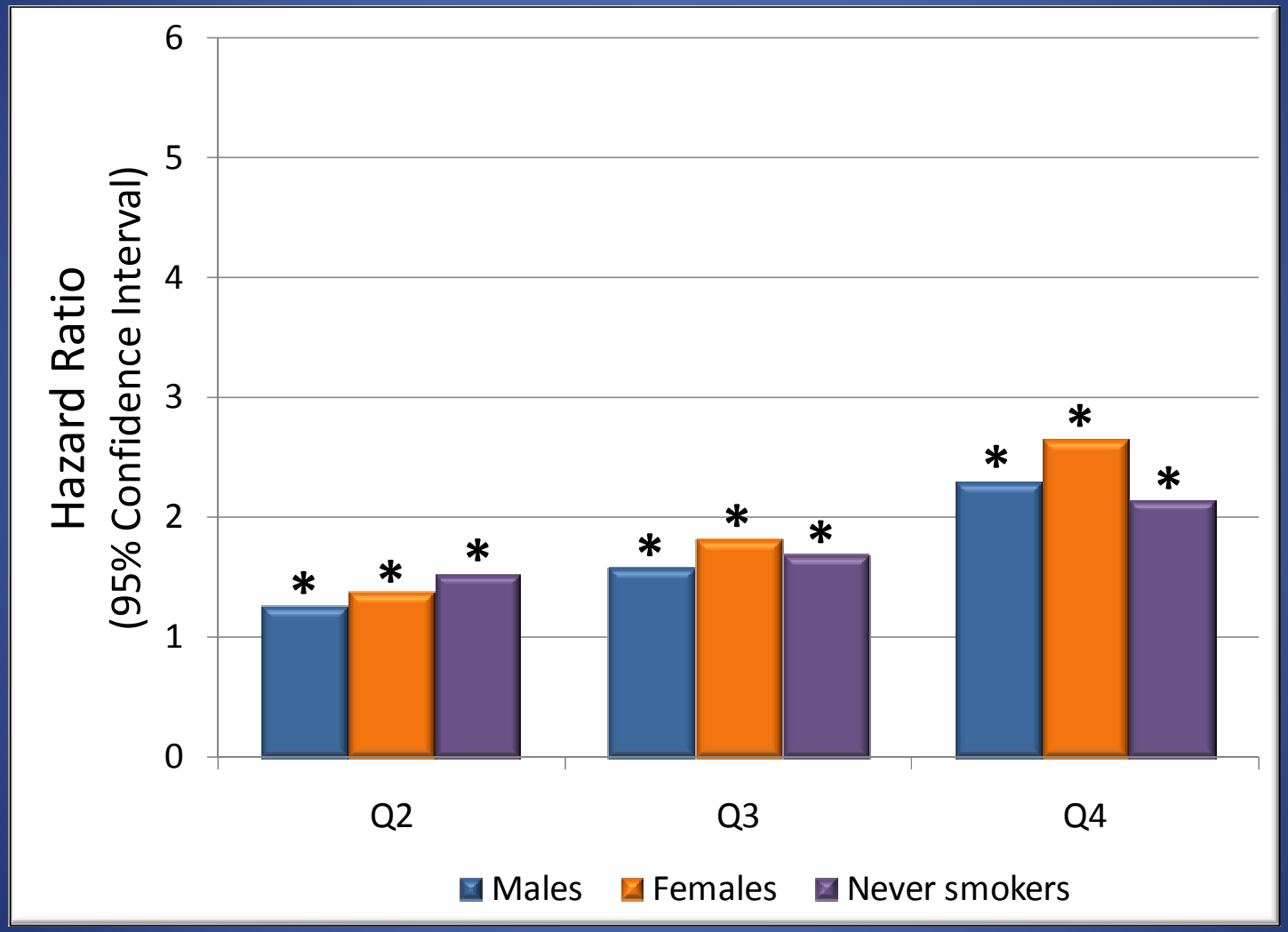
Level of Lung Function: Hospitalization with COPD



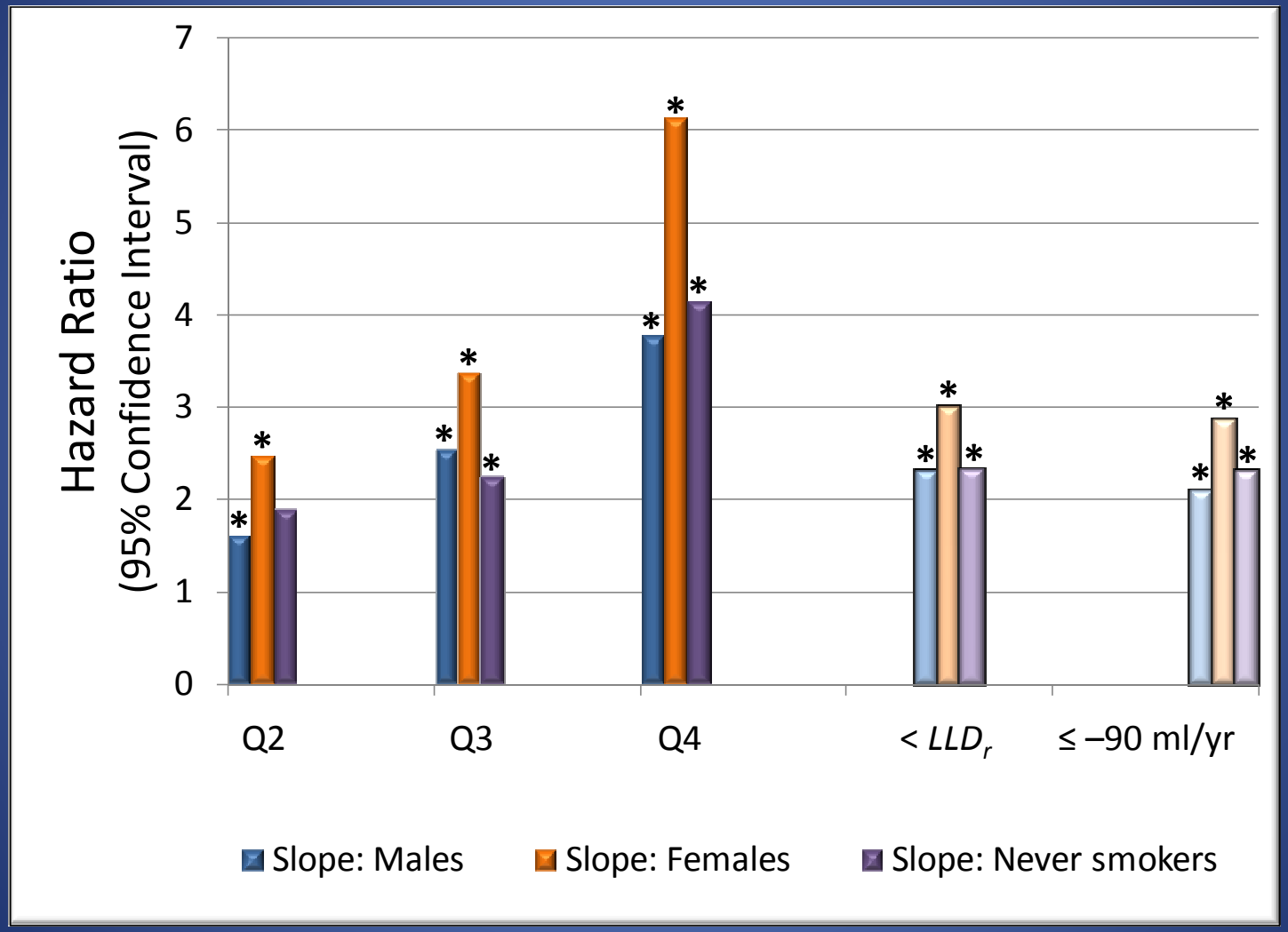
Level of Lung Function: COPD or CHD Mortality



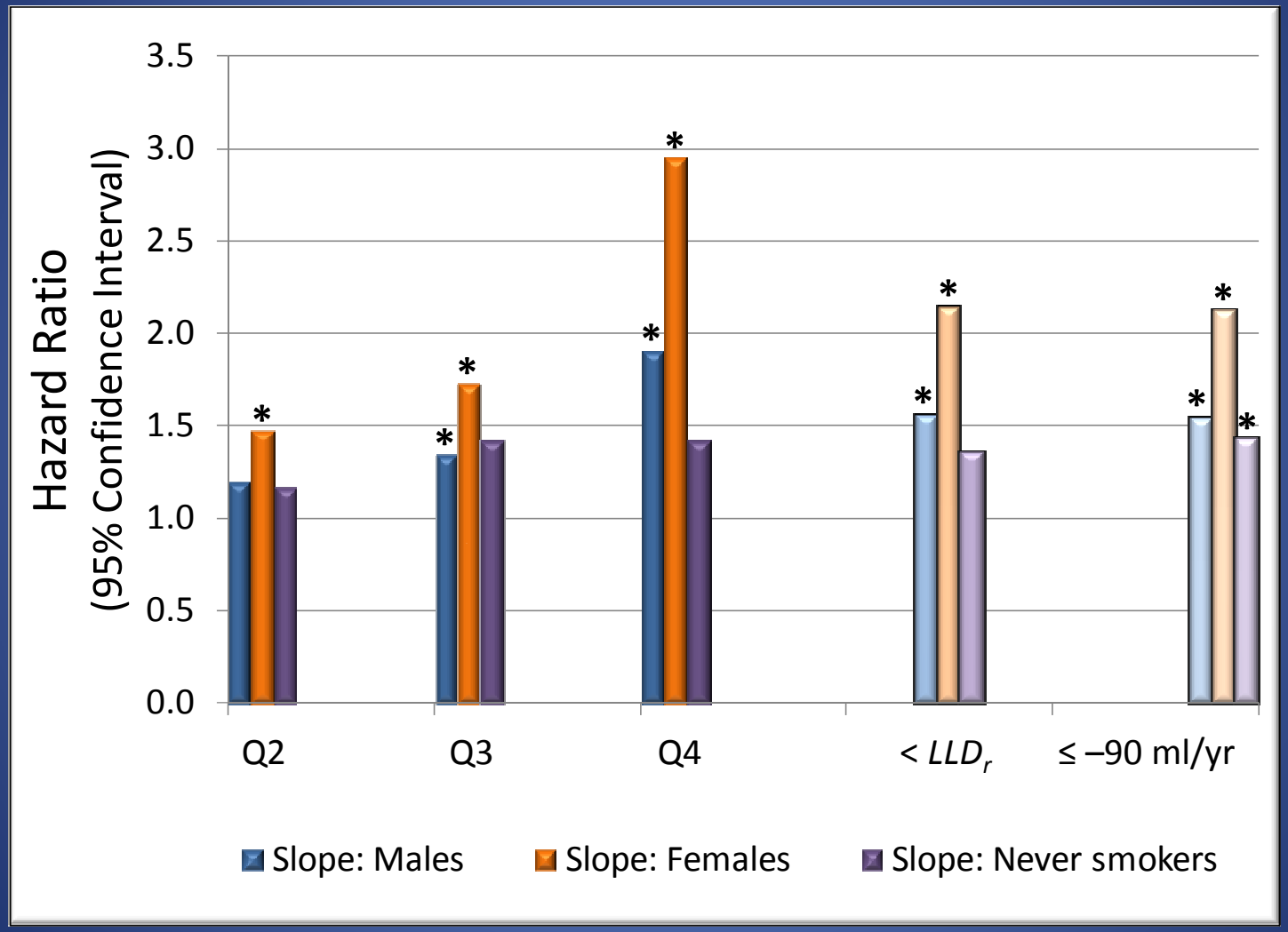
Level of Lung Function: All-cause Mortality



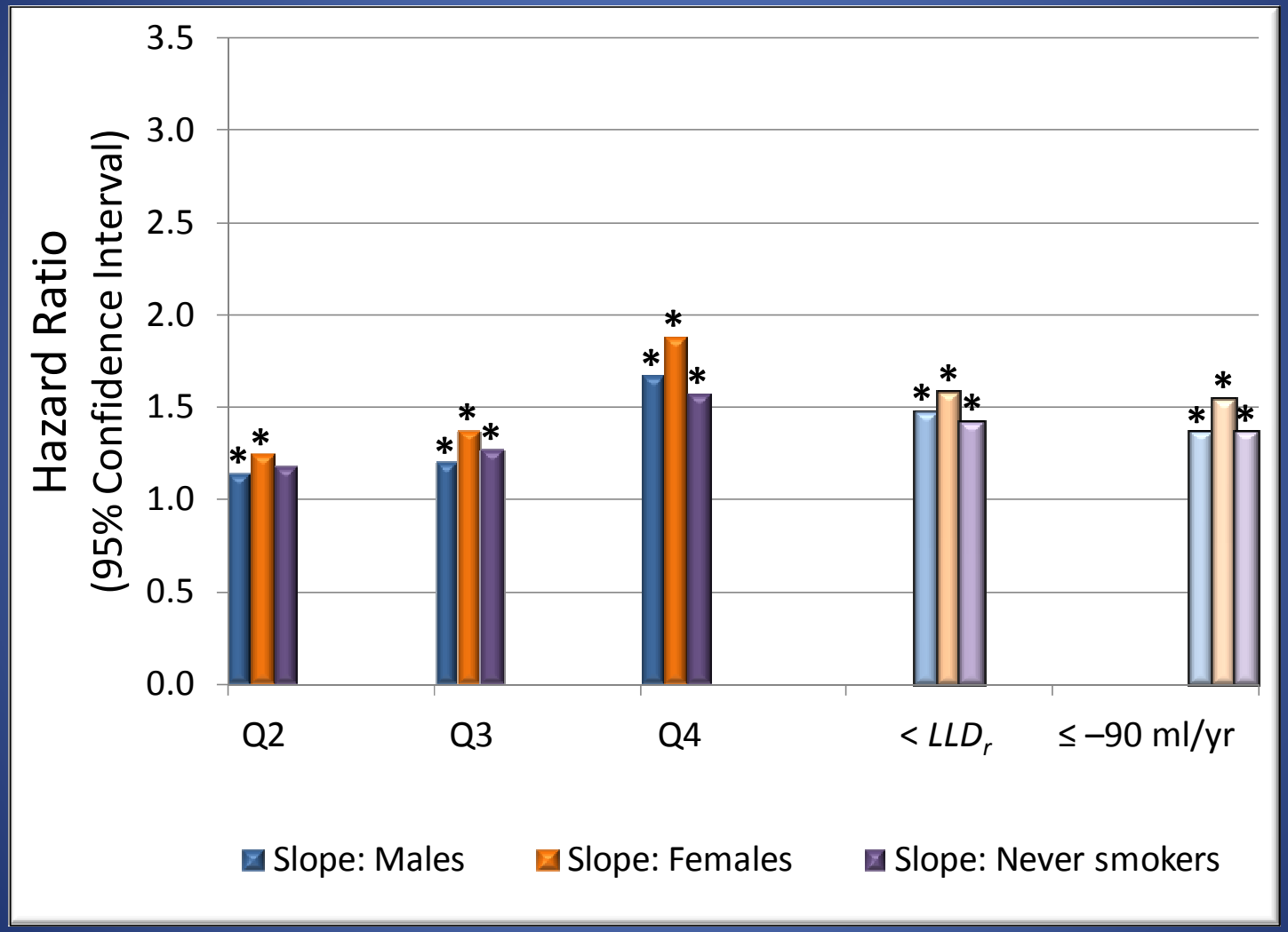
Lung Function Decline: Hospitalization with COPD



Lung Function Decline: COPD or CHD Mortality

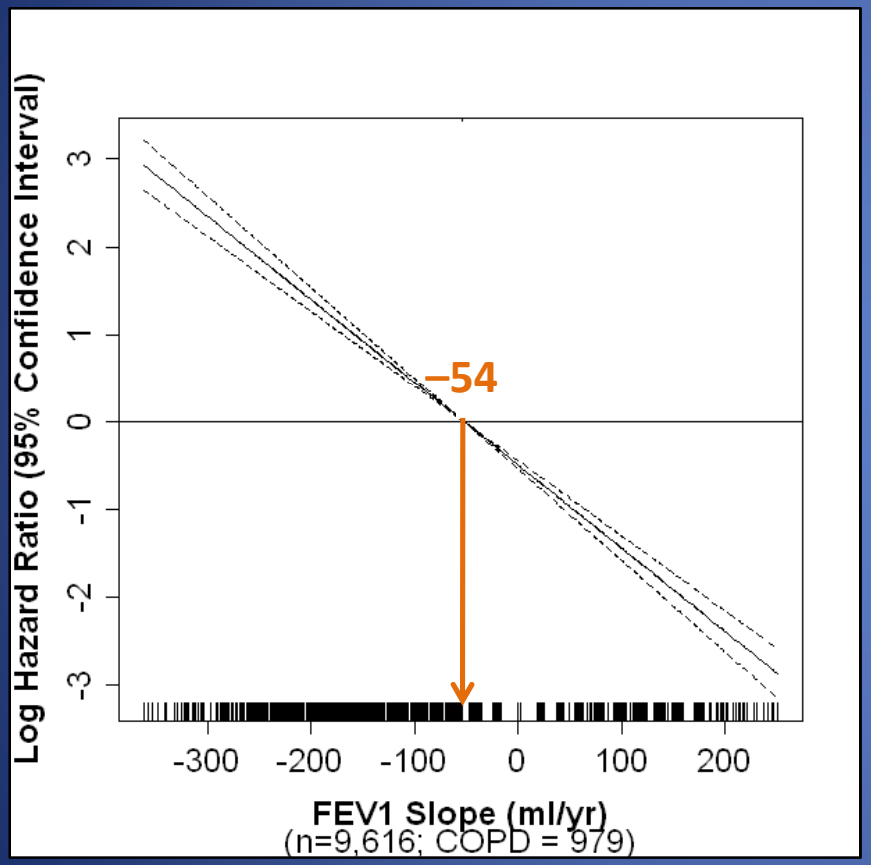


Lung Function Decline: All-cause Mortality



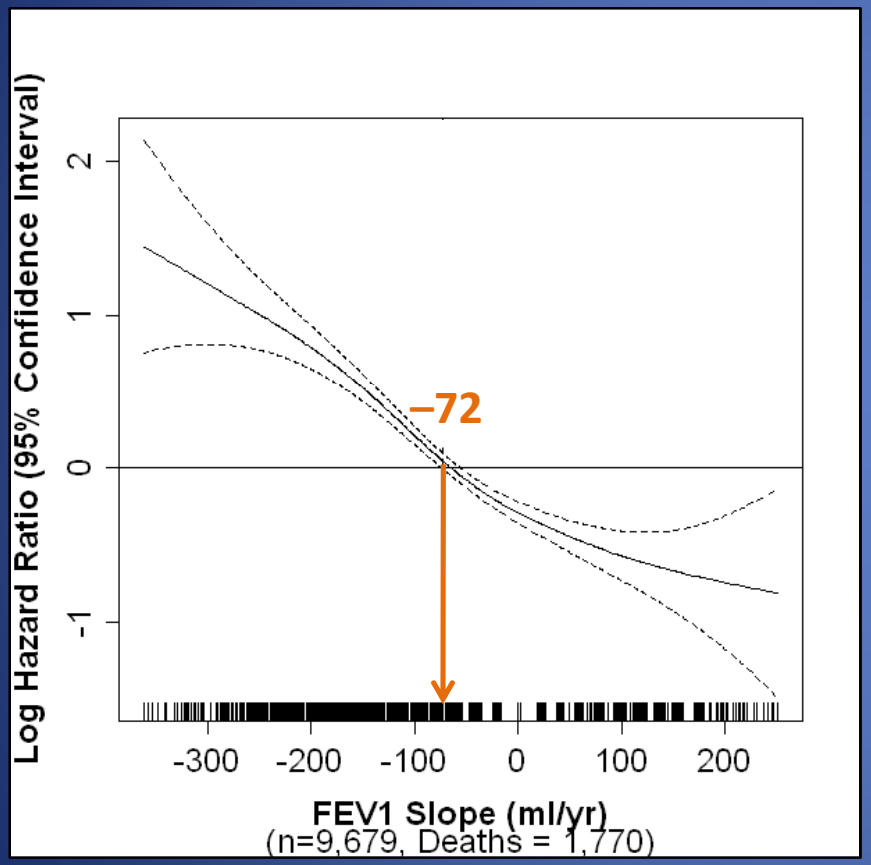
Objective 2: Investigate the level at which lung function decline becomes a significant predictor of morbidity and mortality

Lung Function Decline: Hospitalization with COPD



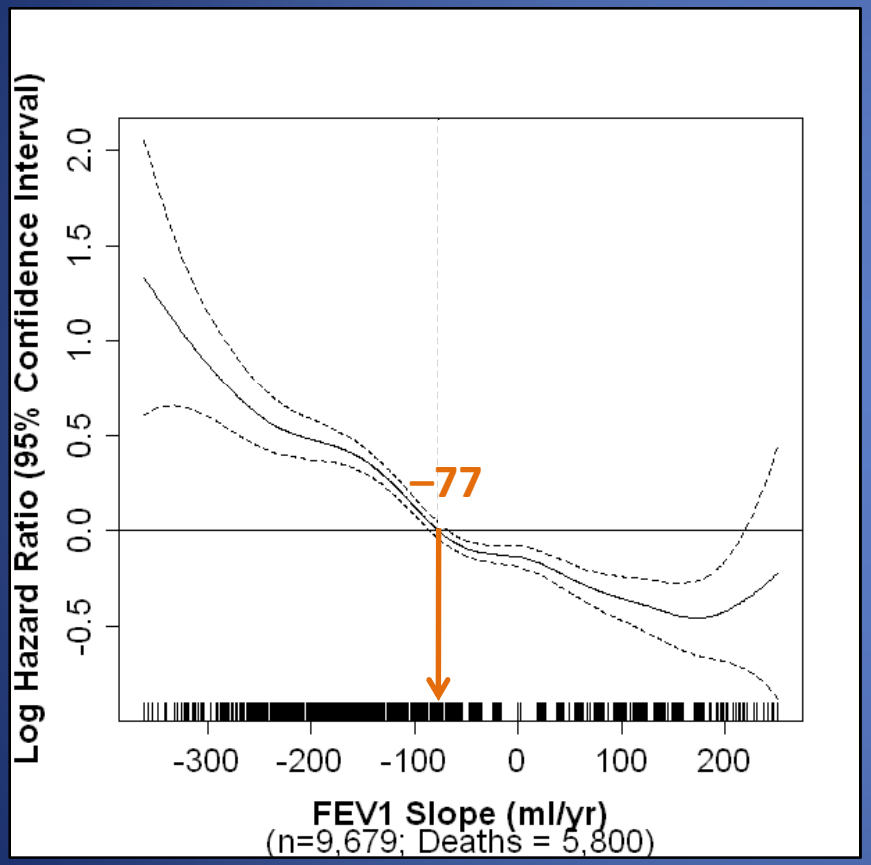
- Risk began to increase at –54 ml/yr
- Linear term was significant ($p < 0.0001$)

Lung Function Decline: COPD or CHD Mortality



- Risk began to increase at –72 ml/yr
- Nonlinear term was significant (p = 0.01)

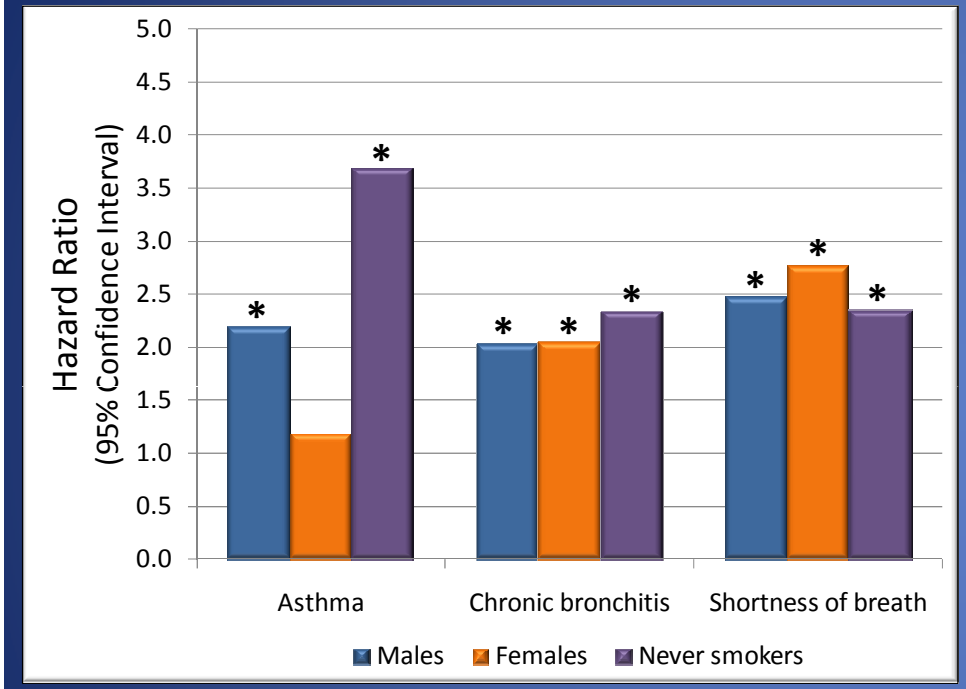
Lung Function Decline: All-cause Mortality



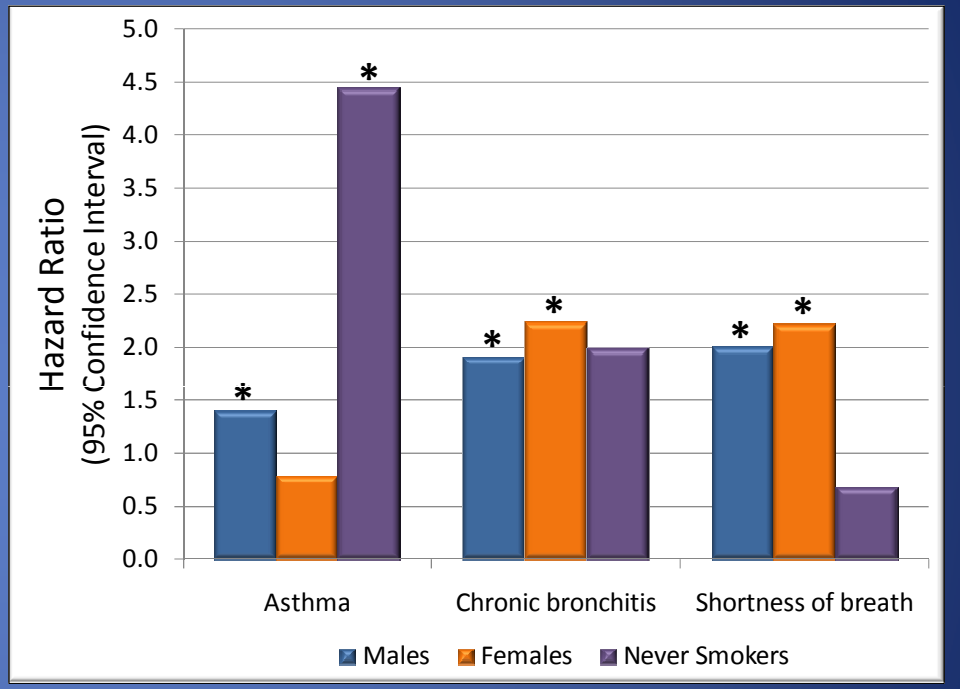
- Risk began to increase at –77 ml/yr
- Nonlinear term was significant (p = 0.0001)

Objective 3: Assess the usefulness of respiratory symptoms and asthma in predicting morbidity and mortality relative to lung function level and decline

Asthma and Respiratory Symptoms: Hospitalization with COPD

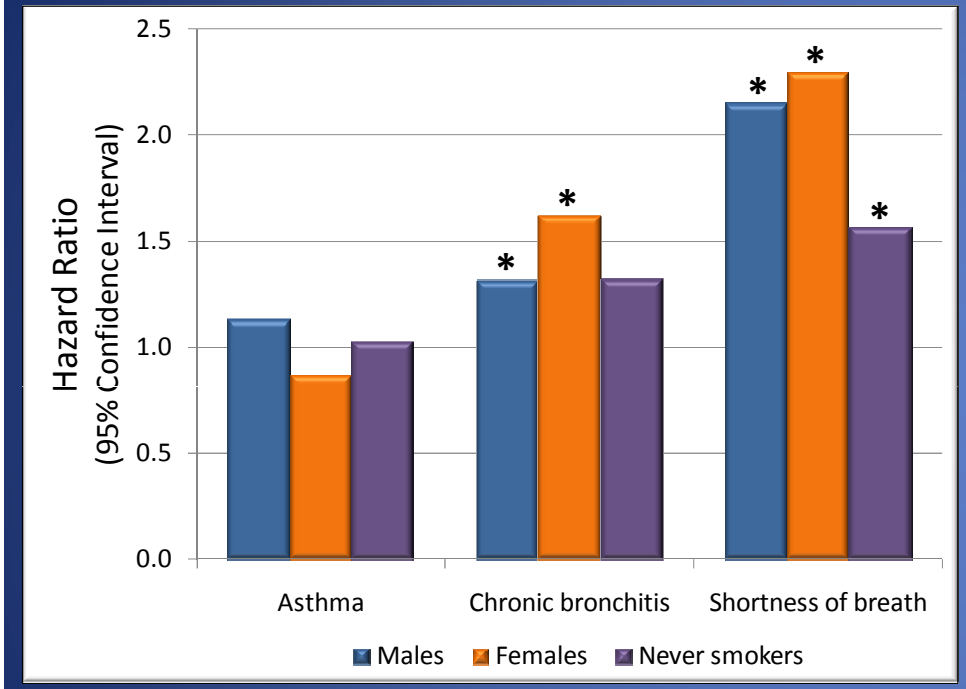


Model with quartiles of the level of lung function

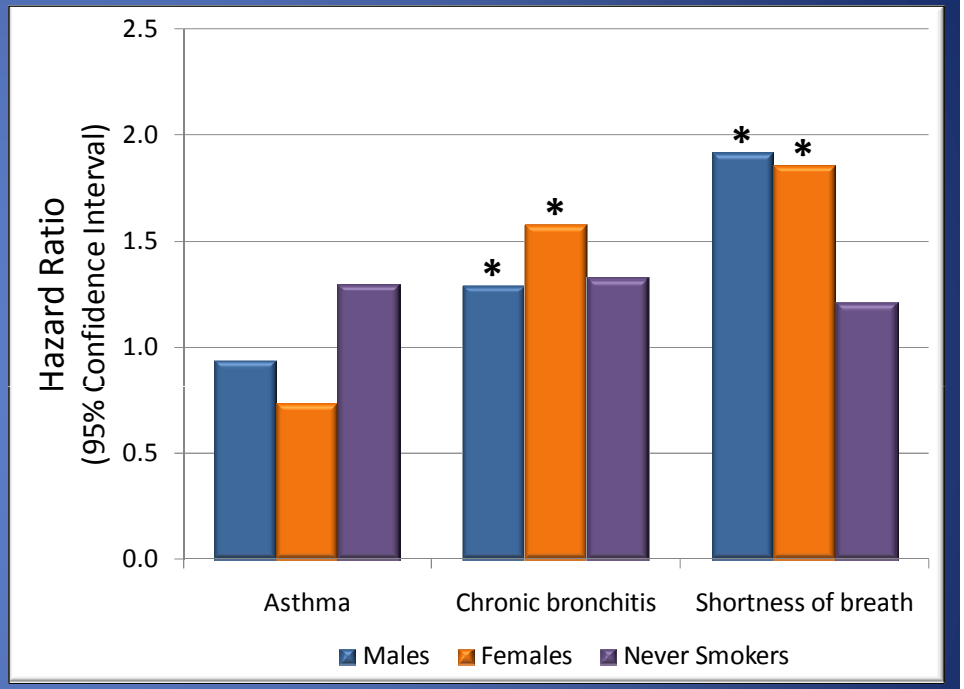


Model with quartiles of the FEV_1 slope

Asthma and Respiratory Symptoms: COPD or CHD Mortality

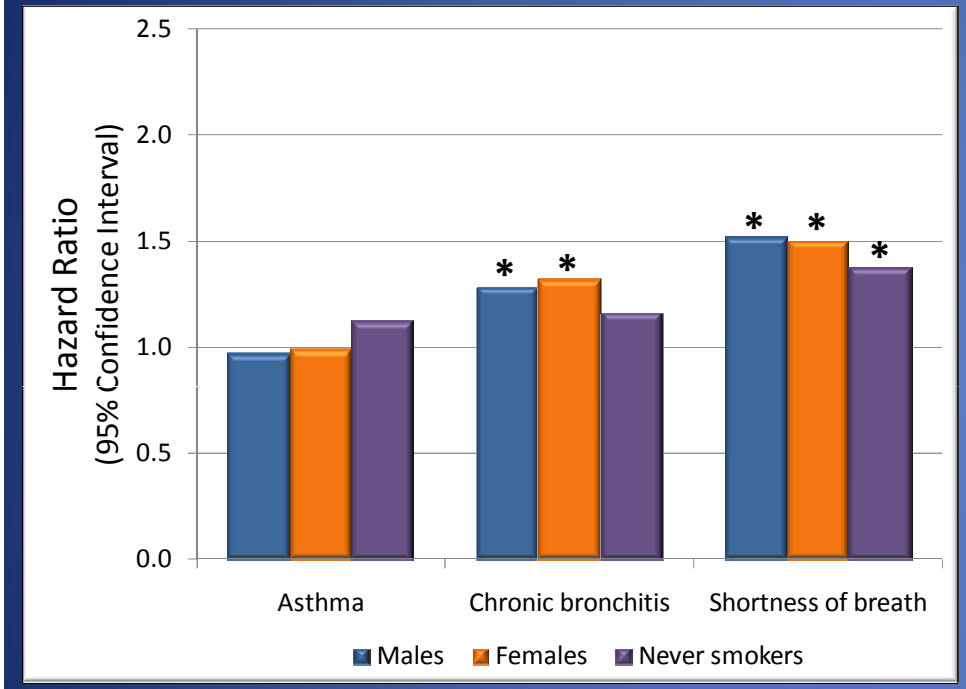


Model with quartiles of the level of lung function

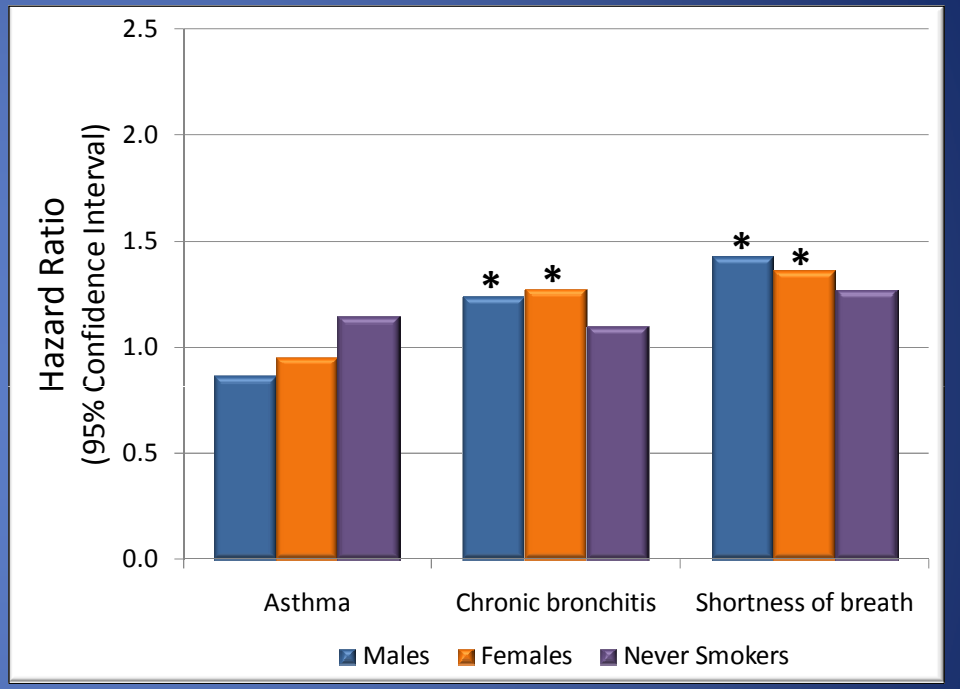


Model with quartiles of the FEV_1 slope

Asthma and Respiratory Symptoms: All-cause Mortality



Model with quartiles of the level of lung function



Model with quartiles of the FEV_1 slope

Conclusions

- Excessive lung function decline is a risk for a hospitalization with COPD, COPD or CHD mortality, and all-cause mortality
  - Even after adjustment for age, baseline lung function, and respiratory symptoms and asthma
- The level and rate of lung function decline generally demonstrated a higher risk of morbidity and mortality than the respiratory symptoms and asthma
- These results provide further evidence that evaluation of excessive lung function decline, in addition to cross-sectional evaluation of the level of lung function, is important in spirometry monitoring programs

Acknowledgments

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  - *Copenhagen City Heart Study*