

# Do Postural Changes in Cardiac Autonomic Balance Predict Incident CHD and Mortality?

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**Disclosure Information:  
There are no relationships to disclose**

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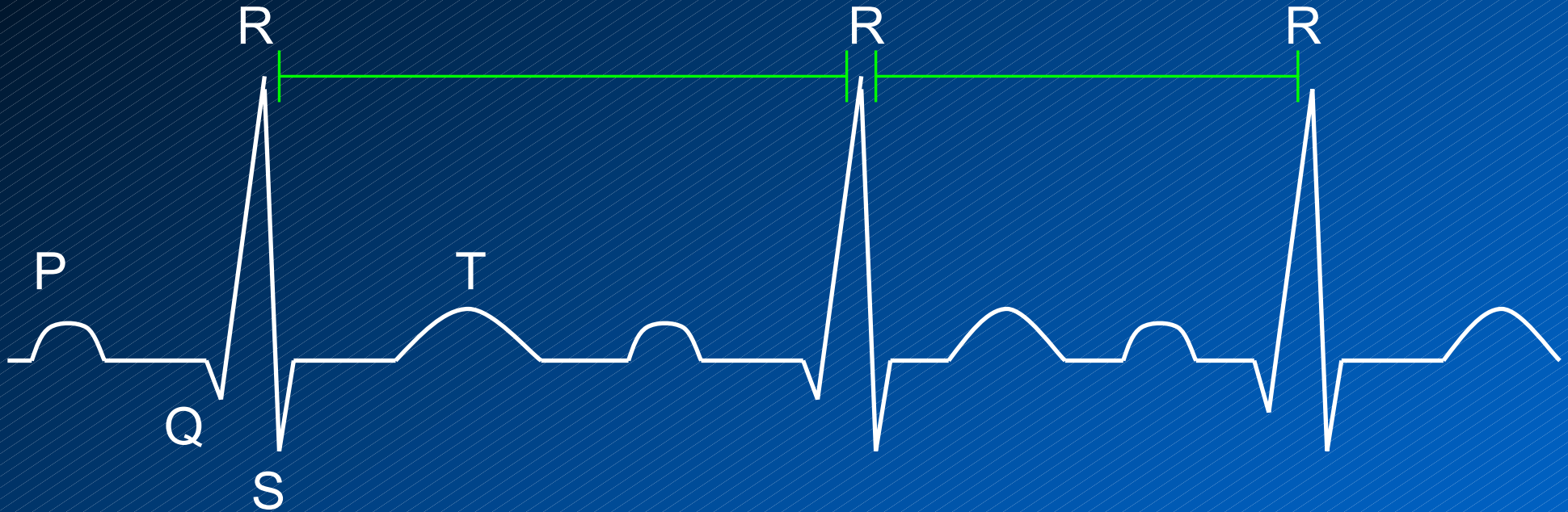
# Background

- The autonomic nervous system controls heart rate, cardiac stroke volume, dilation, and contractility
- Balance results from antagonistic contributions from parasympathetic and sympathetic divisions
  - Parasympathetic responsible for vegetative functions
  - Sympathetic responds to stimuli to increase responsiveness

# Heart Rate Variability (HRV)

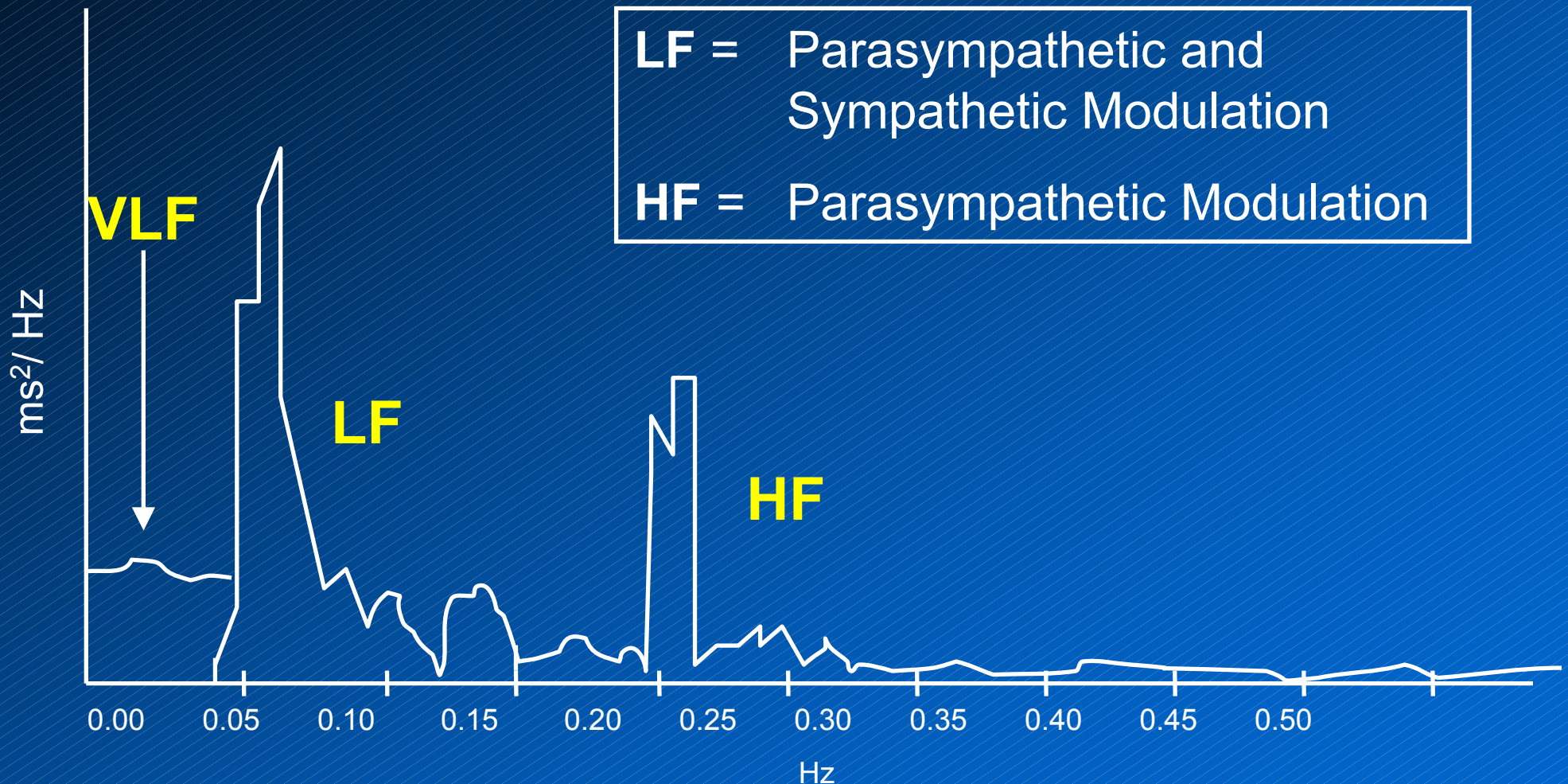
- Heart Rate varies in response to respiration and stress
- Variability is modulated by the autonomic nervous system
- Validated non-invasive technique to estimate specific components of autonomic function

# Time Domain Heart Rate Variability

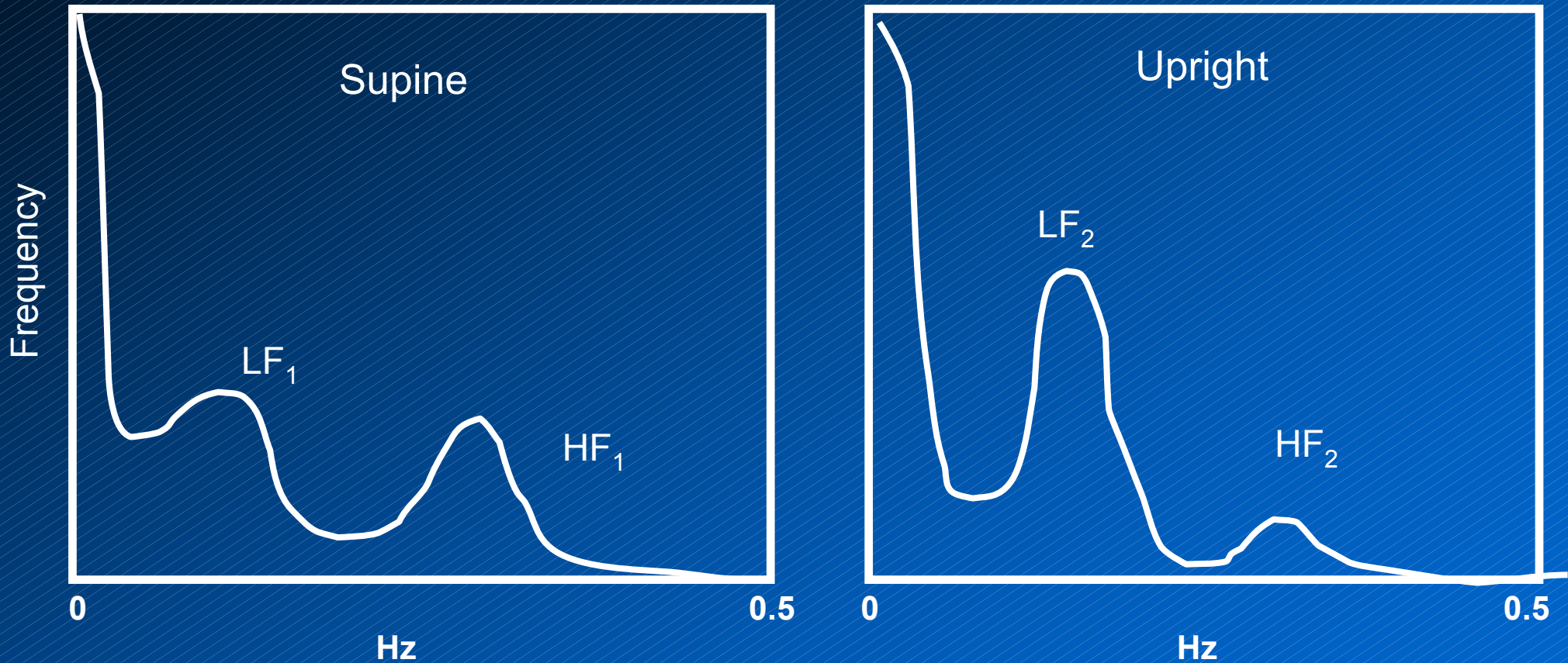


- R-R interval is the time elapsed between heart rate beats
- Interval length can be measured directly
- Statistical properties of the length between intervals can be measured, e.g. standard deviation of R-R (SDNN)

# Frequency Domain Analysis: Power Spectral Density Curve



# HRV Response to Postural Change



Adapted from : Task Force of European Society of Cardiology and the North American Society of Pacing and Electrophysiology. *Circulation* 1996; 93: 1043-1065

# Study Questions

- Does the cardiac autonomic response to postural change predict incident CHD and all-cause mortality?
- Does low standing HRV demonstrate the same inverse relationship with events as supine HRV?
- Does prevalent diabetes modify the relationship between postural change HRV and incident events?

# Atherosclerosis Risk in Communities Study (ARIC)

- Longitudinal study of atherosclerosis in approx. 16,000 adults aged 45-64 from 4 US communities
- Comprehensive risk factor data collected at baseline clinic examination
- Clinic re-examination every three years
- Annual follow-up of events through death certificate and community surveillance

**Total ARIC Cohort:  
n= 15,792**

**HRV Measured in 1<sup>st</sup> 6 months: n= 816**

**Non-black/white: n= 99**

**Age < 45: n= 48**

**Prevalent/Missing CHD: n= 1,490**

**Invalid/missing HRV (33%)**

**Supine: n= 2,092**

**Standing: n= 4,025**

**Study Cohort: 9,267**

# Postural Change Indices:

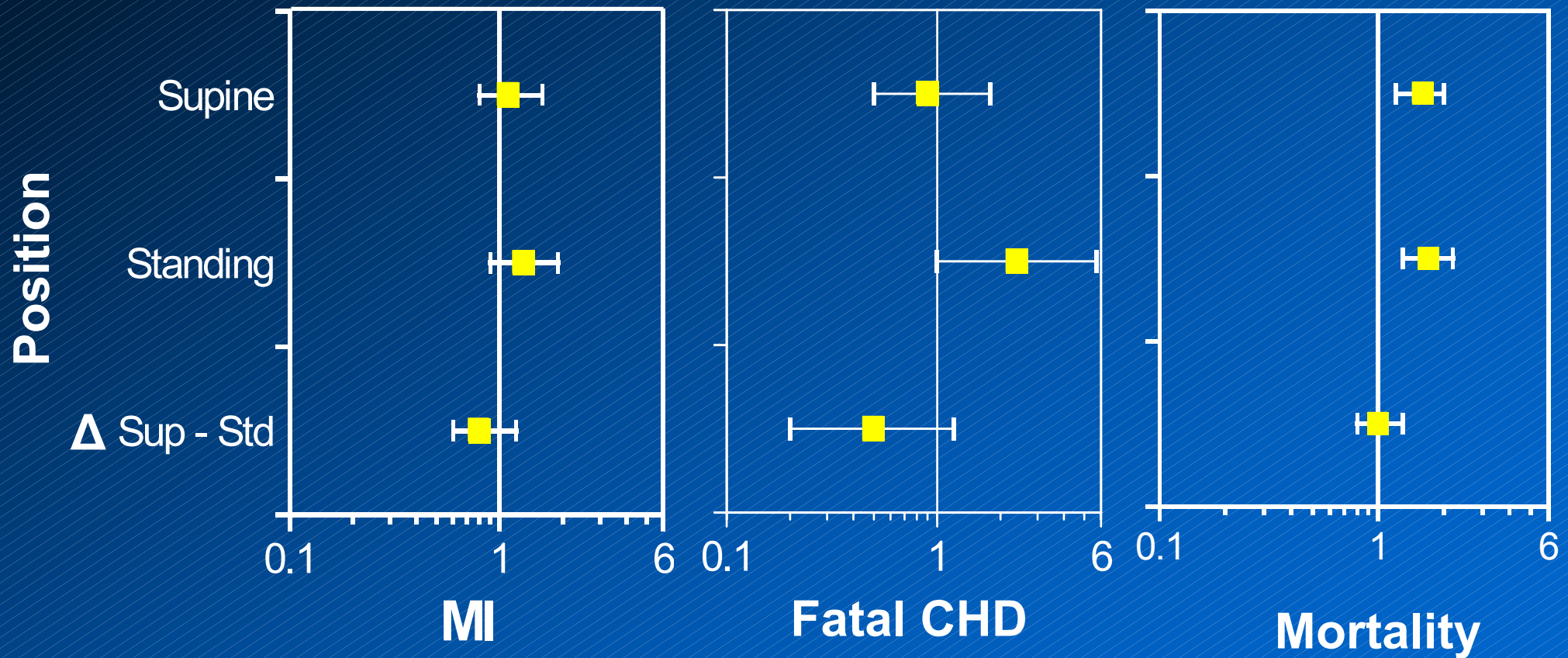
Supine HRV (2 min.) – Standing HRV (2 min.)

- $\Delta$ HF (ms<sup>2</sup>) HF power absolute units (0.15-0.40 Hz)
  - » Parasympathetic withdrawal
- $\Delta$ SDNN (ms) Standard deviation of normal R-R
  - » Change in overall modulation of autonomic balance
- $\Delta$ R-R (ms) Inverse of heart rate
  - » Heart rate change

# Event Ascertainment (1987-1997)

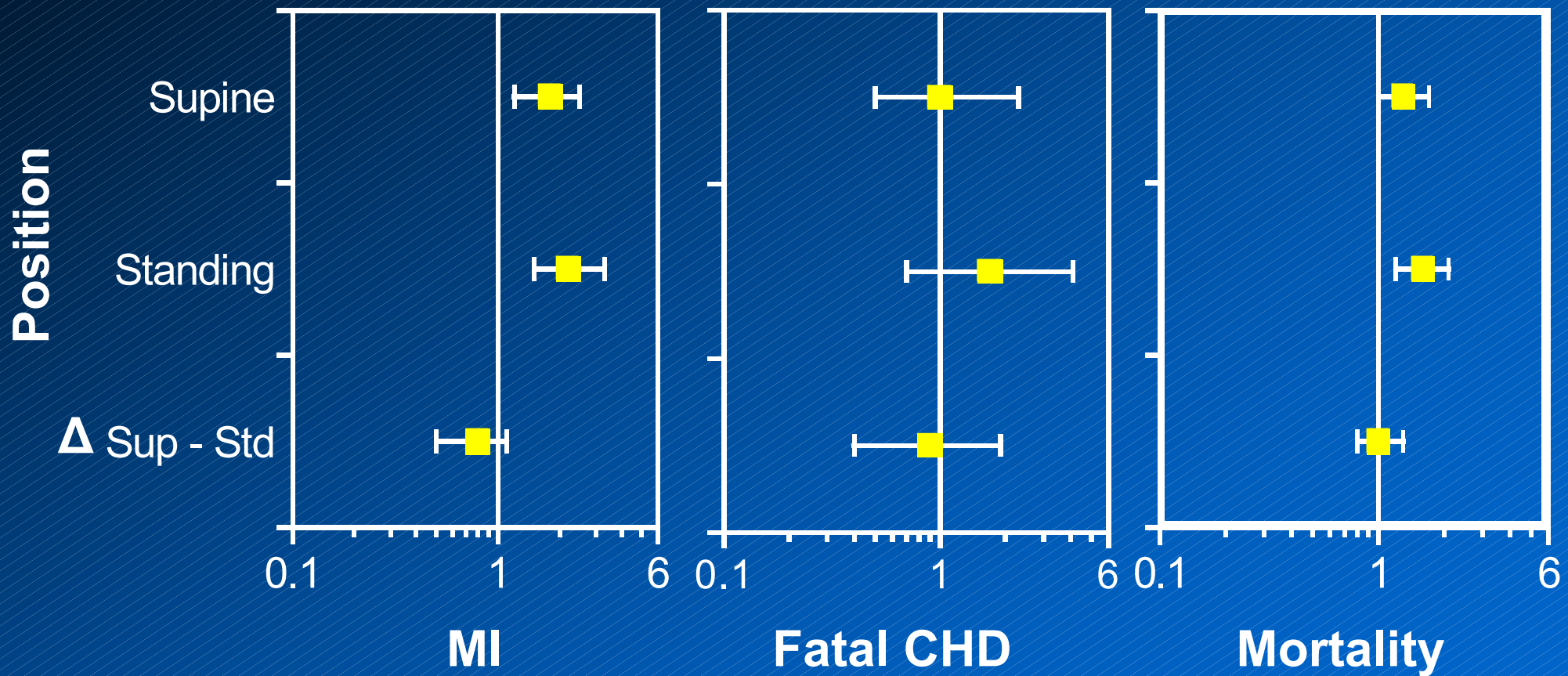
- Incident MI (n = 297)
  - ICD-9 codes: 402, 410-414, 427,428, and 518.4
  - Chest pain, cardiac enzymes, ECG changes
- Fatal CHD (n = 63)
  - Underlying cause of death consistent with ICD-9 codes
  - MI 1 month prior to death or chest pains within 72 hours
- Non-CHD mortality (n = 540)
  - Death from any cause other than CHD

# Adjusted\* Hazard Ratios (95% CI) of Each Event, Lowest v. Highest Quartiles: HF Power (Parasympathetic Withdrawal)



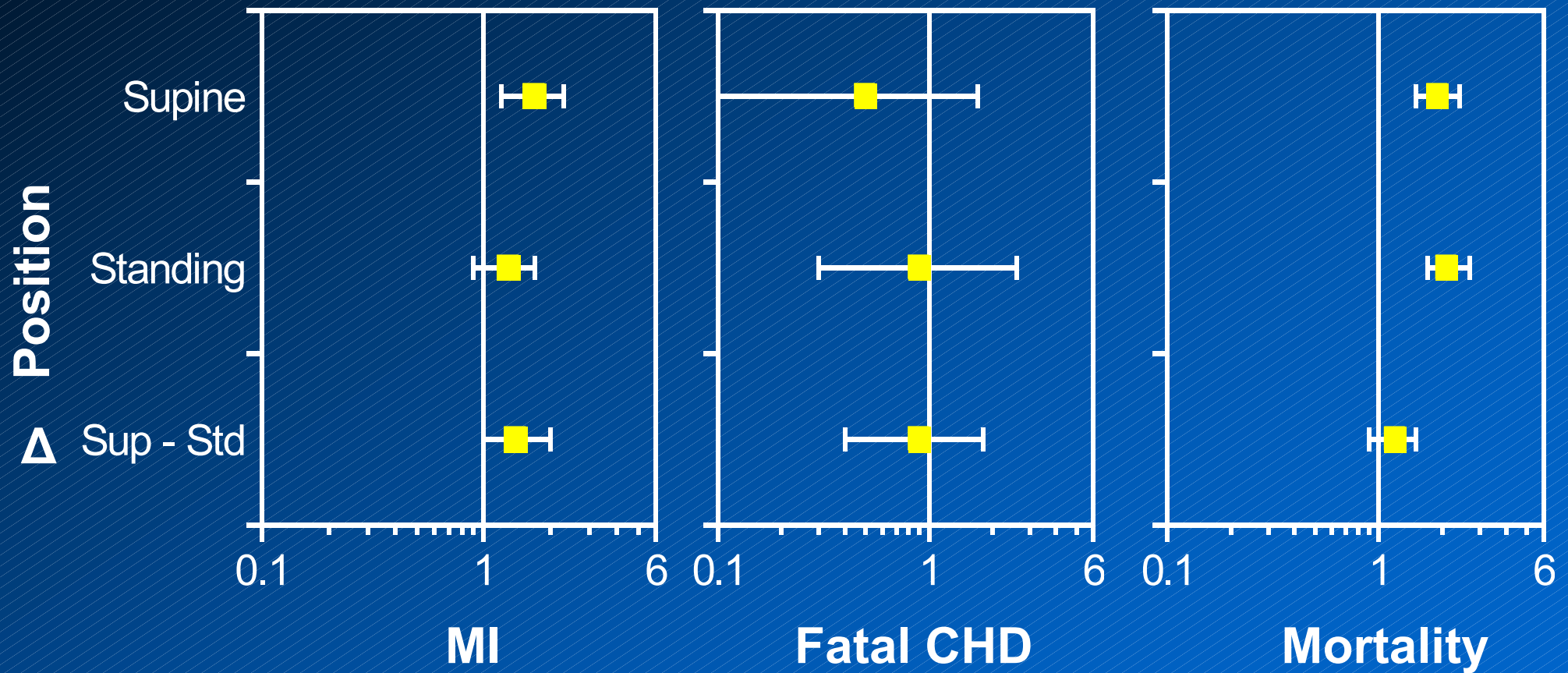
\*Age, race, gender, medication use, and heart rate

# Adjusted\* Hazard Ratios (95% CI) of Each Event, Lowest v. Highest Quartiles: SDNN (Change in Overall Modulation)



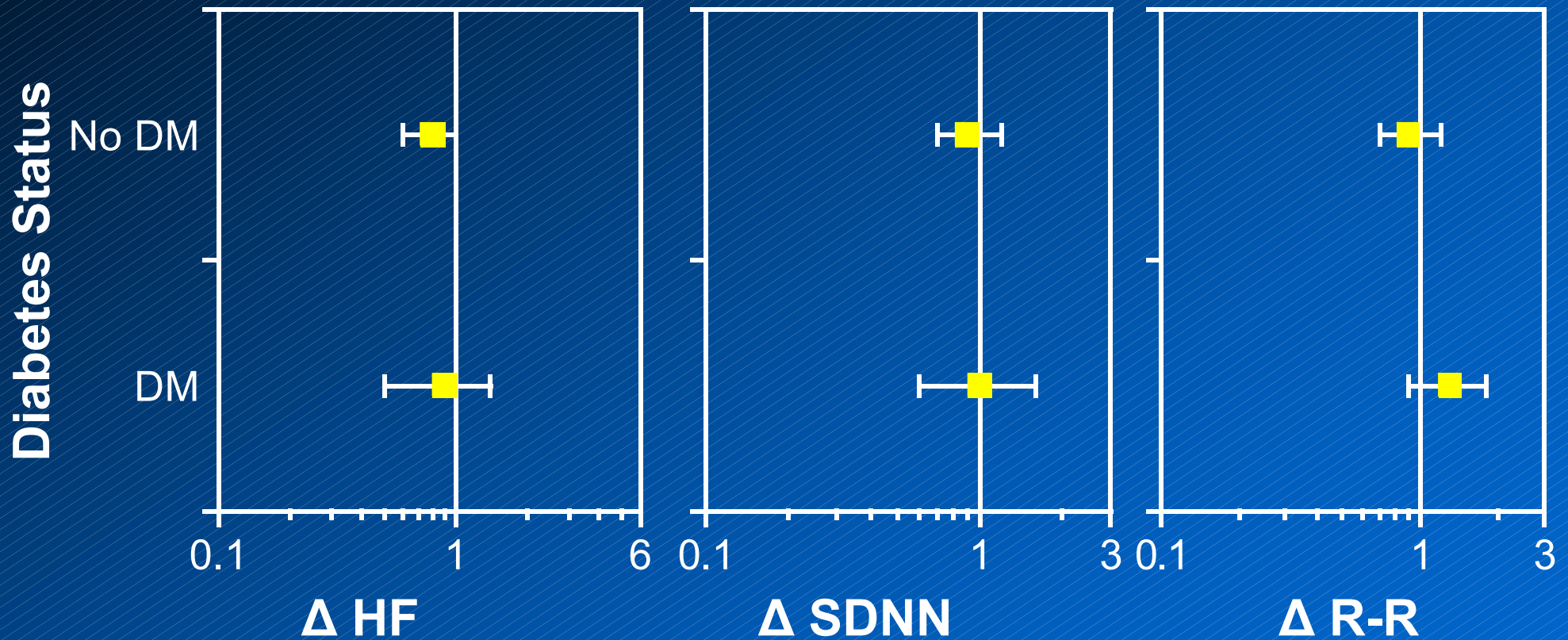
\*Age, race, gender, medication use, and heart rate

# Adjusted\* Hazard Ratios (95% CI) of Each Event, Lowest v. Highest Quartiles: R-R Intervals (Heart rate change)



\*Age, race, gender, medication use

# Adjusted\* Hazard Ratios (95% CI) of Mortality by Diabetes Status, Lowest v. Highest Quartiles of $\Delta$ HRV



\*Age, race, gender, medication use, and heart rate

# Conclusions

- Protective association between supine and standing HRV and incident events
- Little association between  $\Delta$ HRV and incident events
  - Not modified by diabetes
- $\Delta$ R-R intervals associated with incident MI

# Limitations and Strengths

- Limitations
  - Large proportion of missing HRV data (33%)
  - Unable to estimate sympathetic activation with short HRV records
- Strengths
  - Validated method to shift autonomic balance
  - Largest population study of autonomic balance with longest event follow-up

# Significance

- No information beyond indices in the supine and standing positions
- Short (< 5 minutes) postural change measures do not predict disease
- Simple measures like heart rate change may identify persons at risk for events



# Characteristics of the Cohort by HRV Data Availability

	Available Data (N=9,267; 67%)	Missing Data (n=4,562; 33%)
Age	53.8 (0.1)*	54.6 (0.1)
Race (%Black)	28.7*	22.9
Gender (% Male)	40.5*	49.0
Educ (% < HS)	22.9	22.8
BMI (kg/m <sup>2</sup> )	27.5 (0.1)*	28.0 (0.1)
Hypertension (%)	33.9	33.5
Diabetes (%)	10.9	11.9
Smokers (%)	25.6	26.9

\*p<0.01