



Swimming-Induced Pulmonary Edema (SIPE) in Triathletes: Effect of Age

Richard E Moon, Stefanie D Martina,
Dionne F Peacher, Claire E Otteni,
Tracy E Wester, Jennifer F Potter

Center for Hyperbaric Medicine & Environmental Physiology
Depts. of Anesthesiology and Medicine
Duke University, Durham, NC

Immersion Pulmonary Edema

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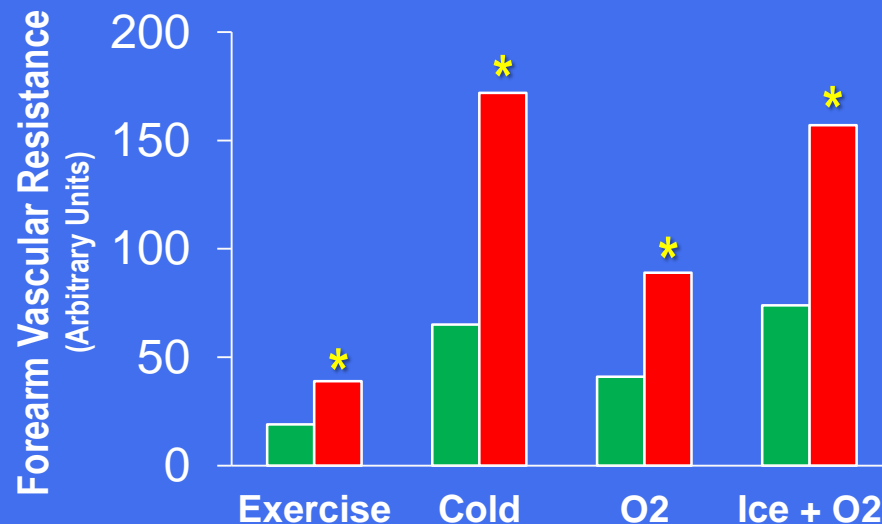
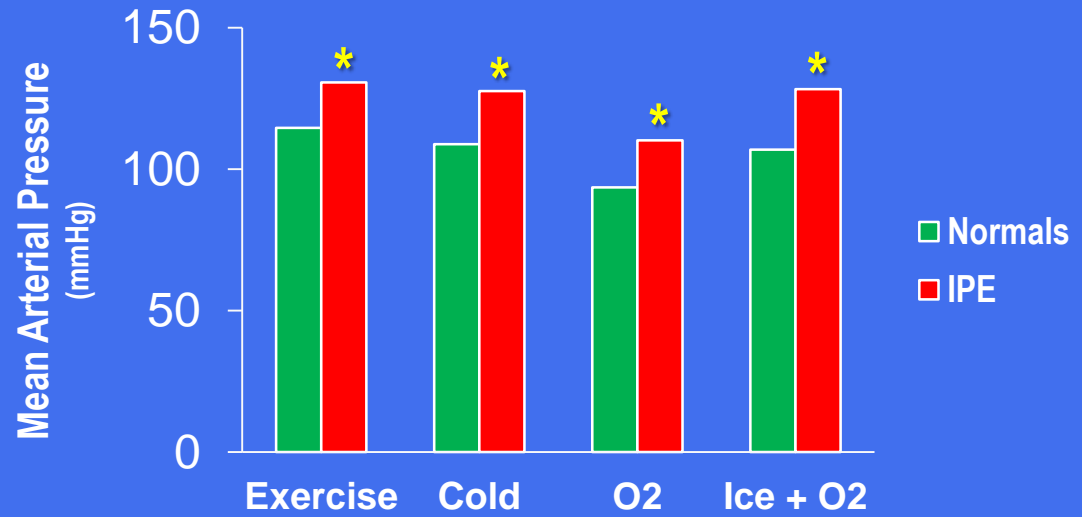
COLD-INDUCED PULMONARY OEDEMA IN SCUBA DIVERS AND SWIMMERS AND SUBSEQUENT DEVELOPMENT OF HYPERTENSION

P. T. WILMSHURST
A. CROWTHER

M. NURI*
M. M. WEBB-PEPLOE

*Department of Cardiology, St. Thomas' Hospital,
London SE1 7EH*

Summary The effect of cold and/or a raised partial pressure of oxygen was examined in eleven people with no demonstrable cardiac abnormality but who had pulmonary oedema when scuba diving or surface swimming, and in ten normal divers. These stimuli induced pathological vasoconstriction in the pulmonary oedema group, nine of whom also showed signs of cardiac decompensation when so stimulated. The pulmonary oedema patients have been followed-up for an average of 8 years. Seven have become hypertensive. Except for the onset of lone atrial fibrillation in one normotensive female diver and development of Raynaud's phenomenon in a normotensive man, there have been no cardiovascular events and no deaths.

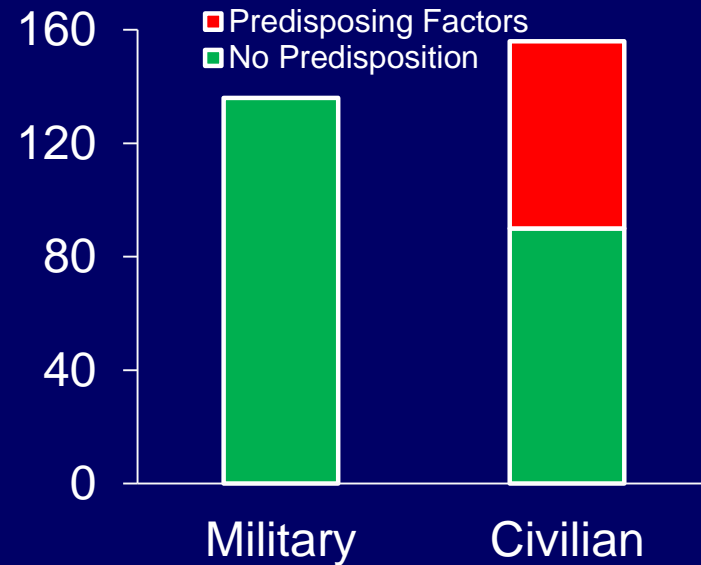
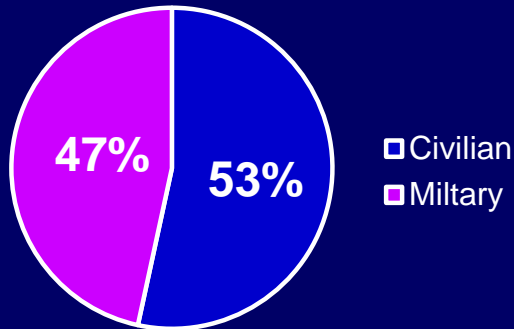


* P < 0.05 vs. Normals

Background

Author	Year	Population	N
Wilmshurst	1989	Civilian divers, swimmers	11
Weiler-Ravell	1995	Military	8 (of 30 individuals)
Shupak	2000	Military	29 cases in 21 swimmers (60% of group)
Mahon	2002	Military	3
Lund	2003	Military	3
Adir	2004	Military	70
Miller	2010	Triathletes	1.4% of 1411 triathletes reported SIPE symptoms

41 Articles Reporting SIPE 1984-2014: 292 Cases



CARDIAC ABNORMALITIES

Hypertension	24
Wall motion abn.	21
Alcoholic cardiomyopathy	1
Takotsubo	4
Myocard. ischemia	21
LVH	9
Mitral regurgitation	4
Atrial fibrillation	2
PVD	1

CARDIAC RISK FACTORS

Elevated lipids	16
Sleep apnea	4
Diabetes	4

PULMONARY CONDITIONS

Asthma	4
Exercise-induced cough	1

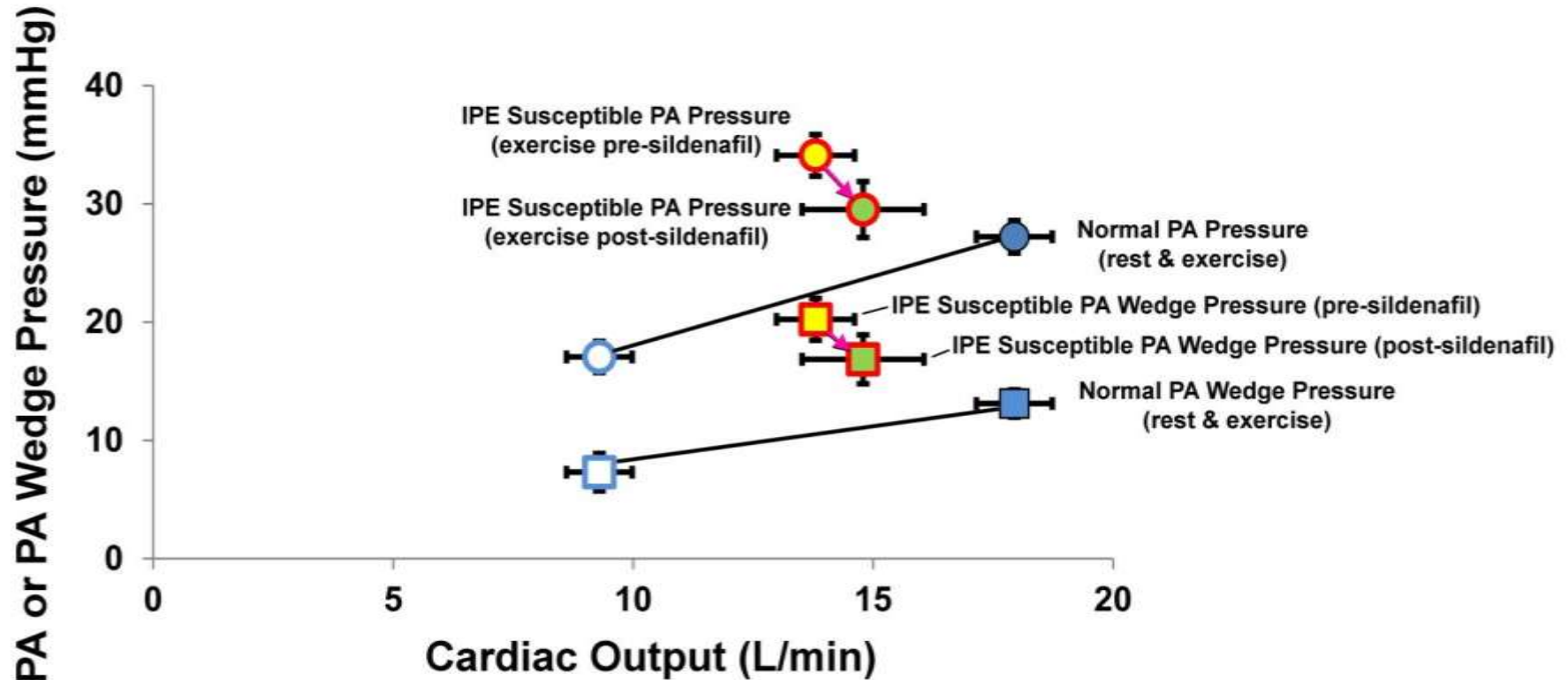
Immersion Pulmonary Edema in Triathletes

- Electronic survey via USA Triathlon
- 1400 respondents, 20 (1.4%) reported having experienced “*Cough productive of pink frothy or blood-tinged secretions*”
- Associated variables with univariate analysis: hypertension, fish oil use, wetsuit use, long course* (*1.9 km swim, 90 km ride, 21.1 km run, or greater)
- Associated factors using multiple logistic regression:



Variable	OR (CI)	P
Hypertension	5.38 (2.15,3.48)	0.0003
Female gender	2.75 (1.26,6.02)	0.02
Long course	3.30 (1.50,7.27)	0.003
Fish oil use	2.66 (1.28,5.54)	0.009

PAP and PAWP During Cold (20°C) Immersed Exercise



SIPE Mechanisms in fit, young athletes?

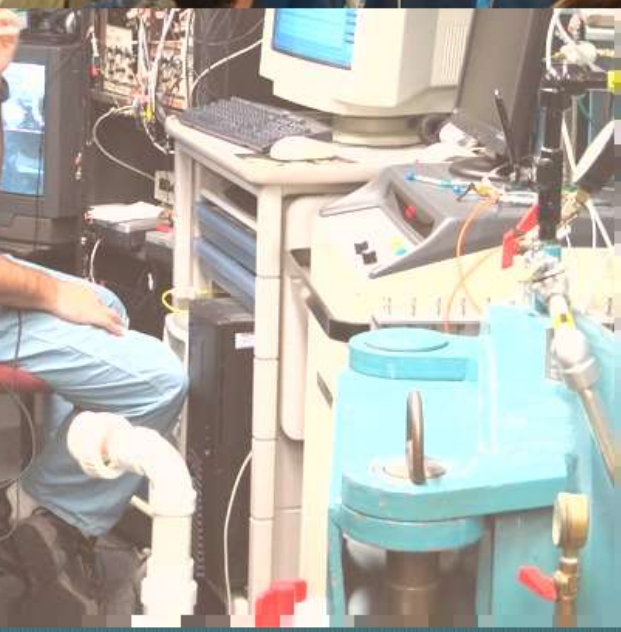
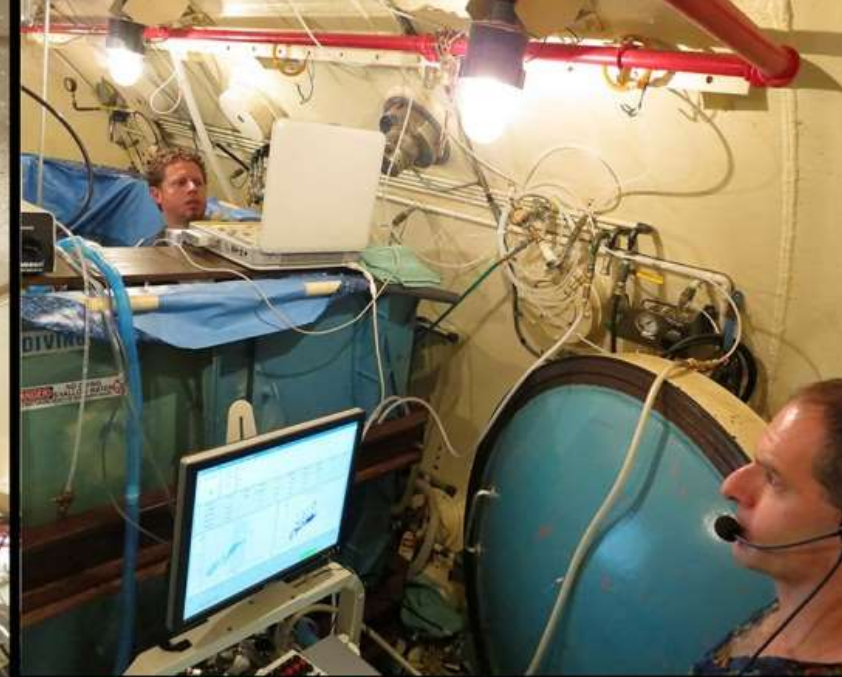


Navy SEALs

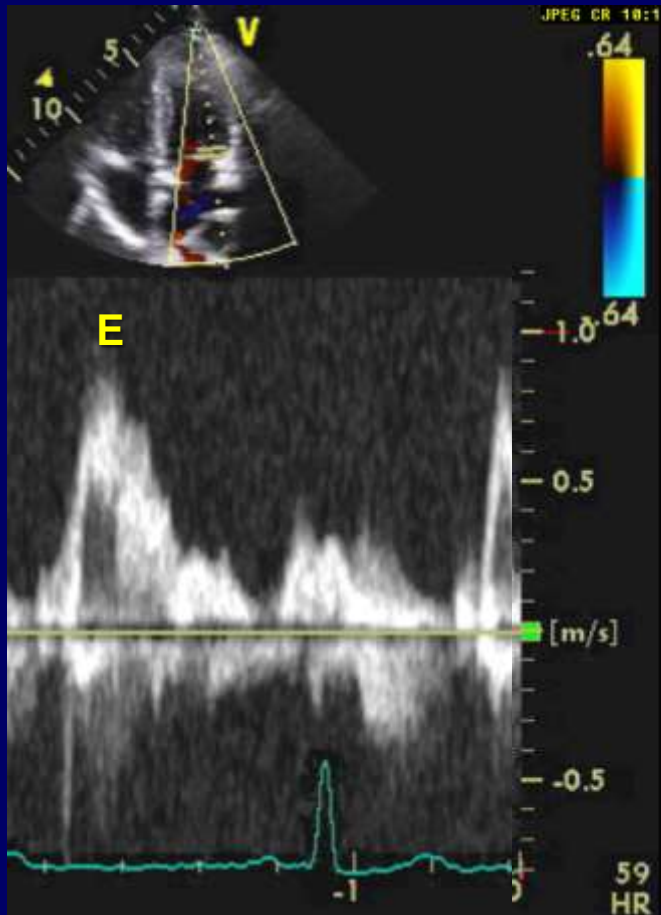


Triathletes

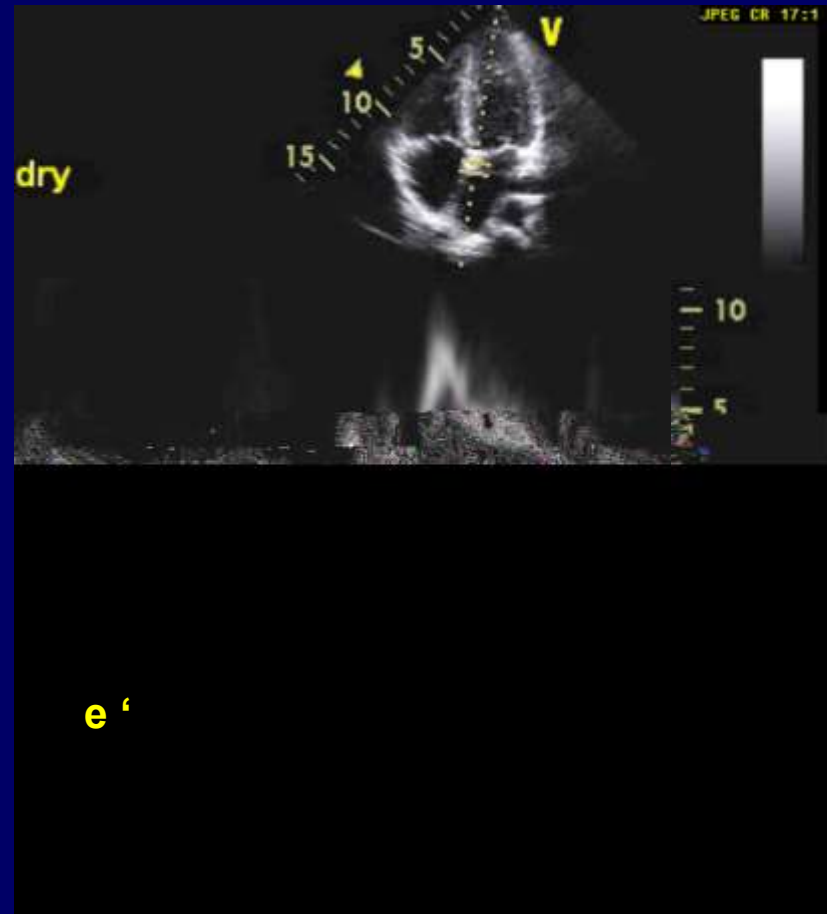
- Excessive hydration
- Impaired diastolic LV filling (\downarrow LV compliance \rightarrow higher LVEDP)
- High exertion levels \rightarrow higher PAP, PA wedge pressure



Measurement of E/e'



flow velocity



annular velocity



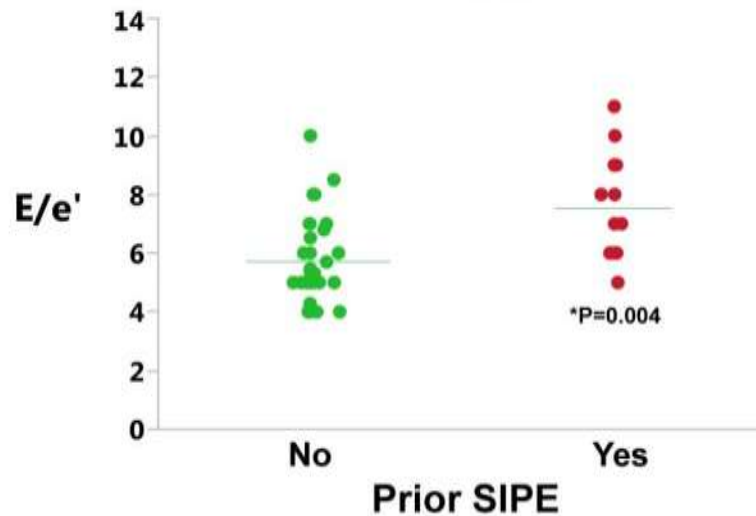
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Control Susceptible
Dry Rest

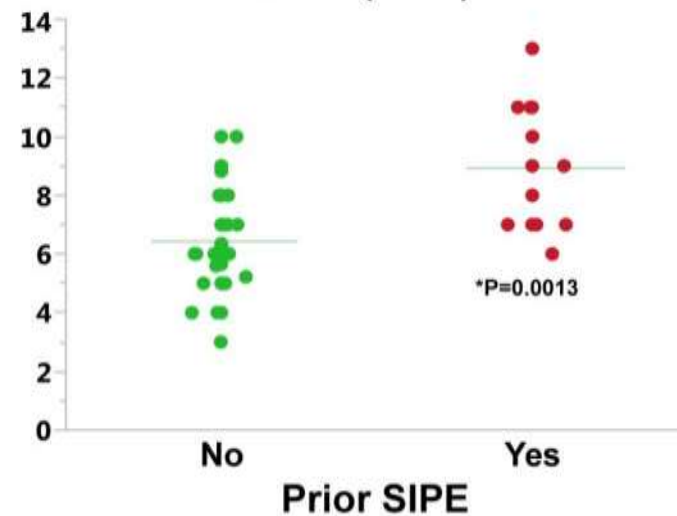
Control Susceptible
Immersed Rest

Control Susceptible
Immersed Exercise

DRY REST



IMMERSED (20°C) REST



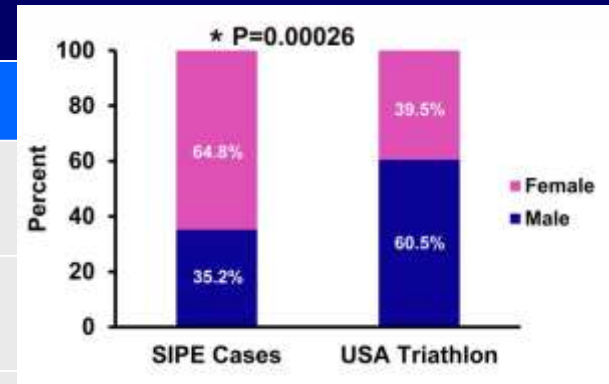
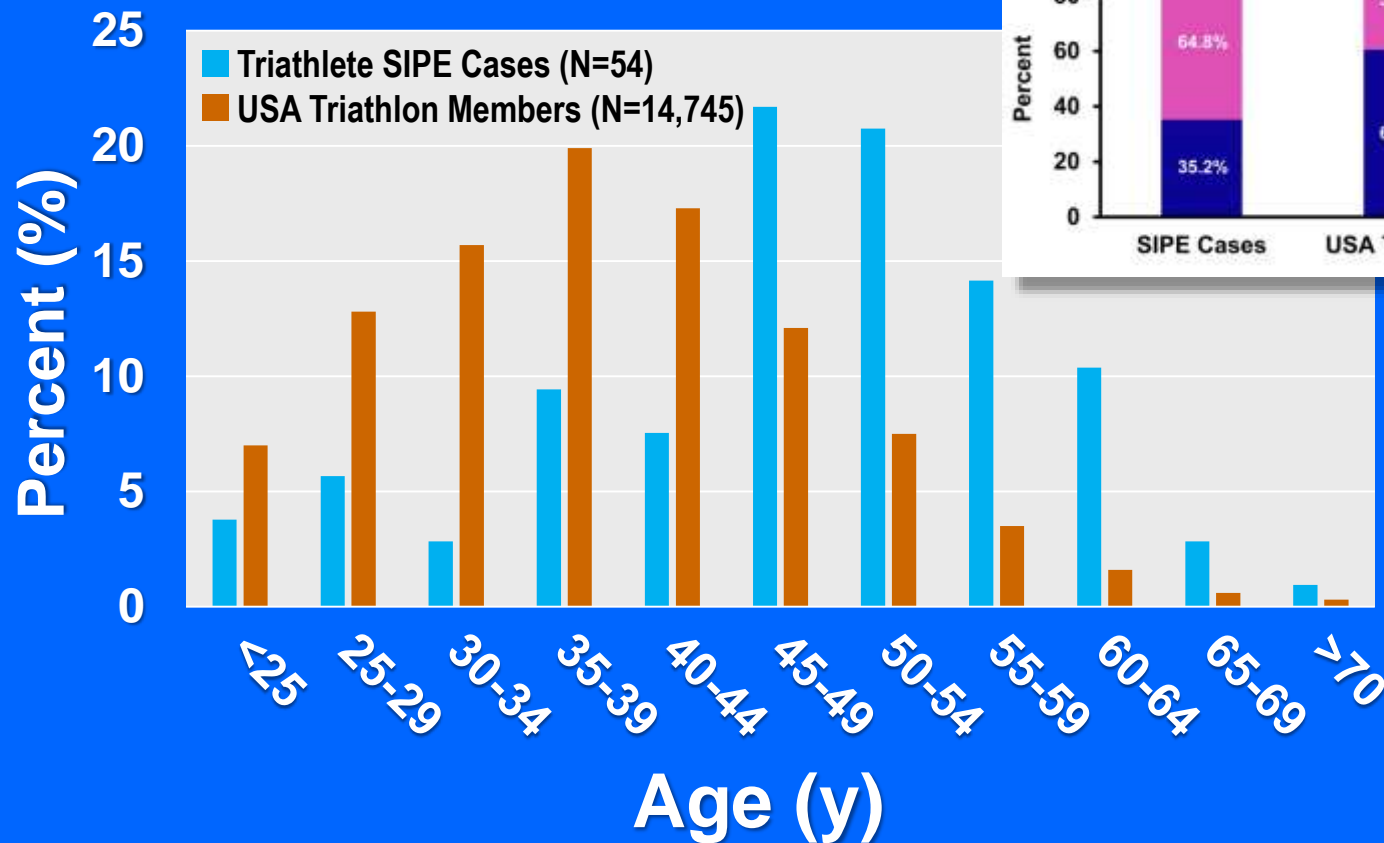
Hypothesis

Susceptibility to SIPE in triathletes may be caused by age-related decrease in LV compliance

Methods

- Duke IRB approval
- Published cases of SIPE in triathletes volunteering for Duke study (N=54) and respondents to USA Triathlon 2008 survey (N=14,745)
- Age and gender distributions compared (Fisher's exact test and chi square)

Results: Age Distribution



Conclusions

- Among triathletes, increased age is a risk factor for SIPE, consistent with age-related reduction in LV compliance or increased prevalence of co-morbidities (e.g. hypertension)
- Compared to males, female triathletes are at higher risk of SIPE, as previously observed



Alicia Armour



Owen Doar



**Aaron
Walker**



**Dionne
Peach**



Eric Schinazi



Mike Natoli



Ivy Forkner



**Dr. Joe
Kisslo**



**Danny
Rivera**



**Ann
Cher**



**Cy
Oster**



**Jennifer
Fraser**



**Marty
Lynch**



Rick Roller



Sonny Boso



**Stefanie
Martina**



Jenna Wiley



**Dawn
Kernagis**



Shelly Pecorella



Eric Alford

