



Head-Out Immersed Exercise as a Screening Test for Swimming-Induced Pulmonary Edema (SIPE)

RE Moon, SD Martina, MJ Natoli, EA Schinazi, B Derrick,
J Logan, JJ Freiburger

Center for Hyperbaric Medicine and Environmental Physiology
Duke University Medical Center
Durham, NC, USA



Immersion Pulmonary Edema (IPE), Swimming-Induced Pulmonary Edema (SIPE)

■ Pulmonary edema occurring in divers, swimmers

■ Dyspnea	70	(100%)
■ Cough	67	(96%)
■ Hemoptysis	39	(56%)
■ Sputum production	63	(90%)
■ Chest pain	6	(9%)
■ Basal inspiratory crackles	64	(91%)
■ Wheezing	6	(9%)

**Adir Y, et al.
Chest 126:394, 2004**

- Most commonly reported in naval combat swimmers during training, triathletes. Prevalence in 2.4-3.6 km open sea swimming trials reported to be 1.8-60% (Shupak A, et al. Respir Physiol 2000;121:25-31; Adir Y, et al. Chest 2004;126:394-9)
- No cardiopulmonary pathology in majority of cases, especially among military
- Evidence supports a hemodynamic cause for SIPE

Hypothesis

Individuals with a history of SIPE are more likely to develop it after an oral fluid pre-load

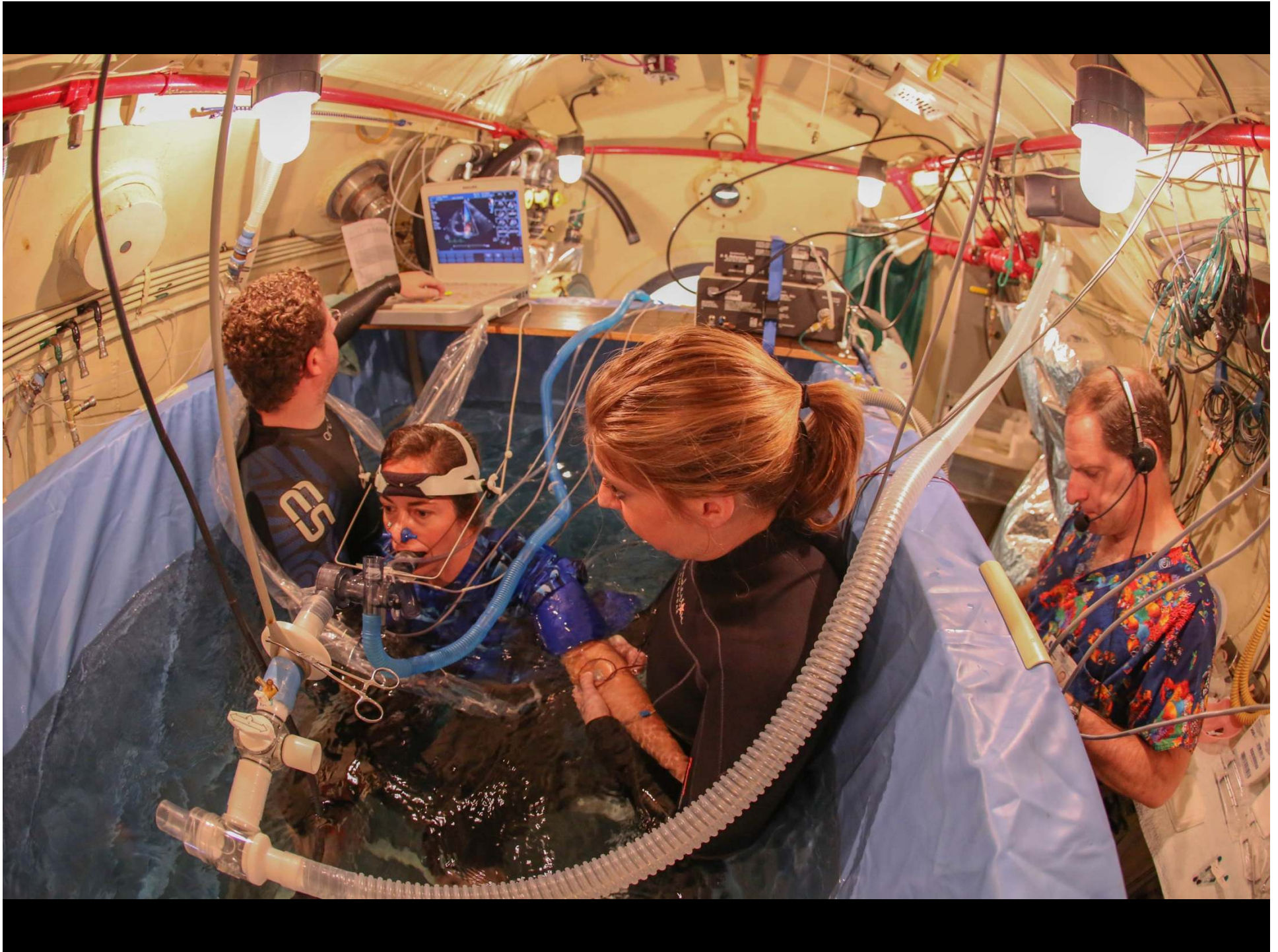
Methods

- Approval by Duke IRB, informed consent
- Volunteers with SIPE history, controls with no SIPE history
- 40 minutes of exercise head-out immersed in 20°C water, no thermal protection
- Exercise with or without 2 L Pedialyte* consumed over 30 minutes before exercise
- Lung exam, spirometry before and after exercise
- Symptoms followed up with chest radiography

*270 mOsm/kg
Na⁺, 45 mEq/L
K⁺ 20 mEq/L
Cl⁻ 35 mEq/L
Dextrose 25 gm/L

Methods

- 11 subjects with past history of SIPE studied. 8 of these re-studied after fluid load on a different day
- 43 subjects with no SIPE history studied. 5 of these re-studied after fluid load



Demographics

(N, Mean \pm SD)

	SIPE History (N=11)	No SIPE History (N=43)
Age (Y)	43.5 \pm 9.3	25.6 \pm 5.8*
Gender (M/F)	9/2	22/21*
BMI (kg/m ²)	25.0 \pm 3.6	23.5 \pm 2.6

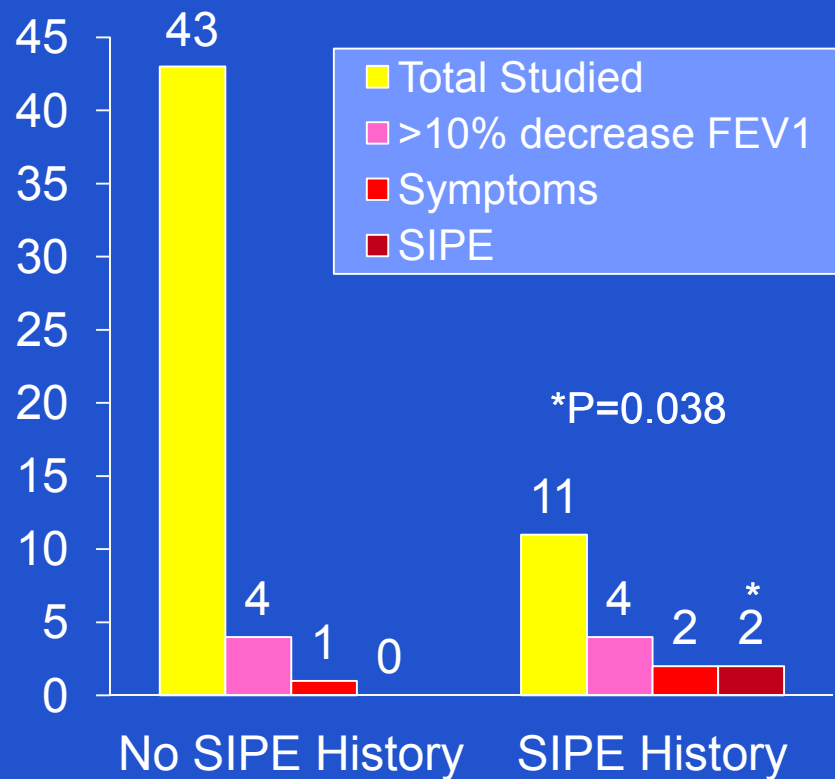
*P<0.05

Results

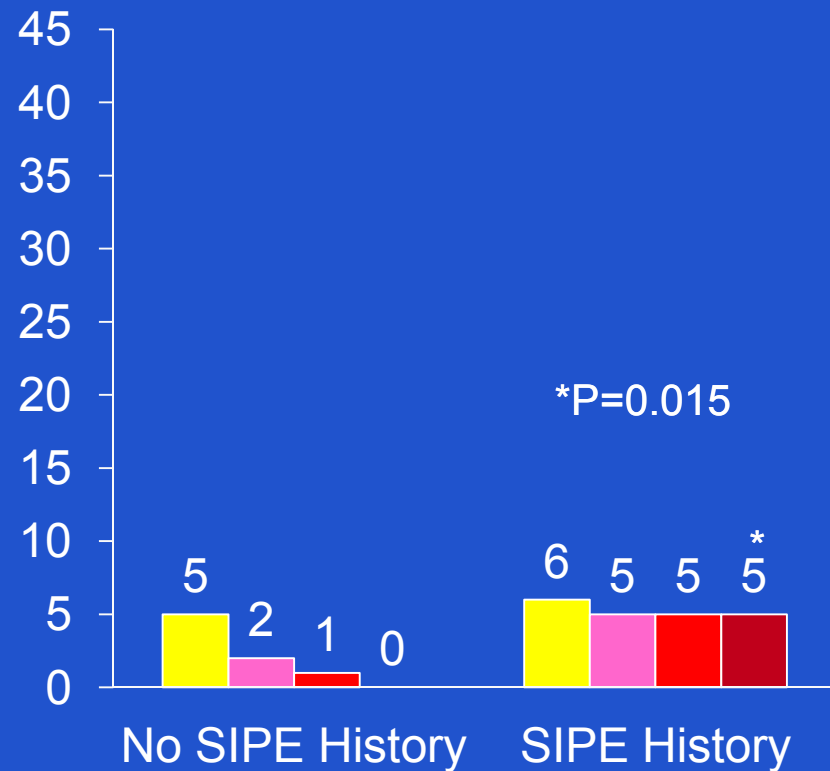
- Of 43 individuals with no SIPE history, one developed cough and reduced FVC, FEV₁ during exercise; 3 others had >10% decrease in FEV₁ post exercise but had no symptoms. Of 5 subjects studied during after the fluid load, one developed cough; one other volunteer had >10% decrease in FEV₁. None developed full SIPE and all were able to complete the 40 minute study
- Of 11 individuals with known SIPE-susceptibility, 2 developed SIPE during the control exercise; 2 others had >10% decrease in FEV₁. Of 6 who were re-studied after fluid loading, 5 developed SIPE and had >10% decrease in FEV₁

Results

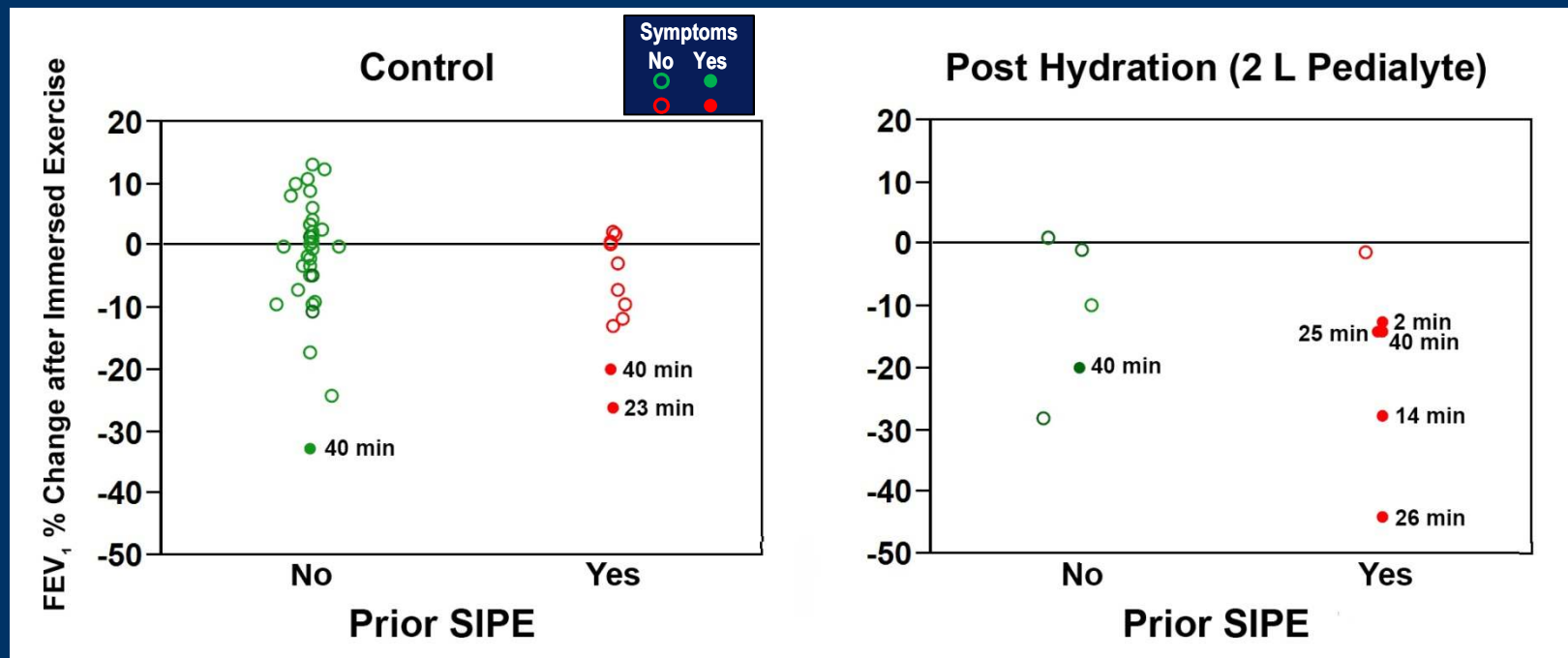
Control Exercise



Exercise after 2 L Pedialyte



Change in FEV₁ after Immersed Cold Exercise in 20°C Water



Conclusions

- Pulmonary edema can be induced in some individuals with a history of SIPE after 40 minutes of head-out immersed exercise in 20°C water
- Fluid loading with an electrolyte solution before immersed exercise increases the probability of SIPE



Bruce Derrick



Alicia Armour



Owen Doar



**Aaron
Walker**



**Dionne
Peach**



Eric Schinazi



Mike Natoli



Ivy Forkner



**Dr. Joe
Kisslo**



**Danny
Rivera**



**Anne
Cherry**

**Claire
Otteni**

**Tommy
Edwards**

**Tracy
Wester**



**Jennifer
Fraser**



**Marty
Lynch**



Jim Logan



Rick Roller



Sonny Boso



**Stefanie
Martina**



Jenna Wiley



**Dawn
Kernagis**



Shelly Pecorella



Eric Alford