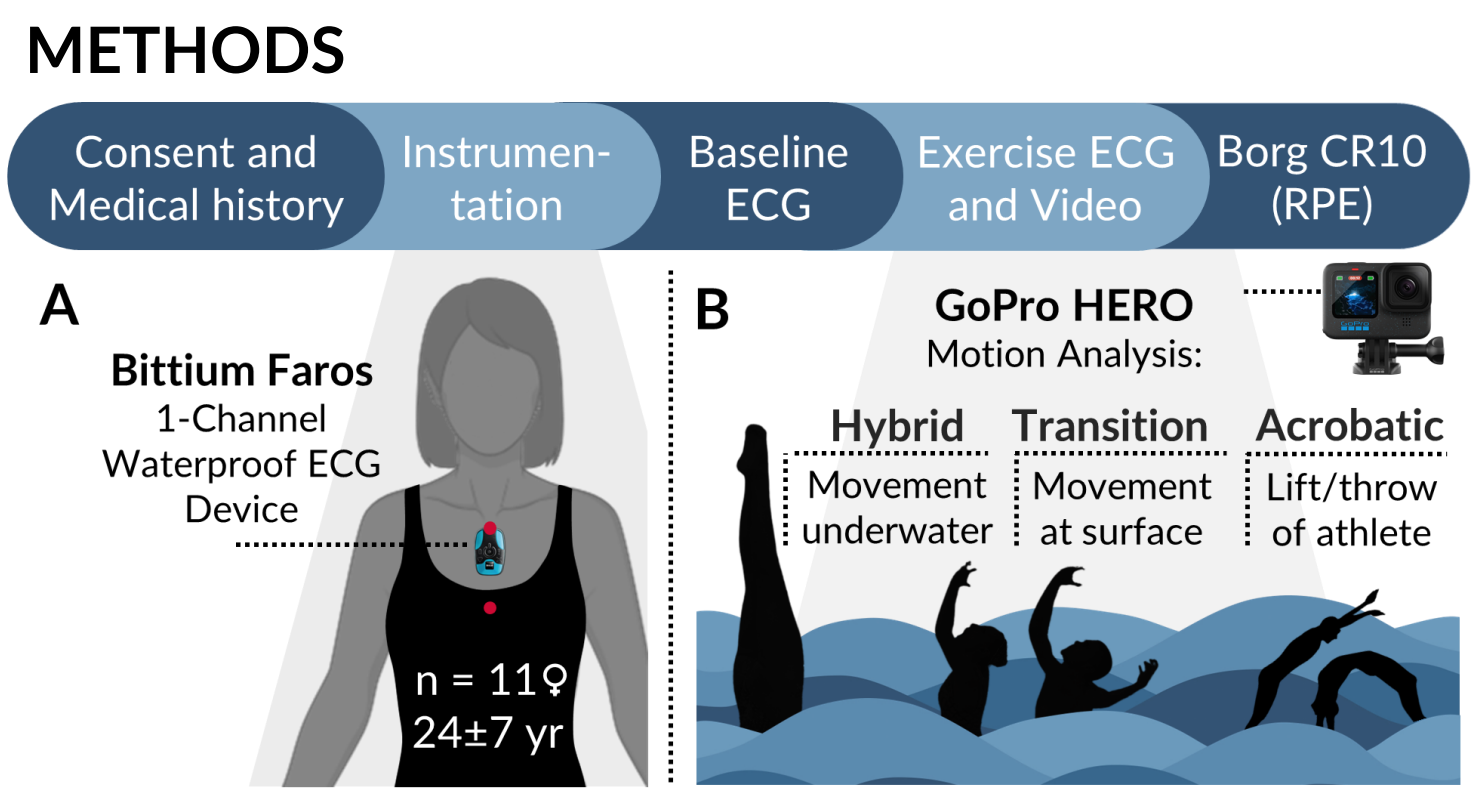


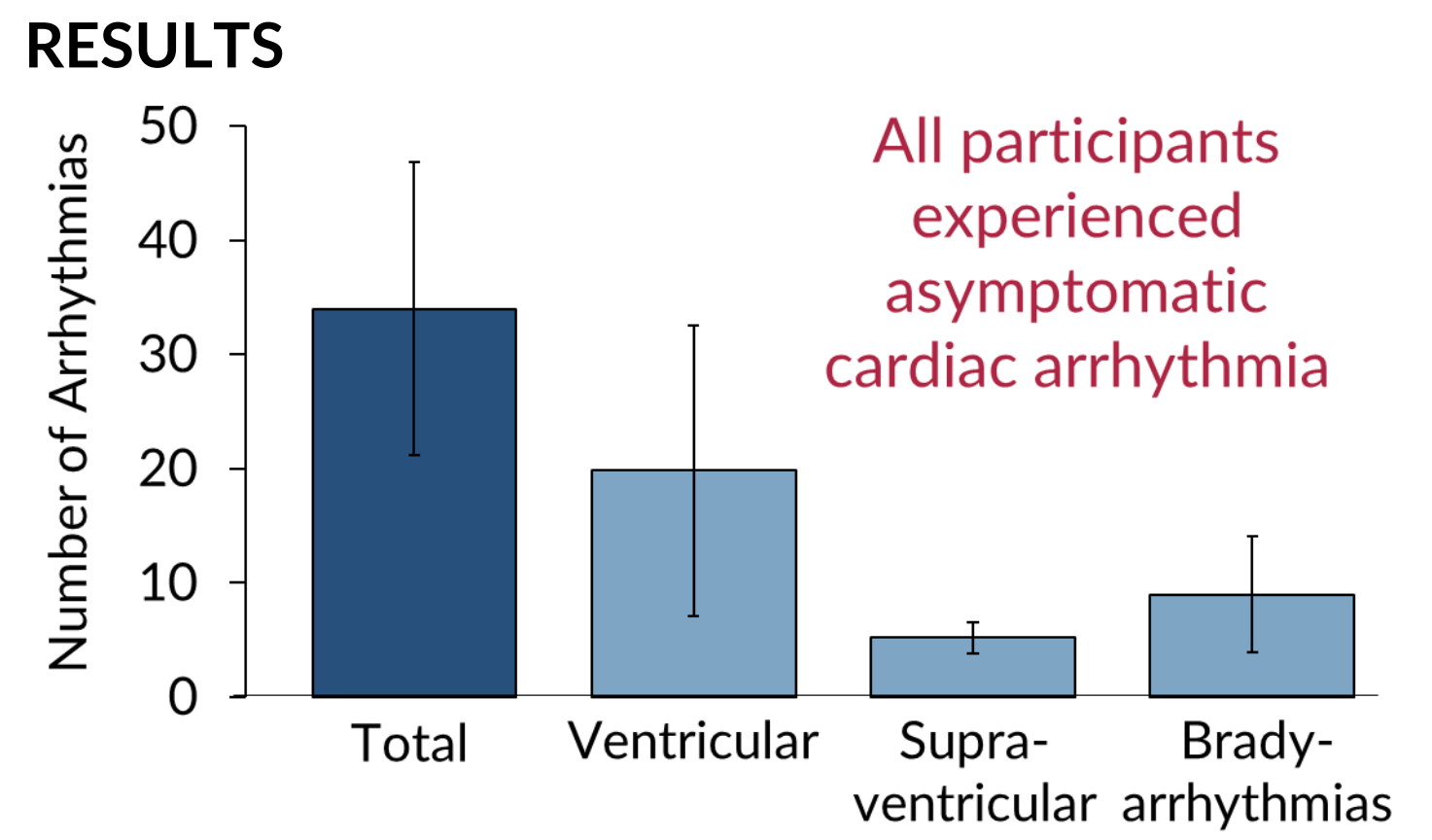
Im-perfect Sync: Autonomic Conflict and Cardiac Responses to Artistic Swimming

Christina Vassilenko, Lavisha Katyal, Dr. Erin Williams, Dr. Shubhayan Sanatani, Dr. Victoria Claydon

BACKGROUND
Unique factors in artistic swimming can provoke autonomic conflict (combined sympathetic (S) and parasympathetic (P) activation of the heart), with the potential for irregular heart beats (Figure 1). Episodes of fainting have occurred while training and competing that raise the possibility of adverse cardiac events.



Testing protocols. Participant characteristics and instrumentation with electrocardiogram (ECG) device (A). Recording setup with key exertional phases contributing to rating of perceived exertion (RPE) (B).



Arrhythmia occurrence. Mean number of arrhythmias observed from various foci experienced by participants.

DISCUSSION
Arrhythmias originated most often in the ventricles occurring as isolated monomorphic ventricular ectopics, polymorphic ventricular ectopics, ventricular couplets, and ventricular ectopics in bigeminy and trigeminy (Figure 2). Instances of supraventricular (atrial and junctional) ectopics, and bradyarrhythmias (conduction blocks and escape beats) were also noted.

High-performance artistic swimmers experience prevalent cardiac arrhythmias caused by autonomic conflict.

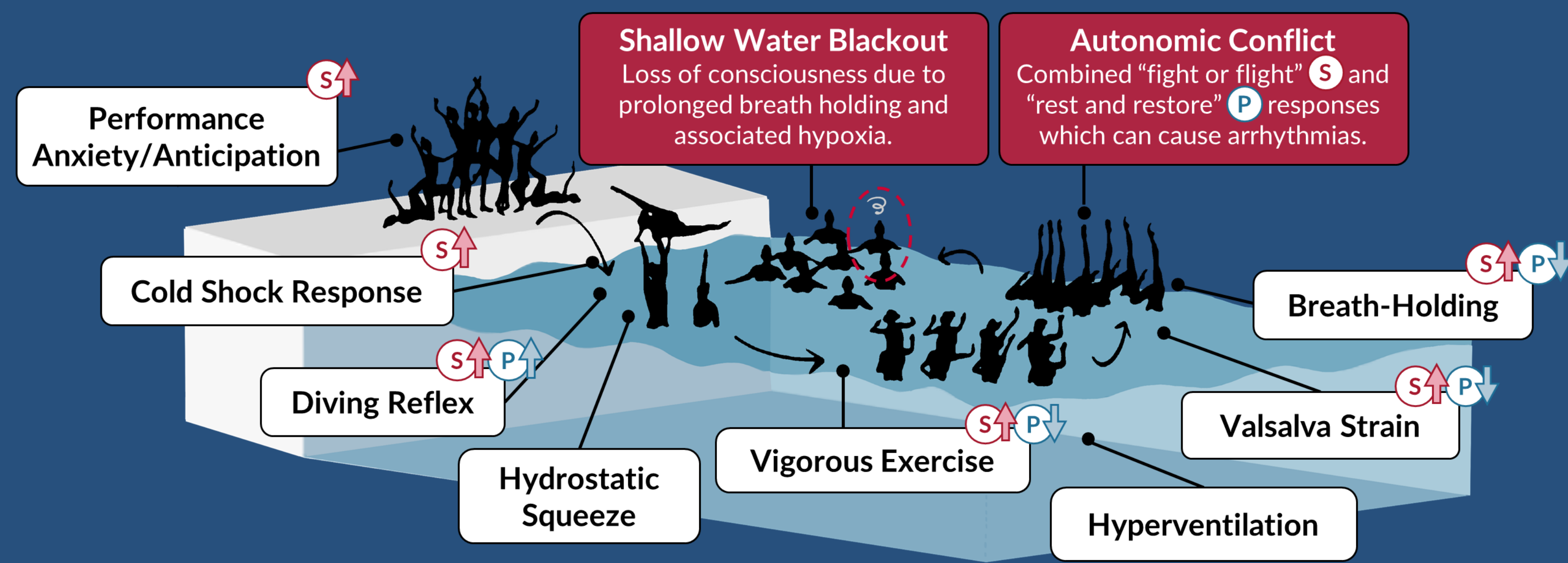


Figure 1. Physiological stressors during artistic swimming. Factors predisposing to syncope and their effects on the autonomic system. Adapted from Williams et al., 2024.

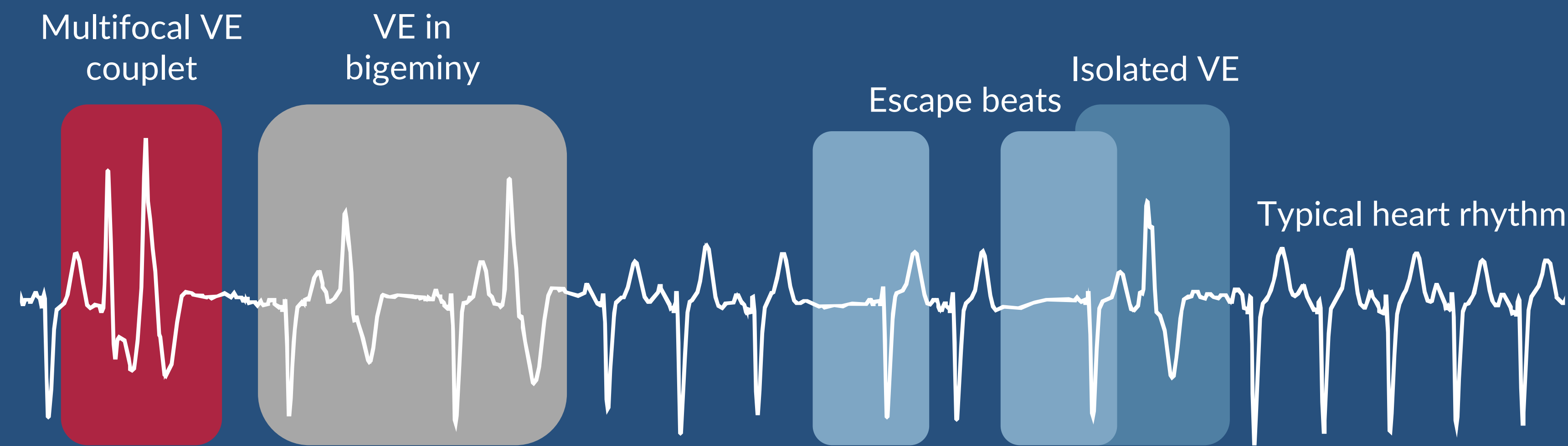
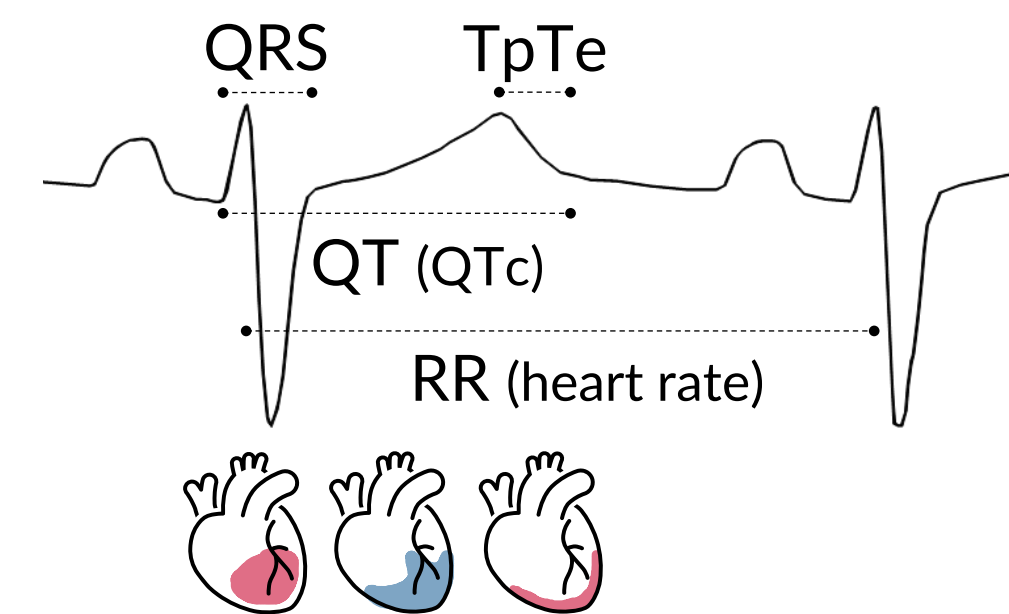
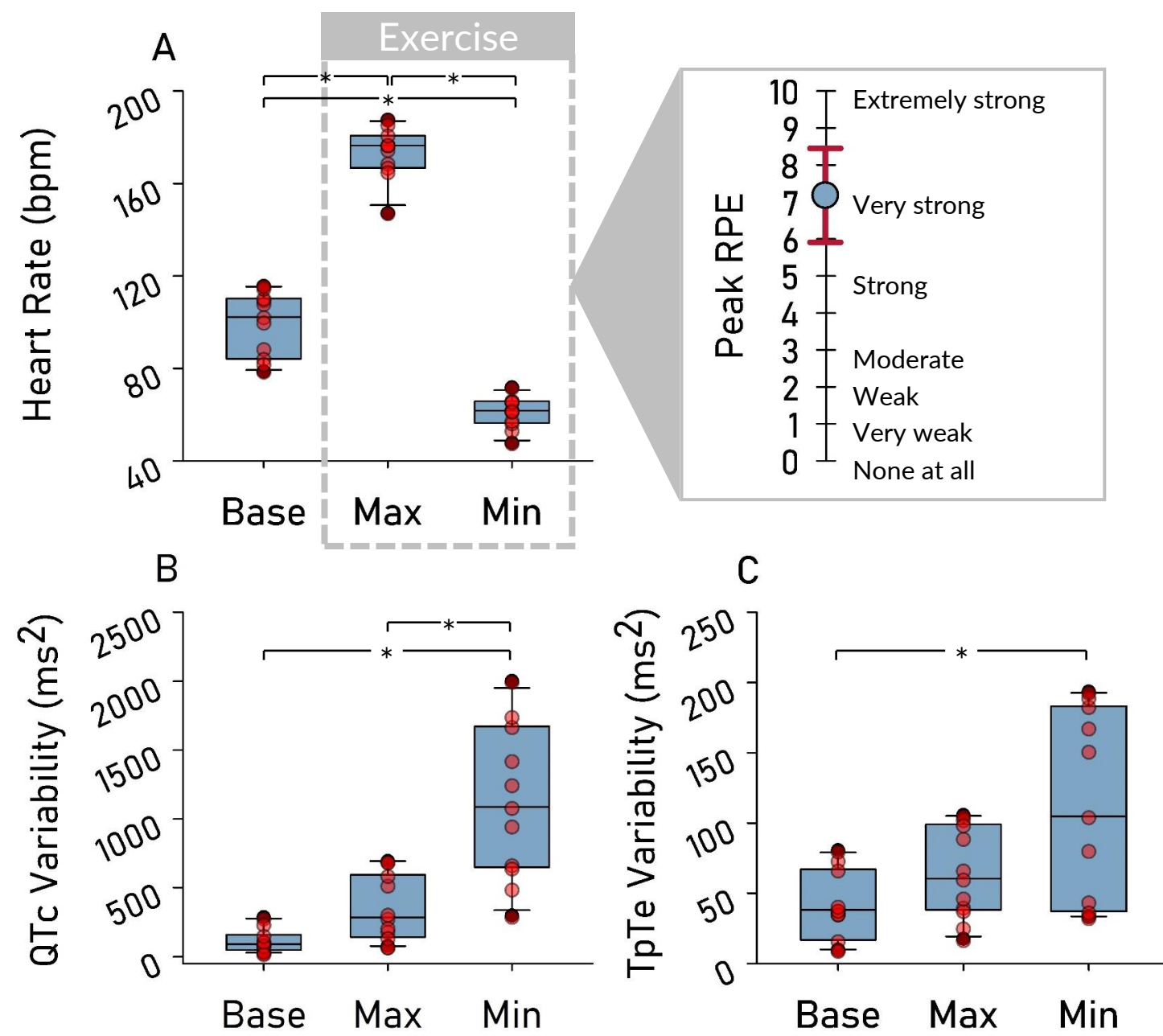


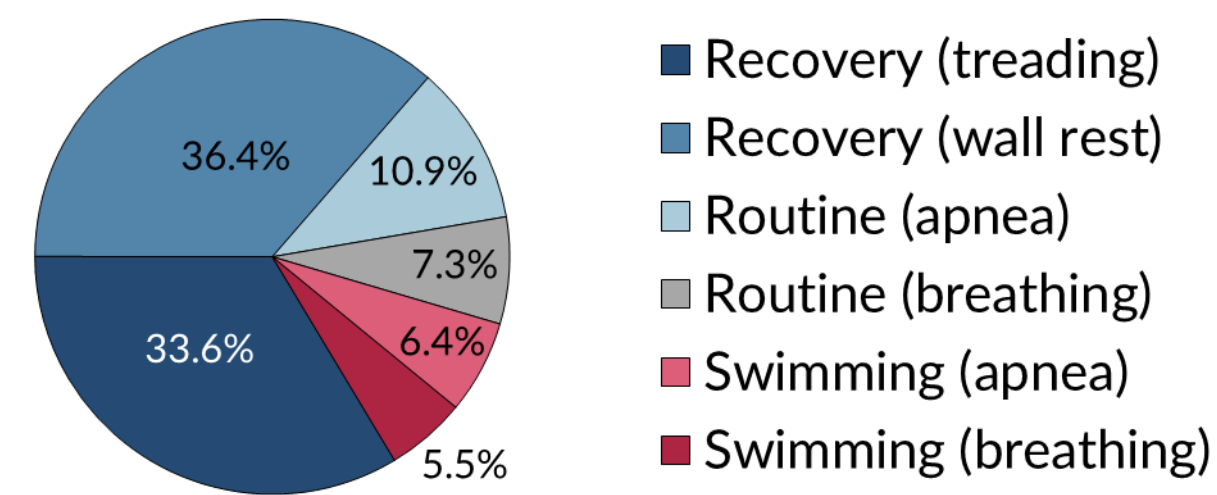
Figure 2. Example arrhythmia during artistic swimming. Participant ECG tracing depicting ventricular ectopics (VE) and inappropriate bradycardia with escape beats occurring during high exercise heart rates.



Measured ECG intervals and associated ventricular cardiac events. QTc is corrected for heart rate using the Bazett method. Pink shows depolarization (cardiac excitation) and blue shows repolarization (cardiac relaxation).



ECG and exercise parameters. Large heart rate range during exercise is indicative of autonomic conflict, with RPE confirming high athlete effort (A). Metrics of ventricular arrhythmia risk derived from QTc variability (B) and Tpeak-Tend variability (C) show increased risk at low heart rates associated with autonomic conflict. *: p<0.05



Activity during arrhythmias. Arrhythmias occur most often when athletes are at rest and recovering after exertion.

IMPLICATIONS
Cardiac arrhythmias are a normal response during artistic swimming. However, by identifying cardiac stressors during artistic swimming, this exploratory study aims to enhance athlete safety practices in this demanding aquatic discipline.

REFERENCES
Williams et al., 2024

Christina Vassilenko, cav2@sfu.ca