UNIVERSITY OF BRESCIA

PhD Program
in
TECHNOLOGY FOR HEALTH

BIOENERGETICS AND BIOMECHANICS OF BREATH-HOLD DIVING

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Background

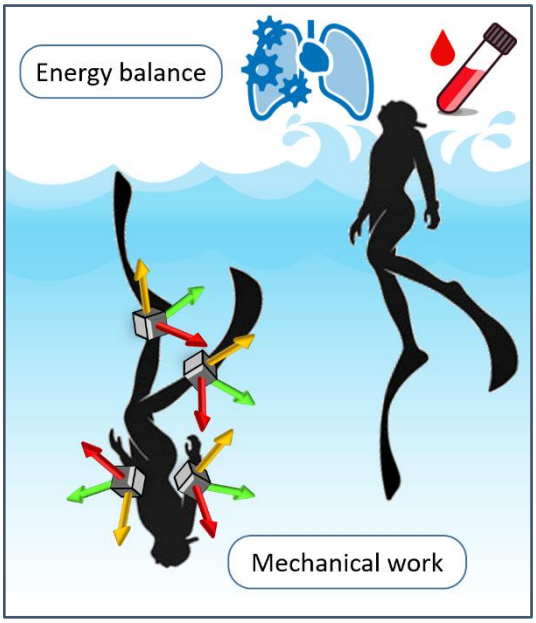
Recreational, professional and competitive breath-hold dives are associated with a well-documented risk of loss of consciousness and drowning. Prevention of these accidents is limited by lack of rigorous quantification of diver's energy stores and energy cost of breath hold diving.

Objectives

To broaden the knowledge on energy balance and biomechanics of breath-hold diving, in order to improve its safety and performance, we will study certified freediving instructors on ground and during two apnea activities: underwater swimming and deep diving.

Methodologies

On ground, we will assess whole-body O_2 stores (by non-invasive measurement of lung volumes and total hemoglobin mass). Wearable waterproof inertial sensors technology will be implemented in order to estimate mechanical power output during horizontal underwater swimming in a pool and deep diving in open sea. After emersion, time course of expired air composition, O_2 saturation, capillary blood hemoglobin and lactate will be evaluated and the different components of energy metabolism will be quantified. Repeated experiments for different distances, speeds and depths and interpretation of results in the framework of well-established biological models will provide energy cost and mechanical efficiency of horizontal underwater and deep diving.



Expected Results and Impact

The scientific advance in energetics of underwater locomotion in apnea will lead to more tailored safety recommendations about intensity and duration and possibly the development of a real-time feedback system on residual breath-hold capacity.