Reasoning of dissertation topic and competency of potential supervisor for admission onto joint LSU and TU doctoral studies in 2019

Area of research (title and code)	**Biomedicine**
Field of research (title and code)	**Physiology**
Topic of research	**Exercise physiology**
Institution	**Institute of Sport Science and Innovations**

Potential supervisor

Pedagogical and scientific degree	**Name, surname**	**Academic position**
PhD	Tomas Venckunas	Professor

Short reasoning of proposed dissertation topic

Title

The effect of High Intensity Interval Training on skeletal muscle aerobic adaptation in endurance athletes: contribution of acidosis load and concurrent aerobic training

Summary

High intensity interval training (HIIT) and its subtype sprint interval training (SIT, performed all-out) are both effective in improving overall exercise capacity, health status, and augmenting aerobic fitness in particular, and both of these types of training are extensively prescribed and practiced among athletes of most of the sports (and especially endurance type of sports) for many decades already. However, some caution among sports practitioners for the implementation of HIIT/SIT as the main training tool is often met because of widespread belief of their community that very intense training periods (mesocycles and macrocycles) or prolonged competitive season which involve repetitive elevations of intramuscular hydrogen ion concentrations (lowers pH as a result of metabolic acidosis via pronounced involvement of anaerobic glycolysis) hinders the adaptation of the peripheral (muscular) aerobic capacity because of the impaired formation and/or maintenance of mitochondrial network. While there are already some of the data supporting that this could be true indeed (via before-exercise manipulating intramuscular milieu by extraneously given acidifying or alkalying agents; Bishop et al., 2006, 2010; Edge et al., 2015), this belief still lacks solid scientific prove, especially when tested on humans, thus more in-depth investigation of the possible "side-effects" of HIIT/SIT (dependence on the type of HIIT/SIT undertaken) is required. On the other hand, continuous aerobic training is also well known to effectively increase muscular mitochondrial pool, along with improved mitochondrial function ('quality'), without any suspicions of negative effects on the aerobic capacity aspect; therefore we suggest that any possible negative side-effects of the acidotic load encountered during some types of repetitive HIIT/SIT workouts might be ameliorated or abolished by concurrently performing aerobic type of training on the other days during the HIIT/SIT training period (the practice which is currently viable in many but not all sports).

We hypothesize that the extent of the acidosis load experienced during HIIT/SIT training program will be counterproductive for the gains in aerobic capacity, that is HIIT/SIT training sessions of the same energy expenditure and similar mechanical load but smaller acidosis load would in long-term induce larger increase in aerobic power and markers of muscle mitochondria as compared with training loads with high increases in blood lactate levels as the indicator of the large contribution of anaerobic glycolysis. If it turns that the hypothesis is at least partially correct (be it total content or function/quality of mitochondria, or both affected), this may indeed warrant the revision of training paradigms for the sake to maximise aerobic capacity in both recreationally active as well as professional athletes.

The aims/objectives of the study are to assess:

1) the effects of the SIT with long versus SIT with short recovery periods on the adaptation of muscular oxidative capacity;
2) the effects of the HIIT with long versus HIIT with short recovery periods on the adaptation of muscular oxidative capacity;
3) the effects of the aerobic training (continuous exercise at moderate intensity) on the adaptation to concurrent and HIIT/SIT training with the seemingly largest metabolic stress to peripheral aerobic capacity gain ratio, as compared to HIIT/SIT training only or moderate intensity continuous exercise only.

Training (and testing) will be performed in the lab setting on treadmill and cycling ergometers (depending on the availability of endurance runners, cyclists or triathletes to volunteering for the particular study), and will be implemented to six groups (8-10 participants each) of young adult recreationally active subjects to semi-professional athletes. Each of the groups will undergo 6-8 weeks of different training interventions: 1-2) 10→20 x ~10 sec. SIT with short (30-50 sec.) or long (2-3 min.) rest intervals; 3-4) 6→12 x ~2 min. HIIT with short (30 sec.) or long (3 min.) rest intervals; 5-6) HIIT/SIT + continuous aerobic training vs. continuous aerobic training only (also compared with the HIIT/SIT group only). Before and by the end of the training interventions, percutaneous needle biopsy will be performed to analyse the mitochondrial biogenesis aspects of muscular adaptation, and aerobic power and endurance as well as anaerobic capacities will be measured with standard ergometric tests and expired gas analysis.

Please indicate the links between the proposed topic for the doctoral thesis and health promotion / physical therapy / sports study programs.

The topic is closely linked to the sports study program.

Is the proposed topic for the doctoral thesis related to currently funded research projects?

No.

Is the proposed topic for the doctoral thesis related to joint research with a foreign institution?

To some extent – either with Orebro university or Karolinska Institute (Sweden) where some analyses of the collected biopsies might be made.

Currently I am a supervisor of 1 doctoral student.

Tomas Venckunas

Supervisor _____ _____

(signature) (Name, surname)

Date 12 March 2019