

Reasoning of dissertation topic and competency of potential supervisor for admission into LSU biology doctoral studies with a participation of Tartu university 2023

Area of research (title and code)	Natural sciences, Biology (N 010)
Field of research (title and code)	Exercise physiology
Topic of research	What are the effects of different physical modalities on mental and cognitive efficiency?
Institution	Lithuanian Sports University, Institute of Sports Science & Innovations, Kaunas, Lithuania

Potential supervisor

Pedagogical and scientific degree	Name, surname	Academic position
Professor, PhD	Marius Brazaitis	Chief researcher

Short reasoning of proposed dissertation topic

Title
Effectiveness of differently structured physical activity along with calorie restriction program on cognitive efficiency and mental fatigue resistance during a simulated mental working day
Short research description (including aims and objectives) (maximum 1500 characters). Workplace sitting is a major contributor to sedentary behavior (Clemes et al., 2014). Data from various countries suggests that adults spend between 6.2 and 9.6 h per day engaging in sedentary behaviors, with a significant portion of this time spent sitting at work (Tudor-Locke et al., 2011). Engaging in continuous cognitively demanding tasks for at least 60 min (Wascher et al., 2014) or prolonged sitting for 2–7 h (Triglav et al., 2019) can lead to subjective mental fatigue (Wennberg et al., 2016) and a deterioration in cognitive function, including impacts on visual searching, problem-solving ability, and attention (Triglav et al., 2019). The full-time workday in an office setting has also been linked to decreases in arousal level and motivation, as well as negative consequences on cognitive information processing, working memory, and the ability to focus (Zhao et al., 2012). Therefore, in the present PhD project we aim to explore options for reducing fatigue during sedentary work that requires the use of cognitive resources. We hypothesize that exercise influences blood circulation in periphery and the brain by altering improved glucose and oxygen delivery to the brain during demanding mental work, and therefore, the first aim of the present project will be to investigate whether aerobic cycling exercise before and right after the mentally demanding working day influences glucose concentration along with modulation in cognitive efficiency and mental fatigue resistance. The second aim will be to investigate whether changing body position by shifting from therapeutic ball to standing position and vice versa would influence glucose concentration, cognitive efficiency, and mental fatigue resistance during mental work. Here we also aim to investigate how calorie restriction which modulates glucose availability would affect the outcomes of the present project research.
Relevance of the problem, its novelty at national and international level (maximum 1500 characters). In the modern world, skilled work is in high demand, and it is important to help workers reduce mental fatigue to improve their welfare and productivity both during and after working hours (Albulescu et al., 2022). Mental fatigue can lead to chronic stress and ultimately burnout, which can have negative physical and mental consequences on workers' well-being and health, such as insomnia, depression, hypercholesterolemia, type 2 diabetes, coronary heart disease, hospitalization due to cardiovascular disorders, musculoskeletal pain, changes in pain experiences, prolonged fatigue, headaches, and gastrointestinal issues (Salvagioni et al., 2017). Taking breaks during work, such as lunch breaks, scheduled breaks, or micro-breaks, has the potential to improve individual well-being and performance (Sonnentag et al., 2022). However, research in this area has been limited, and the effects of recovery during these shorter intervals are not yet fully understood (Sonnentag et al., 2022). Recently, we have concluded that Lithuanian hygiene standards involving regular short breaks with low physical activity during the working day do not protect against exhaustion caused by mental work. Even with short breaks, the sensation of fatigue

develops and the worker's ability to focus attention and to activate neural resources became compromised during the 7 h of mental tasks. As a result, cognitive functions such as attention, executive control, visual tracking, learning, and visual recognition (which seem to be the most susceptible to fatigue) are affected (Brazaitis and Satas, 2023). These cognitive functions do not seem to recover fully to the baseline level after a 4.5-h rest. Recent research, however, has demonstrated the potential benefits of shorter but more frequent microbreaks in improving energy levels and reducing fatigue without negatively impacting productivity (Albulescu et al., 2022). Incorporating aerobic physical activity during these breaks can also enhance the restorative effects (Blasche et al., 2018). Therefore, by investigating the effectiveness of differently structured physical activity on cognitive efficiency and mental fatigue resistance during a simulated mental working day we would be able to provide essential results for discussing prevention of exhaustion caused by mental work.

Research methods and possibilities for conducting these studies (maximum 1500 characters).

Gas analyser (Cortex or Omincal) for metabolic activity; Heart rate monitor (Polar); Velo ergometer (Lode); Therapeutic ball and table with atomized high control system; Sleep and activity monitor MotionWatch 8; Equipment (-80 or -20 fridge (Thermofisher); Centrifuge) needed for blood and saliva sampling and storing; Plate reader for blood and saliva analysis (Tecan); Body composition (Tanita); Cognition testing (ANAM4 battery); Electroencephalography (Brain Products, Gilching, Germany) and dedicate EEG room; Eye pupil tracker (Pupil core, Pupil Labs GmbH, Sanderstraße, Berlin, Germany) needed to monitor pupil diameter during the mental work. All needed equipment and facilities for a successful PhD project are available at LSU.

Is the proposed topic for the doctoral thesis related to currently funded research projects? Please indicate the links between the proposed topic for the doctoral thesis and funded research projects.

Project no. S-MIP-23-84. In this recently (start date 2023.04.01, end date 2026.04.01; funded sum 150 000 Eur.) started project we aimed to investigate the effect of calorie restriction on mental and cognitive efficiency during the mentally demanding working day, which relates directly with present PhD proposal. The grant money will be used for funding lab materials needed to perform the study.

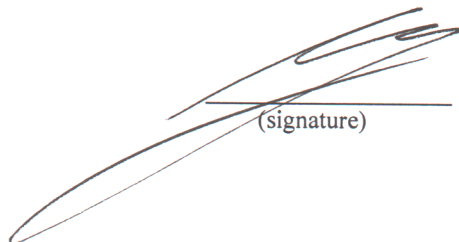
Is the proposed topic for the doctoral thesis related to joint research with a foreign institution? Please indicate the links between the proposed topic for the doctoral thesis and research with a foreign institution

The proposed doctoral project will bring together at least two major institutions Lithuanian Sports University (LSU) and Johannes Gutenberg-Universität Mainz. At LSU, the main interventions will be performed, and samples will be collected for analysis which will be partly analysed at Mainz. We will closely cooperate with Perikles Simon head of the Department of Sports Medicine, Prevention and Rehabilitation research which has a long-lasting word leading experience on investigating metabolic, psychological, and physiological outcomes in response to different physical and psychological stress condition.

Currently I am supervisor of 3 doctoral students.

Supervisor

Date 2023 04 28



(signature)

Marius Brazaitis

(Name, surname)