

## **Effects of Cognitive Fatigue Induced by the Time Load Dual-Back Task on Sustained Attention, Brain Perfusion and Oxygenation in Student Pilots**

Kanokporn Leelartapin\* Warong Lapanun\*\* Sakesan Kantha\*\*\* Dr.Hirofumi Tanaka\*\*\*\*

Dr.Daroonwan Suksom\*\*\*\*\*<sup>1</sup>

### **ABSTRACT**

Fighter pilots operate in a highly stressful environment that requires multitasking, high-cognitive demand, and gravity stress. Prolonged periods of intense and sustained activities in fighter pilot cause cognitive fatigue that leads to impairments in cognitive and physical performance. A loss of proper attention may jeopardize operational safety. We investigated cognitive and physiological alterations during experimentally-induced cognitive fatigue in student pilots. Fourteen male student pilots (25±1 years) undergoing the basic fast jet training performed attention tasks and psychomotor vigilance task before and immediately after the 16-minute Time Load Dual-back task (TloadDback), a working memory dual task in which a classic N-back working memory task and interfering second task (odd/even decision task) was individually adjusted. Individual processing capacity was assessed prior to the experiment to set the minimal time duration that student pilots could maintain task performance at >85%. After TloadDback, sustained attention, reaction-timed task as assessed by psychomotor vigilance task reaction time increased by 5.96% (p< 0.01). Frontal lobe oxygen saturation (via cerebral near-infrared spectroscopy) increased by 1.95% and 1.26% and hemoglobin index decreased by 3.31% and 1.65% during the psychomotor vigilance task in left and right frontal lobe respectively (all p< 0.05). Peak systolic flow velocity, time-averaged peak blood flow velocity, and time-averaged mean blood flow velocity (transcranial Doppler) decreased after the cognitive fatigue test. In conclusion, cognitive fatigue induced by TloadDback significantly impairs behavioral alertness and sustained attention and alters brain perfusion as assessed by cerebral blood flow velocity and cerebral regional oxygen saturation during the psychomotor vigilance task in student pilots.

**Keywords:** Mental fatigue; Military pilot; Reaction time; Cerebral blood flow; Cerebral oxygenation

<sup>1</sup> Corresponding author: Daroonwan Suksom, Ph.D., Faculty of Sports Science, Chulalongkorn University, Rama 1 Road, Wangmai, Pathumwan, Bangkok, Thailand; E-mail: Daroonwan.S@chula.ac.th

\*Student, Doctor of Philosophy in Sport and Exercise Science, Faculty of Sports Science, Chulalongkorn University, Thailand

\*\*Air Marshal, Directorate of Medical Services, Royal Thai Air Force, Thailand

\*\*\* Air Marshal, Directorate of Operations, Royal Thai Air Force, Thailand

\*\*\*\*Professor, Department of Kinesiology and Health Education, The University of Texas, Austin, USA

\*\*\*\*\*Professor, Faculty of Sports Science, Chulalongkorn University, Thailand

\*\*\*\*\*Exercise Physiology in Special Population Research Unit, Chulalongkorn University, Bangkok, Thailand