

Popular science abstract

The positive effect of physical activity on central nervous system (CNS) has been demonstrated in numerous clinical and experimental studies. Regular physical activity contributes to the improvement of mood and cognition, especially learning and memory. However, little is known about the exact mechanisms by which the skeletal muscle activity and whole body mobilization exert long-lasting beneficial changes in the CNS.

High-caloric western diet, popular in developed countries significantly increase the risk of obesity, type 2 diabetes, cardiovascular episodes, stroke and cancer. Sedentary lifestyle and resulting low exercise capacity lead to disturbances that also increase the risk of those diseases. Moreover, either the epidemiological or clinical studies indicate the frequent co-occurrence of these diseases with disturbances in CNS. Glucose is the primary energy substrate for the brain which proper functioning is completely dependent on the continuous supply of this carbohydrate. Glucose transport across the BBB depends on the specialized protein GLUT1 present in the endothelial cells of brain vessels. Studies carried out in recent years show that abnormal glucose metabolism may contribute to the development of a number of CNS disorders, among others, Alzheimer's, Parkinson's, Huntington diseases, multiple sclerosis and depression.

The exposure to chronic stress seems to have significant negative impact on the CNS functions. The activation of "stress axis" lead for example to the elevation of glucocorticosteroids level, which may influence the brain glucose metabolism. Therefore, it may be suggested that diet induced disturbances in energy metabolism may be modified by the exposure to stress. It has been proposed that regular physical activity may contribute to the development of a kind of "resistance" and ability to quickly cope with the negative effects of exposure to stress.

The aim of the planned research is to answer if and how regular aerobic physical activity affect the metabolism and transport of glucose to the brain in female rats exposed to western diet and chronic social stress. Female rats will be fed with the prepared fodder reproducing the human western diet and/or subjected to a stress induced by social instability for 8 weeks. In order to verify if regular physical activity may reduce the adverse effects caused by diet and stress, female rats will be additionally subjected to the procedure of regular physical activity for consecutive 6 weeks. Then, biochemical examinations will be carried out to assess various metabolic pathways associated with the metabolism of glucose. Measurements will be performed in the hippocampus and frontal cortex - the structures either playing an important role in cognitive processes or involved in the mechanisms engaged in the response to stress. Moreover, the potential correlation between glucose metabolism disturbances and chosen cognitive functions, measured with the appropriate behavioural tests, will be assessed.

The problem of cerebral glucose metabolism disturbances was not undertaken so far in the context of the disorders induced by an western diet, exposure to stress and low physical exercise capacity, which indicates the innovative nature of the project. The research topics of this project fit into the main public health issues of our society. The role of physical activity in the prevention and therapy of CNS diseases is still underestimated either among physicians or society. Study of the effect of physical activity on the CNS is particularly important because it may contribute to the development of new therapies based on naturally occurring protective mechanisms.