Traumatic brain injury (TBI) is one of the leading causes of mortality and disability worldwide. The high cost of the treatment and rehabilitation is a major financial burden for patients, their families and society as a whole. Moreover, the injuries resulting from falls, sport injuries, traffic accidents and miliary injuries may contribute to the development of serious neurological problems, such as neurodegenerative diseases, behavioural disorders or epilepsy. **Unfortunately, no therapies are available that may limit the post-injury changes and decrease the risk of the development of other neurological disorders.** One of the phenomena responsible for post-traumatic brain transformation is formation of glial scar, created by reactive astrocytes. The scar isolates the injury site from healthy tissue, limits the spread of inflammation and supports the restoration of disrupted blood-brain barrier. However, it was shown that glial scar can contribute to formation of aberrant neuronal circuits and promote neuronal hyperexcitability, which increases the risk of post-traumatic epilepsy development. Therefore, it is crucial to develop novel therapies that would limit the negative consequences of glial scar formation, by modulation of reactive astrocytes behaviour.

Ketogenic diet (KD) is a high-fat, low-carbohydrate diet, that induces a state of ketosis, when neurons utilize ketone bodies, produced in the liver during fatty acids oxidation, as an energy source, instead of glucose. It has been used for many years in the therapy of diabetes, obesity and drug-resistant epilepsy. It is supposed, that KD may have a beneficial effect on injured brain. Animal studies revealed that KD application decreases the volume of injury, limits neuronal degeneration and improves animals' outcomes in behavioural tests. However, the influence of KD on reactive astrocytes and glial scar formation has not been studied in details so far. The previous research of our team indicated an ability of KD to modify astrocytes morphology and metabolic activity, as well as to change the number and volume of myelinated nerve fibres. **Thus, we suppose that KD application in TBI may modulate the process of astrocytes activation and reduce deleterious effects of scar formation.**

The aim of our study is to evaluate the influence of ketogenic diet on the dynamic process of glial scar formation and other post-injury changes in rat brain, after penetrating brain injury. KD will be applied for 2, 8, 16 or 30 days after TBI induction. Histological analysis will provide insight to the effect of KD on astrocyte morphology, glial scar size and degeneration of neurons. Biochemical analysis of brain tissue will allow us to investigate the levels of proteins associated with astrocyte activation, while analysis of animal blood will provide information on the effect of KD on injury-induced inflammation. Changes in the course of nerve fibres will be examined using magnetic resonance tractography. In addition, the effect of ketone bodies supplementation on glial scar formation will be examined in cell cultures. Performing of the aforementioned analyses in both males and females will let us identify possible sex differences in the brain response to injury and assess the effectiveness of the ketogenic diet in both sexes. **We expect that our study will provide a new perspective on the process of glial scar formation and post-traumatic brain transformation, and that it will contribute to the development of novel effective therapies aimed at modulating astrocyte activity in brain injury.**