histamine. Likewise, little is known about the neural correlates underlying its pharmacological effects. Resting state functional Magnetic Resonance Imaging studies have shown that modafinil alters the functional coupling among cortical regions encompassing the default mode, dorsal attention, and frontoparietal networks, a set of brain regions whose activity modulates a wide range of cognitive domains [1,2]. Interestingly, recent evidence suggests a crucial role of the thalamus in modulating the cortico-cortical interaction, and especially of the mediodorsal and pulvinar nuclei in shaping the within- and between-network interaction of the default mode network [3]. Thus, the investigation of how modafinil shapes thalamocortical functional connectivity is a critical missing piece to understanding the relationship between the drug-induced modulation of brain networks and the cognitive enhancement. Herein, we investigated whether modafinil alters the functional thalamocortical connectivity in a nucleus-specific manner.

Methods: Data included brain scan images of forty-nine cognitively healthy subjects with no history of neurological disorders. A single dose (100 mg) of modafinil was administered in a double-blind and placebo-controlled study. Participants were divided into two groups, depending on whether they took the drug (n=25) or the placebo (n=24). The structural Magnetic Resonance Imaging data were analyzed to parcel the thalamus into its constituent nuclei based on individual anatomy. These anatomically-defined nuclei were used for a seed-based analysis to map nucleus-specific modifications of the resting-state functional Magnetic Resonance Imaging connectivity.

Results: Using anatomical images, the thalamus of each subject was parceled in fifty nuclei (twenty-five units for each hemisphere). Given that some of the nuclei were too small in size to be used as seeds in resting state functional Magnetic Resonance Imaging analysis, the parceled nuclei were merged in nine thalamic subfields: the anterior group including the anteroventral nucleus and the dorsal lateral nucleus; the mediodorsal nuclei; the sensory pulvinar complex including its anterior, inferior, and lateral nuclei; the cognitive medial pulvinar complex; the lateral geniculate nucleus; the non-specific nuclei; the ventral-anterior group; the ventrolateral regions; and ventral-posterior complex. We have found that a single dose of modafinil selectively increased the functional connectivity of the mediodorsal nuclei with the default mode, dorsal attention, and frontoparietal networks. No further change was found between the rest of thalamic subfields and the cortical networks.

Conclusions: These findings help to understand the effects of modafinil intake on thalamocortical circuits, by identifying specific thalamic nuclei acting to modulate the cortico-cortical interactions. Further investigations on effective connectivity are needed to provide more detailed information on the directionality and causal relationships of these interactions.

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FUNCTIONALLY ACTIVE PROTEINS IN SOME BRAIN AREAS AS POSSIBLE TARGETS FOR THE PREVENTION OF BRAIN DYSFUNCTIONS UNDER EXPERIMENTAL DIABETES

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Type 2 diabetes (T2D) which is initiated by insulin resistance is accompanied by a risk of brain dysfunctions development. Despite numerous studies of vitamin D role in brain functions, including neurogenesis, neurotransmission, neuroprotection, etc., its neuroprotective mechanisms under T2D are not completely understood. It was shown that cognitive decline development in T2D is associated with 25(OH)D level and vitamin D has a potential role in their prevention [1]. It is not excluded that alterations in the level of functional brain proteins induced by T2D can play a crucial role in CNS dysfunctions. The purpose of the study was to investigate vitamin D3 effect on the level of some specific proteins in different brain areas (cerebral cortex, cerebellum, hippocampus) under T2D in rats. The levels of glial fibrillary acid protein (GFAP), ionized calcium-binding adaptor molecule 1 (Iba-1), phospho-tau (p-tau), neuronal nitric oxide (nNOS), neurofilament heavy chain (phosphorylated and non-phosphorylated, pNf-H, Nf-H) were evaluated by immunoblotting followed by densitometric analysis. Results are presented as Mean ± SD. The significant difference between the means was detected by one-way ANOVA at the 0.05 significance level. All experiments were performed on T2D model induced by a high-fat diet combined with low-dose STZ injection (25 mg/kg, b.w., i.p.) in male Wistar rats (≈ 220 g, b.w.) treated 30 days with or without vitamin D3 (1000 IU/kg b.w. per os.). Diabetes development was confirmed by hyperglycemia (blood glucose level increased by 2.8-fold), insulin resistance testing, and increasing body weight compared to control. Vitamin D3 treatment of diabetic rats led to a partial decrease in glucose level, 25(OH)D content normalized in blood serum, but didn't affect body weight. Under T2D in cerebellum and cortex level of GFAP expression was increased indicating the development of reactive astrocytosis but vitamin D3 didn't affect it. T2D induced elevation of Iba1, microglia/macrophage-specific protein, level in cortex and hippocampus which was decreased by vitamin D3. In the regulation of different functions in CNS, including neurogenesis and neurodegeneration under physiological and pathological conditions, nNOS plays a very important role being responsible for the level of NO generation. It was established that nNOS level was increased in cerebellum and hippocampus in T2D, but normalizing effect of vitamin D3 was observed only in the hippocampus. P-tau level, a major microtubule-associated protein of a mature neuron, was increased in cortex and cerebellum and partially decreased by vitamin D3 in both areas. Nf-H is important for protein-protein interactions, which are regulated locally in the axon by phosphorylation. T2D led to a slight increase in pNf-H and Nf-H levels in cortex. Vitamin D3 treatment led to a lowering of pNf-H and Nf-H levels in cortex compared with the diabetic group, and in hippocampus compared with the control group. Our findings demonstrate a positive neuroprotective effect of vitamin D under T2D, which can realize via influence on investigated protein functioning suggesting that treatment by vitamin D can be used as additional therapy. However, further studies are needed to investigate the other possible mechanisms of vitamin D action under T2D.

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NEUROBIOLOGY OF OBSESSIVE-COMPULSIVE DISORDER: AN FMRI STUDY OF CHECKING COMPULSIONS

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BACKGROUND: Obsessive-compulsive disorder (OCD) is a usually chronic mental disorder characterized by obsessive thoughts and/or compulsive behaviors to varying degrees, which can sometimes be severe and disabling. Management of OCD is still often insufficient, hence the need for more precisely targeted treatments which would require a better understanding of the pathophysiology of this disorder.

Compulsions observed in OCD have been the subject of numerous investigations on the clinical, psychological, and more recently neurobiological levels. Nevertheless, the genesis of these behaviors and their pathological redundancy, as well as their cortico-subcortical correlates, have not yet been elucidated.

Current available functional neuroimaging data are essentially measured at resting state, under exposure to anxiety-provoking stimuli [1], or behavioral tasks that only target some aspects of compulsivity [2]. These data suggest the presence of functional abnormalities in the cortico-striato-thalamo-cortical circuits [3] in OCD.

Checking is one of the most common types of compulsions seen in people with OCD. In order to progress in the understanding of the neurobiological processes underlying compulsive behaviors, we propose this work based on an experimental provocation of checking compulsions and previously validated in clinical