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COMPARISON OF THE EFFECTS OF MG-THREONATE AND GINKGO BILOBA ON THE COGNITIVE FUNCTIONS OF STUDENTS.

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Introduction. In the context of rapid digitalization and increasing information flow, there has been a decline in the ability to maintain sustained attention and cognitive activity. Excessive use of social media, increased screen time, and sleep and circadian rhythm disturbances play a significant role in this. Chronic sleep deprivation and irregular daily routines are associated with impaired memory, attention, and executive functions. In addition, the constant influx of new information contributes to superficial data processing and reduced long-term memory consolidation. In this regard, improving cognitive functions, including memory, attention, and learning ability, remains a pressing task for modern clinical pharmacology and neurology. One of the areas of pharmacological correction of cognitive disorders is the use of nootropic agents. The term "nootropics" was introduced in 1964, and Piracetam was the first representative of this group. Modern ideas about the mechanisms of action of nootropic drugs include: modulation of neurotransmission (glutamatergic, cholinergic, GABAergic, etc.); effects on neuroplasticity and synaptogenesis; improvement of cerebral microcirculation and neuron metabolism; antioxidant and neuroprotective effects. The group of so-called "cognitive enhancers" includes racetams, neuroamino acids, GABA derivatives, cerebral vasoactive drugs, as well as nutraceuticals with potential nootropic effects, including magnesium L-threonate, standardized extracts of Ginkgo biloba, and L-theanine. In this study, magnesium L-threonate and standardized Ginkgo biloba extract were selected as objects of comparative analysis. These agents were chosen because of the availability of published clinical studies confirming their potential positive effect on cognitive function, as well as their relatively favorable safety profile. Magnesium L-threonate is considered a form of magnesium with an increased ability to cross the blood-brain barrier, which

potentially affects synaptic plasticity and learning processes. In addition, magnesium threonate has a number of other functions in the body, specifically:

- it is a cofactor for 300 enzymes
- regulates blood pressure
- regulates blood glucose levels
- maintains potassium and calcium levels
- regulates ATP synthesis, storage, and transport
- reduces neuronal excitotoxicity
- participates in the synthesis of proteins and fatty acids
- participates in the synthesis of B vitamins
- It promotes the activation of NKG2D receptors (which are activators of natural killer cells) on the surface of T lymphocytes and natural killer cells, which in turn has antiviral and antineoplastic effects.

In turn, Ginkgo biloba also has a number of functions on the nervous system and the body as a whole:

1. **Antioxidant neuroprotection**

Reduction of free radical formation, inhibition of lipid peroxidation, and protection of neuronal mitochondria. Confirmed in RCTs for mild cognitive impairment.

2. **Improvement of cerebral microcirculation**

Vasodilation and reduction of platelet aggregation due to antagonism to platelet activating factor (PAF). Effectiveness has been demonstrated in vascular dementia.

3. **Modulation of neurotransmitter systems**

Potentiation of cholinergic and dopaminergic transmission, enhancement of synaptic plasticity (LTP).

4. **Anti-apoptotic action**

Inhibition of the caspase cascade and stabilization of mitochondrial membranes.

5. **Reduction of excitotoxicity**

Partial regulation of NMDA receptor hyperactivation and Ca^{2+}-induced damage.

6. **Improvement of cognitive functions**

Statistically significant improvement in memory, attention, and information processing speed at doses of 120–240 mg/day for ≥8–12 weeks.

7. **Antiplatelet effect**

Blockade of PAF and reduction of platelet aggregation.

8. **Improvement in peripheral microcirculation**

Increased tissue perfusion in chronic vascular disorders.

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9. **Anti-inflammatory effect**

Reduction in pro-inflammatory cytokine levels.

It should also be noted that the drugs being compared belong to different pharmacological and biological categories: magnesium L-threonate is a synthetic compound, while Ginkgo biloba is of natural origin. Thus, the study involves not only a comparative evaluation of individual drugs, but also an analysis of the differences between synthetic and phytotherapeutic approaches to the correction of cognitive functions.

Research's goal. The aim of the study is to conduct a comparative assessment of the effects of magnesium L-threonate and standardized Ginkgo biloba extract on cognitive functions (memory, attention, executive functions) and sleep quality in students, as well as to determine the feasibility of their use for longer-term treatment.

Objectives.

1. Assess the baseline level of cognitive function, attention, memory, and sleep quality in study participants.
2. To study the dynamics of cognitive function and memory indicators against the background of magnesium L-threonate intake.
3. To study the dynamics of cognitive function and memory indicators against the background of Ginkgo biloba intake.
4. Conduct a comparative analysis of the effectiveness of the two drugs.
5. To assess the tolerability and safety of the drugs under study.

Materials and methods. The study included two groups of students aged 22-21: the first group took magnesium threonate for three months, and the second group took Ginkgo biloba. To evaluate the final effect of the drugs, a questionnaire was compiled, based on which four parameters were assessed: 1) attention and thinking; 2) memory; 3) sleep; 4) psycho-emotional background. Participants rated statements from each parameter on a point system, where 0 points meant significant deterioration; 1- slight deterioration; 2 -no change; 3 -slight improvement; and 4- significant improvement.

Main part. Students took these two nootropics for three months and assessed their effect using a specially designed questionnaire.

Two-fifths of the participants who took Mg threonate rated all statements related to memory at 3 points, which highlights the positive effect of this drug on working memory. They noted that it became slightly easier for them to remember new information, they were better at reproducing previously studied material, and it became less challenging to focus on small, more detailed pieces of information

and, accordingly, to retain them in their minds. Two other participants from the same group scored the maximum points in terms of sleep, noting that it was more simple for them to fall asleep, they woke up less often at night, and felt more rested and full of energy after sleeping. At the same time, 50% of students stated that magnesium threonate had a positive effect on their psycho-emotional state and also scored the maximum points in this section. Finally, in terms of attention/thinking, no significant changes were identified, with 80% saying they did not feel any changes related to improved attention and concentration, and 20% noting a reasonable development .

In turn, in the group of students who took Ginkgo biloba, we obtained more encouraging results from the last section mentioned. As many as three participants scored between 15 and 20 points. This tells us that the drug helps to increase focus on the given tasks, information is processed faster, and now there is more smooth and fast transition between tasks, which is one of the key and necessary aspects of a student's academic life. Also, in the "Ginkgo biloba" group, 20% of participants claimed slight improvements in sleep, while the rest alleged that everything remained the same. In the memory section, there were also no noticeable changes, with only 1/10 showing a moderate increase.

Conclusion. The results of the study showed that both drugs had a positive effect on the cognitive and psycho-emotional indicators of the subjects. At the same time, magnesium threonate was mainly associated with improved sleep quality, memory indicators, and stabilization of the psycho-emotional state. In the group receiving Ginkgo biloba, there was a more pronounced growth in concentration when performing cognitive tasks, as well as rise in the speed of information processing. The data obtained allow us to consider both drugs as potential means for optimizing the learning activities of students. However, it is advisable to choose a specific agent taking into account the priority cognitive parameters that require correction or enhancement. Considering the mechanism of action of nootropic agents and the literature data, in order to achieve a more pronounced and sustained effect, it is recommended to use them in courses lasting at least 6–12 months, followed by an assessment of their efficacy and tolerability.

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