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One-carbon Metabolism: A Key Player in the Maintenance of Cognitive Health during Aging

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Introduction

The aging process is accompanied by a myriad of changes, including alterations in cognitive function that may range from subtle decline to more pronounced deficits [1]. The maintenance of cognitive health during aging is a complex interplay of various physiological processes and emerging research has shed light on the crucial role of one-carbon metabolism in this intricate equation. One-carbon metabolism, a network of interconnected biochemical pathways, is integral to the synthesis and regulation of essential molecules such as nucleotides, amino acids and methyl groups. Its impact extends beyond basic cellular functions, influencing epigenetic modifications and contributing to the overall health of the brain. Understanding the role of one-carbon metabolism in healthy brain aging holds promise for unravelling novel therapeutic avenues and interventions to support cognitive well-being in the elderly [2].

Description

One-carbon metabolism serves as a metabolic hub in the cell, facilitating the transfer of one-carbon units between different molecular substrates. At the core of this network are folate, vitamin B12 and other related cofactors, orchestrating reactions critical for DNA synthesis, repair and methylation [3]. Methylation, in particular, plays a pivotal role in regulating gene expression and influencing various cellular processes. As the brain ages, alterations in one-carbon metabolism can impact these fundamental mechanisms, potentially contributing to cognitive decline and increasing susceptibility to neurodegenerative diseases. Folate and vitamin B12, obtained through the diet, are essential for sustaining these pathways and deficiencies in these nutrients have been implicated in age-related cognitive impairment [4]. The epigenetic influence of one-carbon metabolism on the aging brain is particularly intriguing. Methylation patterns can modulate the expression of genes associated with neuronal plasticity, neuroprotection and inflammation. Dysregulation of these epigenetic processes may contribute to the development of cognitive disorders. Additionally, one-carbon metabolism intersects with pathways related to neurotransmitter synthesis and antioxidant defense, further emphasizing its multifaceted role in maintaining cognitive health [5].

Conclusion

In conclusion, the intricate web of one-carbon metabolism emerges as a key player in the maintenance of cognitive health during aging. The delicate balance of folate, vitamin B12 and related cofactors in this metabolic network influences fundamental processes such as DNA synthesis, methylation and neurotransmitter regulation. Recognizing the impact of one-carbon metabolism on the epigenetic landscape provides valuable insights into the molecular underpinnings of cognitive aging. As research in this field advances, targeted interventions focusing on optimizing one-carbon metabolism may offer promising strategies to promote cognitive resilience and mitigate age-related cognitive decline. Acknowledging the complexity of these metabolic pathways opens avenues for further investigation, paving the way for a deeper understanding of the molecular mechanisms underlying healthy brain aging and potential avenues for therapeutic interventions.

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Conflict of Interest

There are no conflicts of interest by author.

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