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Neuroprotective effects of Iron and Melatonin Supplementation during Gestational period in wistar rat offspring: Evidence from behavioral, biochemical, and histological studies

Abstract:

Some environmental chemicals can be harmful if present at specific concentrations and under certain conditions. Growing evidence suggests that exposure to heavy metals, particularly early in life, influences an individual's development (Anesti et al., 2023). Among these substances, we find heavy metals such as iron. Iron is the second most abundant metal in the Earth's crust and is an essential trace element for cellular life, as it is a component of certain enzymes (Muckenthaler et al., 2017). It plays a crucial role in fundamental biological processes such as oxygen transport, oxidative phosphorylation and the Krebs cycle. Furthermore, it is involved in catecholamine neurotransmitter metabolism and myelination in the central nervous system, which is essential for correct nerve conduction and communication in the brain (Afzal et al., 2023; Larkin & Rao, 1990; Thirupathi & Chang, 2019). Paradoxically, iron deficiency and iron overload can cause behavioral and cognitive disorders. Iron deficiency in early stages of development can lead to long-term impairments in cognitive functions, memory and motor skills (Bakthavatchalam & Thangarajan, 2023). Additionally, iron deficiency has been linked to increased susceptibility to mood disorders and may impact the brain's ability to change and adapt, known as plasticity, as well as function. cognitive (Omar, 2023). Due to high iron requirements for various cellular functions, mammals are more susceptible to iron deficiency during development (Gundacker et al., 2023a). This can lead to abnormalities in the structure and function of organs that primarily rely on iron stores, such as the nervous system (Bakthavatchalam & Thangarajan, 2023). Iron deficiency during the fetal and neonatal periods can have lasting consequences on brain development and behavior in adulthood (Markova et al., 2019; Shah et al., 2021). Fetal and neonatal iron deficiency has been associated with increased susceptibility to several neuropsychiatric disorders in adulthood, particularly autism and schizophrenia (Gundacker et al., 2023b). Several studies suggest that iron supplementation may be a potential remedy for depression caused by iron deficiency (Aubuchon-Endsley et al., 2012; Kukuia et al., 2022). Not only iron deficiency, but also iron overload pose high and significant risks for the development and function of the nervous system (Martins et al., 2022; Rezqaoui, Boumlah, et al., 2023; Rezqaoui, Ibouzine- dine, et al, 2023; Wu et al., 2020). Iron accumulation in the brain has been documented in neurodegenerative conditions such as Alzheimer's disease (AD), contributing to cognitive, memory, and motor dysfunctions (Liang et

al., 2020). Iron exposure during the neonatal period has been shown to impair memory and influence the functioning of the ubiquitin-proteasome system, which plays a role in protein degradation and synaptic plasticity (Figueiredo et al., 2016). Disruption of iron balance in the brain can also affect neurophysiological processes, cognitive functions and social interactions, thus playing a role in the occurrence of neuropathologies (Ferreira et al., 2019). Excessive iron accumulation early in life can have lasting consequences on brain maturation and behavior in later stages of life. Melatonin supplementation administered early in life could potentially exert a prolonged impact on brain and behavioral development in adulthood. Research indicates that melatonin plays a critical role in regulating nervous system construction during the prenatal and initial postnatal growth phases (Arutjunyan et al., 2019). Scientific studies have revealed that melatonin can protect the maturing brain from damage induced by oxidative stress and inflammation, and alleviate behavioral irregularities and learning impairments triggered by hypoxia-ischemia (HI). in neonatal animal models (Carloni et al., 2008). Furthermore, studies have shown that melatonin can increase the number of proliferative cells in the hippocampus and improve cognitive functions after exposure to prenatal irradiation, implying that it can improve both brain development and behavior (Garofoli et al., 2021). To our knowledge, no studies have examined the effect of perinatal administration of iron and melatonin after supplementation during pregnancy on depression, anxiety, memory impairment, and oxidative stress in the hippocampus and the prefrontal cortex of the offspring. In light of the above, this study sought for the first time to investigate the neuroprotective effect of perinatal administration of iron and melatonin on the affective and cognitive state of adult male and female offspring from mothers exposed during pregnancy.

Biography

Ayoub Rezqaoui, a dedicated scholar from Ibn Tofail University in Morocco, embraces a passion for knowledge and innovation. With an insatiable curiosity and a commitment to academic excellence, Ayoub explores the intersections of science and technology. Fueled by a desire to make meaningful contributions to his field, he seeks to bridge gaps and push boundaries. Ayoub's journey is marked by perseverance, intellect, and a relentless pursuit of understanding.