Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/19629
DOI URL: http://dx.doi.org/10.21474/IJAR01/19629

RESEARCH ARTICLE

MALNUTRITION AND COGNITIVE DEVELOPMENTAMONG UNDER FIVE YEARS CHILDREN IN INDIA

Neelam[1] and Sukanya Chakravorty[2]

1. Research Scholar, Department of Home Science (Foods and Nutrition), Mahila Mahavidyalaya, Banaras Hindu University, Varanasi.
2. Assistant Professor, Department of Home Science (Foods and Nutrition), Mahila Mahavidyalaya, Banaras Hindu University, Varanasi.

Manuscript Info

Manuscript History
Received: 10 August 2024
Final Accepted: 14 September 2024
Published: October 2024

Key words: -
Malnutrition, Cognitive Development, Under Five Years Children, Early Childhood

Abstract

Malnutrition is a silent epidemic that is associated with structural and functional brain disease. Malnourished children have been found to have a wide range of cognitive abnormalities.Malnutrition in under five yearschildren has been linked to lower intelligence quotient, cognitive development, academic achievement, and behavioural difficulties in school-aged children compared to matched controls.The aim of this review is to give a comprehensive overview of the current knowledge on the link between malnutrition and cognitive development. A study was conducted by the secondary data including review paper, research articles, WHO report, newspaper articles and NFHS-5 report in the literature that have attempted the existing knowledge on the study. This article discusses the most important malnourished factors and its associations with cognitive functions.

Introduction:-

Malnutrition impacts cognitive development in the form of stunting and wasting among children of their full potential, having repercussions for children, countries, and the global community. Children who receive proper nutrition develop, grow, learn, play, engage, and contribute. According to Global Nutrition Report 2021,an unacceptable proportion of people are still suffering from starvation. Low birth weight affects 20.5 million newborns worldwide (14.6 percent of all live births) (**Global Nutrition Report, 2021**). There are 149.2 million stunted children under five, 45.4 million wasting children (6.7 percent), and 38.9 million overweight children (5.7 percent)**(WHO, 2021)**.If the meet its global targets (Childhood wasting,childhoodoverweight,Anaemia,Low birth weight, Breast feeding) of bringing the total number of stunted children down to 87 million by 2030 and 104 million by 2025,more aggressive measures will be required.In the meanwhile,meeting the overweight objective would necessitate reversing the existing trend**(UNICEF, 2020)**. All-India level child nutrition indicators show a minor improvement as stunting has decreased from 38 to 36 percent, wasting from 21 to 19 percent, and underweight from 36 percent **(NFHS-5)**.

Many researches includedconnection between cognitive functions and biochemical markers,have attempted to elucidate the mechanisms behind the emergence of these dysfunctions**(Kar et al., 2008)**. Malnutrition may cause a slowed rate of improvement in some but not all higher order cognitive activities with aging,as well as long – term cognitive deficits.Chronic protein energy deficit interferes with the ongoing development of higher cognitive

Corresponding Author:- Neelam
Address**:-** Research Scholar, Department of Home Science (Foods and Nutrition), Mahila Mahavidyalaya, Banaras Hindu University, Varanasi.

processes in children rather than leading to a generalized cognitive impairment. Structural malnutrition manifests as tissue damage, growth retardation, disorganized differentiation, decreased synapses and synaptic neurotransmitters, delayed myelination, and reduced overall development of dendritic arborization of the developing brain.

Future generations are impacted by the long-term cognitive effects of childhood starvation. Nevertheless, there aren't many neuroimaging studies using more recent techniques to investigate brain anatomy and function in populations with a history of childhood starvation, and the results haven't yet been linked to behavioural or cognitive outcomes. A complete picture of the impact of the childhood starvation on the brain is urgently needed, one that connects the evolution of the brain and cognition over time.This awareness will help us better identify those who are most vulnerable to neurodevelopmental issues, which will enable us to create early, focused treatments to enhance the health and well-being of those who were malnourished as children**(Galler et al., 2021)**.

Review of Literature:-

Malnutrition effects on motor activities, cognitive function,attention span,language development and physical work capacity, which has an impact on childhood performance and health. Memory issues, intellectual sluggishnessor learning problems in reading, writing, or arithmetic are all signs of cognitive abnormalities brought on by malnutrition**(Algarín, 2013)**.

Childhood malnutrition associated with environmental and social factors, including poverty, overcrowding, maternal depression, poor maternal intelligence quotient and child maltreatment, have a significant impact on cognitive, language, and socio-emotional development**(Algarín et al., 2013)**.

Problems in the structure and function of the brain are associated with malnutrition. In the developing brain, structural malnutrition manifests as tissue damage, growth retardation, disorganized differentiation, decreased synapses and synaptic neurotransmitters, delayed myelination, and reduced overall development of dendritic arborization. Delays in the brain's temporal sequences' maturity interfere with the formation of neural networks**(Rathod et al., 2016)**.

Numerous environmental elements, including nutrition, have been shown to have an impact on neurocognitive development in both humans and animals. It has been proven that nutrition has an impact on the brain throughout one's life. The methods by which nutrition affects mental health, on the other hand, are still unknown. Deficits in omega-3 fatty acids and vitamin B12 have been associated with adverse effects on synaptic plasticity and cognition. While research indicates that taking supplements of omega-3 fatty acids and vitamin B12 can reduce the risk of cognitive impairment**(Bryan et al., 2004)**.

Findings: -

Micronutrients are one of many elements that influence cognitive development as well as brain growth. Micronutrients strongly associated with improved cognitive function. Vitamin A also affects the brain. The retinoids control the differentiation of neurons and may possibly be involved in depression, sleep, memory, Parkinson's disease, and Alzheimer's disease**(Benton, 2008)**.Two main types of micronutrients required for optimal cognitive function are the water-soluble vitamins (B complex and C) and the minerals calcium, magnesium, and zinc. Vitamin B2, B6, B12, nicotinamide,folate, and vitamin C are specifically required for the metabolism of dopamine and noradrenaline within the CNS (Table no.1). B vitamins and vitamin C work together in happens during histamine breakdown and the brain's tryptophan**(Hioui, 2019)**.

Table no.1: -

Examples of how water-soluble vitamins affect the creation of neurotransmitters via influencing the metabolism of amino acids		
Ascorbic Acid	Tyrosine	• Dopamine • Noradrenaline
Thymine	Glutamic acid	• GABA (γ-aminobutyric acid)
Riboflavin	Tyrosine	• Noradrenaline • Serotonin • Benzylamine
	Tryptophan	

Nicotinamide		• 5-Hydroxytryptamine • Serotonin
Pyridoxine	Glutamic acid	• GABA tyrosine • Dopamine • Adrenaline • Noradrenaline Tryptophan • 5-Hydroxytryptamine • Serotonin Histidine • Histamine
Source- E HUSKISSON1, S MAGGINI2 AND M RUF2 1Consultant Physician, King Edward VII Hospital, London; 2Bayer Consumer Care AG, Basel, Switzerland, 2007, The Influence of Micronutrients on Cognitive Function and Performance		

Many numbers of micronutrients essential for cognitive development.Iron, zinc, and iodine are a few of them. Zinc is a necessary micromineral that contains 200 enzymes. It is also a structural component of numerous proteins, hormones, hormone receptors, and neuropeptides**(Sandstead, 2000)**. Cognitive impairment has been demonstrated to be one of the primary health effects of zinc deficiency, even if the exact role of zinc in the brain is still elusive. **(Huskisson et al., 2007)**.Micronutrient deficiencies, such as those in iron and selenium, may affect iodine status and increase the symptoms of iodine shortage. In children with goitre, iron deficiency can change how the CNS regulates thyroid metabolism and how well iodized salt and oil work to treat the condition**(Hioui, 2019)**.

Conclusion:-

The present study revealed that many more micronutrients was playing crucial role in cognitive development.Most of the researches' found malnutrition is silently affects under five years of age children. In this stage balanced diet provides nourishment to children for proper development of organs and other biochemical functions. Therefore, Child can perform very well in all achievements.The study contains major scientific research on early childhood malnutrition and its effects on brain functions and cognition, as well as issues that emerged up in studies conducted in underdeveloped nations. The findings of these searches consistently show that cognitive performance declines with age. Malnutrition throughout childhood has long-lasting impacts on cognition that affect the following generation.Chronic protein energy deficiency does not only manifest as general cognitive impairment in comparison to children who receive appropriate nourishment; it also has distinct effects on the development of cognitive processes during childhood. In addition to permanent cognitive deficiencies that do not significantly improve with age, stunting may cause delays in the development of cognitive skills. During childhood, when cognitive processes are developing at a rapid pace, protein energy deficiency has a more severe effect on the rate of attention, executive functions including cognitive flexibility, working memory, and visuospatial abilities like visual construction.

Acknowledgement:-

Extending gratitude towards Institute of Eminence, Banaras Hindu University, University Grants Commission (UGC) and DST- CURIE for their kind support to pursue this research work in terms of funding.

References:-

1. Algarín, C., Nelson, C. A., Peirano, P., Westerlund, A., Reyes, S., & Lozoff, B. (2013). Iron-deficiency anemia in infancy and poorer cognitive inhibitory control at age 10 years. Developmental Medicine and Child Neurology, 55(5), 453–458. https://doi.org/10.1111/dmcn.12118
2. Benton, D. (2008). Micronutrient status, cognition and behavioral problems in childhood. In European Journal of Nutrition (Vol. 47, Issue SUPPL.3, pp. 38–50). https://doi.org/10.1007/s00394-008-3004-9
3. Bryan, J., Osendarp, S., Hughes, D., Calvaresi, E., Baghurst, K., & Van Klinken, J. W. (2004). Nutrients for cognitive development in school-aged children. In Nutrition Reviews (Vol. 62, Issue 8, pp. 295–306). https://doi.org/10.1301/nr.2004.aug.295-306
4. Galler, J. R., Bringas-Vega, M. L., Tang, Q., Rabinowitz, A. G., Musa, K. I., Chai, W. J., Omar, H., Abdul Rahman, M. R., Abd Hamid, A. I., Abdullah, J. M., & Valdés-Sosa, P. A. (2021). Neurodevelopmental effects of childhood malnutrition: A neuroimaging perspective. NeuroImage, 231. https://doi.org/10.1016/j.neuroimage.2021.117828

5. Global Nutrition Report, (2021), The state of global nutrition - Global Nutrition Report, 2021 Global Nutrition Report | The state of global nutrition - Global Nutrition Report
6. Hioui, M. EL. (2019). The Cognitive Effects of Malnutrition. In Clinical Neuroscience & Neurological Research International Journal Editorial (Vol. 2019, Issue 2). https://chembiopublishers.com/submit-manuscript.php
7. https://doi.org/10.1093/jn/130.2.347S
8. Huskisson, E., Maggini, S., & Ruf, M. (2007). The Influence of Micronutrients on Cognitive Function and Performance. In The Journal of International Medical Research (Vol. 35). DOI: 10.1177/147323000703500101
9. Kar, B. R., Rao, S. L., & Chandramouli, B. A. (2008). Cognitive development in children with chronic protein energy malnutrition. Behavioral and Brain Functions, 4. https://doi.org/10.1186/1744-9081-4-31
10. M, E. H., AOT, A., Y, A., & S, R. (2017). The Relationship between Nutritional Status and Educational Achievements in the Rural School Children of Morocco. Journal of Neurology and Neurological Disorders, 3(1). https://doi.org/10.15744/2454-4981.3.101
11. National Family Health Survey (NFHS-5): Report. Ministry of Health and Family Welfare, Government of India, 2021. Available at: https://main.mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf
12. Popiołek, A. K., Chyrek-Tomaszewska, A., Stachowicz-Karpińska, A., Bieliński, M. K., & Borkowska, A. (2020). Biochemical parameters in cognitive functions. In Neuropsychiatric Disease and Treatment (Vol. 16, pp. 2479–2489). Dove Medical Press Ltd. https://doi.org/10.2147/NDT.S267673
13. Rathod, R., Kale, A., & Joshi, S. (2016). Novel insights into the effect of vitamin B12 and omega-3 fatty acids on brain function. In Journal of Biomedical Science (Vol. 23, Issue 1). BioMed Central Ltd. https://doi.org/10.1186/s12929-016-0241-8
14. Sandstead, H. H. (2000). Symposium: Dietary Zinc and Iron-Recent Perspectives Regarding Growth and Cognitive Development Causes of Iron and Zinc Deficiencies and Their Effects on Brain 1. In J. Nutr (Vol. 130). https://doi.org/10.1093/jn/130.2.347S
15. United Nations Children's Fund (UNICEF), World Health Organization (WHO), International Bank for Reconstruction and Development/The World Bank. Levels and trends in child malnutrition: UNICEF / WHO / World Bank Group Joint Child Malnutrition Estimates: Key findings of the 2023 edition. New York: UNICEF and WHO; 2023. CC BY-NC-SA 3.0 IGO. Available at: https://www.who.int/publications/i/item/9789240073791
16. World Health Organization, World Health Report: Malnutrition, Available at:https://www.who.int/news-room/fact-sheets/detail/malnutrition.