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ROLE OF MICRONUTRIENTS IN IMMUNOCOMPROMISED PATIENTS

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ABSTRACT :

Micronutrients are essential elements that are useful in daily life. Vitamins and minerals serve as important sources of micronutrients. Each micronutrient has a specific role in particular diseases. Their role of micronutrients in immunocompromised individuals is very important. Some trace metals such as selenium, vanadium and chromium play a crucial role in controlling blood glucose. Particularly, vitamin E, A, C, D, B₆, B₁₂. Vitamin C has very good antioxidant properties. Antioxidants may protect against cell damage in the body. Vitamin A as retinoic acid is involved in maintaining intestinal immune defence and tolerance. Vitamin E contains anti-inflammatory effects in it. Vitamin D as a micronutrient can help in reducing both systolic and diastolic blood pressure. Micronutrient deficiencies are most common among the immunocompromised patients. Moreover micronutrients with carotenoids help in the survival of AIDS patients. Micronutrients are often considered as magic wands that enable the body to produce enzymes and certain other substances for proper growth and development. Micronutrient deficiencies depend on food supply and consumption patterns. Though micronutrients are known for immune function, there is also associated disadvantage that overdose may lead to the defect. Hence this review about micronutrients in immunocompromised patients should be elaborated and clinically explained in future research.

INTRODUCTION

Micronutrients are considered as the essential components in our daily life process. Vitamins and minerals are considered as micronutrients (1). They are the essential component of a high-quality diet and have a profound impact on health too (2). Immunocompromised state is a state in which there is an absence of immunity to fight the disease (3). Vitamins play an important role in maintaining immune function in the body. Minerals help in growth, bone function and health, fluid balance and others (4,5). Though overdosage of micronutrients can lead to defects in the immune system. It is used as different variants in case of immunocompromised patients. Immunocompromised diseases include type two diabetes mellitus, AIDS, cancer and more (6). Trace metals like selenium, vanadium and chromium play a crucial role in controlling blood glucose concentration. Particularly, vitamin E, A, C, D, B₆, B₁₂(7)

Micronutrients play a major role in maintaining the tissue function. In respiratory disorders, micronutrients are very important in gaining vitamin D and helps in prevention and treatment of the diseases (8). Some research explained that micronutrients play the vital role in wound healing mainly in type 2 diabetes. They help in immune homeostasis regulation, Genome alterations. Micronutrients along with mixed carotenoids play an important role in survival of AIDS. Moreover, vitamin A and zinc as an important source of micronutrients helps in survival of AIDS (9,10). There included plasma protein carriers. Previous studies confirmed that diabetes is a micronutrient deficiency caused due to the oxidative damage. In the case of ageing, micronutrients improve their extended life expectancy. The micronutrients involved in ageing include calcium, iron, vitamin A, D, C, and B₁₂ and also in bone growth and health processes (11,12). In case of cancer, there is adequate supplementation that can also lead to DNA damage and maybe the feature of causing cancer. Fruits and vegetables can also be found around the world in preventing the risk of cancer. Role of micronutrients in malarial anaemia includes the main role in pathogenesis (13). Malnutrition in infants, children and pregnant mothers can also be a cause for this malarial anemia (14). Micronutrients play a vital role in the immune system. Moreover micronutrient deficiency may lead to defects in the immune system. Also overdosage of micronutrients containing food leads to defective immune systems (15). In the case of pregnancy, micronutrients help in influencing the health of the mother and the child. Moreover, micronutrients help in long-term health of offspring (16).

Micronutrients can be obtained from the plant sources. Micronutrients play a key for the management of type 2 diabetes mellitus(17,18). Phytochemical activity of micronutrients is effective against cancer and effective in case of lung cancer (19) Provides antihyperglycemic property (20). Selenium (21) plays a role in apoptosis and cell cycle (22,23). Also used in respiratory disorders (24) and in oxidative stress (25). Type 2 diabetes is associated with fatty liver (26,27). ZnO contains potent antioxidant properties (28,29)

Micronutrients play an important role as a part in every process of the body. In this type of review study, there included different roles of micronutrients that

are used as an important source in immunocompromised state of the patients. Though there can be better identification of particular micronutrients for particular immunocompromised states. The lacunae of this review study is to find the major role of micronutrients in different clinical aspects. Copper as the micronutrient plays a major role in haemoglobin synthesis and organ functions. Micronutrient deficiency found to include Iron deficiency, folic acid deficiency, vitamin D deficiency, Riboflavin deficiency etc.(30). The aim of this study is to analyse the role of micronutrients in immunocompromised states.

ROLE OF ZINC, BORON AND FLUORIDE

Zinc is an essential ion that plays an important role in the maintenance of the normal physiological and deficiency of the zinc has many manifestations ranging from delayed wound healing, immune dysfunction (31). Boron as a micronutrient helps in the bone growth and maintenance, CNS functions and inflammatory response. Silicon can be beneficial for wound healing and bone maintenance. Fluoride though it is not an essential element, but it is provided by contamination that benefits bone strength. Fluoride toxicity may be an important concern in parenteral nutrition (32,33).

MICRONUTRIENTS ROLE IN TYPE 2 DIABETES

Type 2 diabetes is characterised by significant loss of important micronutrients (34,35). Micronutrients play an important role in the body in type 2 diabetes. Bone health is usually very important for growth. They may also be important for immune system function. Selenium, chromium and vanadium, though important trace elements, act as micronutrients and help in controlling blood glucose concentration through their insulin mimetic effects. Various micronutrients can be restored and can be improved by restoring deficient micronutrients to the recommended levels (36). Thereby increasing their resistance to infection and helps in supporting faster recovery when it is infected. Chromium can be considered as a mineral prescribed to control diabetes mellitus. They include favourable effects on chromium supplementation for glycaemic control of patients with diabetes (37)

ROLE OF MICRONUTRIENTS IN AIDS

There are about few randomised controlled trials of multiple micronutrient supplementation in persons with AIDS. Some researchers found that micronutrient supplementation is effective in reducing the progression with the probability of 97.9 percent of cases. They can be low-cost and it is a standard of care for HIV. Micronutrients along with mixed carotenoids play an important role in the survival of AIDS. Zinc and vitamins A are the major sources of micronutrients in the survival of AIDS. Micronutrients are plasma protein carriers too (38)

MICRONUTRIENTS IN IMMUNE SYSTEM

Micronutrients play an integral role in the immune system. However, both deficiency and overdose of micronutrients can impair the immune systems. Vitamin B mainly contributes to the overall health and well-being that include energy metabolism, Methylation and and synthesis and repair of DNA and also for proper immune function. It's deficiency leads to neuro cognitive

disorders, immune dysfunction, osteoporosis and also leads to increased risk of developing degenerative disease, especially cardiovascular disease and osteoporosis (39). Immune function may be improved by restoring deficient micronutrients to recommended levels when infected. Supplementation of vitamin D may reduce this systolic and diastolic blood pressure in diabetes patients. A diverse type of diet and regular exposure to the sunlight can be the best and important sources for a balanced macronutrient supply to the body in order to maintain an immune defence mechanism (40)

ROLE IN AGING

Vitamin B Is an important micronutrient that is involved in aging. Optimisation of vitamin B status of the elderly people may prove beneficial in the prevention of degenerative disease (41). Vitamin, mineral, fatty acid intake helps the elderly population and achieve optimal diet quality and supports health and ageing. This involves judicious use of supplementation of different micronutrients (42,43). Some research depicts that oxidative stress can be damaging and contribute to the aging processes

ROLE IN CANCER

Micronutrients are essential cofactors and are important for the maintenance of normal nutritional status in case of cancer patients. Fruits and vegetables are also involved in preventing the risk of the cancer (44). Selenium is a naturally occurring element with both nutritional and toxicological properties. Highest selenium exposure and selenium supplement suggested to protect cancer . Iron is a vital trace element that acts as a micronutrient in the mammalian life. It is also involved in the DNA synthesis, cell cycle, growth, oxidative phosphorylation etc.. Moreover it is implicated in the pathogenesis of colorectal cancer (45).

MICRONUTRIENTS ROLE IN PREGNANCY

Inadequate supplementation of trace elements like iron, copper, zinc, manganese and selenium during pregnancy can lead to fetal developmental abnormalities and leads to predisposition of the child to disorders in later stages (46). Trace elements are the key elements of a complex that is responsible for antioxidant defence system modification. During pregnancy, demand for energy and micronutrients are increased. Consequences of insufficient micronutrient supply might lead to goitre , anaemia and folic acid deficiency. Micronutrients that are helpful in pregnancy include Iodine, Iron and folic acid (47). Pre-conception micronutrient interventions may approach to reduce anaemia and Iron deficiency metabolism in pregnancy. Multiple micronutrients and folic acid are recommended mostly in this as they increase the maternal and infant iron stores, but causes no anaemia (48).

CONCLUSION

Micronutrients play an important role in the maintenance of the normal physiological function.

In this review study, the importance and role of micronutrients in some of the diseases are explained. The role of micronutrients in certain immunocompromised diseases is also explored.. Though micronutrients are known for immune function, there is also associated disadvantage that

overdose may lead to the defect. Hence much more research is needed for the effects of micronutrient supplementation on immune functions and also for clinical outcomes. The differences or interaction between the trace elements can be done for the future study. The study including the role of micronutrients in immunocompromised state of the patient can be elaborated and clinically important as future research.

REFERENCE

1. Sheikh-Ali M, Mooradian AD. The role of micronutrients in managing diabetes. *Diabetes Spectr* [Internet]. 2009; Available from: <https://spectrum.diabetesjournals.org/content/22/4/214?fbclid=IwAR1R9aUcd>
2. UNICEF. *The State of the World's Children 2006: Excluded and Invisible*. UNICEF; 2005. 143 p.
3. Dropulic LK, Lederman HM. Overview of Infections in the Immunocompromised Host. *Microbiol Spectr* [Internet]. 2016 Aug;4(4). Available from: <http://dx.doi.org/10.1128/microbiolspec.DMIH2-0026-2016>
4. Chaitanya NC, Muthukrishnan A, Krishnaprasad CMS, Sanjuprasanna G, Pillay P, Mounika B. An Insight and Update on the Analgesic Properties of Vitamin C. *J Pharm Bioallied Sci*. 2018 Jul;10(3):119–25.
5. Huskisson E, Maggini S, Ruf M. The role of vitamins and minerals in energy metabolism and well-being. *J Int Med Res*. 2007 May;35(3):277–89.
6. Azoulay E, Soares M, Benoit D. Focus on immunocompromised patients. *Intensive Care Med*. 2016 Mar;42(3):463–5.
7. Panchal SK, Wanyonyi S, Brown L. Selenium, Vanadium, and Chromium as Micronutrients to Improve Metabolic Syndrome. *Curr Hypertens Rep*. 2017 Mar;19(3):10.
8. Cepeda J, Fuentes C, Zenteno D, Bustos R. Versión in press ID 747. *Rev Chil Pediatr* [Internet]. 2019; Available from: https://www.researchgate.net/profile/Raul_Bustos/publication/329104928_Vitamina_D_y_enfermedades_respiratorias_pediaticas_Vitamina_D_and_pediaticas_respiratory_diseases/links/5bf5c2db92851c6b27d16956/Vitamina-D-y-enfermedades-respiratorias-pediaticas-Vitamin-D-and-pediaticas-respiratory-diseases.pdf
9. Bosede BE, Olubayo A, John A, Adesoji F, Aduragbemi A, Ayodele I, et al. AMELIORATIVE ROLE OF ANTIOXIDANT MICRONUTRIENTS: SELENIUM, VITAMINS C AND E ON OXIDATIVE STRESS AND WOUND HEALING IN TYPE 2 DIABETIC PATIENTS WITH FOOT ULCER IN IBADAN. *IIOAB Journal* [Internet]. 2012;3(4). Available from: [https://www.iioab.org/Vol3\(4\)2012/3\(4\)1-5.pdf](https://www.iioab.org/Vol3(4)2012/3(4)1-5.pdf)
10. Van Graan AE. Nutritional management in HIV/AIDS infection. *Nutrition for the Primary Care Provider* [Internet]. 2015; Available from: <http://www.ilfattoalimentare.it/wp-content/uploads/2016/03/Nutrition-for-the-Primary-Care-Provider-nestle.pdf#page=142>
11. Espaladori MC, Maciel KF, Brito LCN de, Kawai T, Vieira LQ, Ribeiro Sobrinho AP. Experimental furcal perforation treated with mineral

- trioxide aggregate plus selenium: immune response. *Braz Oral Res.* 2018 Oct 11;32:e103.
12. Mikkelsen K, Apostolopoulos V. B Vitamins and Ageing. *Subcell Biochem.* 2018;90:451–70.
 13. Chaitanya NC, Muthukrishnan A, Babu DBG, Kumari CS, Lakshmi MA, Palat G, et al. Role of Vitamin E and Vitamin A in Oral Mucositis Induced by Cancer Chemo/Radiotherapy- A Meta-analysis. *J Clin Diagn Res.* 2017 May;11(5):ZE06–9.
 14. Shoja Z, Chenari M, Jafarpour A, Jalilvand S. Role of iron in cancer development by viruses. *Rev Med Virol.* 2019 Jul;29(4):e2045.
 15. Nussenblatt V, Semba RD. Micronutrient malnutrition and the pathogenesis of malarial anemia. *Acta Trop.* 2002 Jun;82(3):321–37.
 16. Maggini S, Pierre A, Calder PC. Immune Function and Micronutrient Requirements Change over the Life Course. *Nutrients* [Internet]. 2018 Oct 17;10(10). Available from: <http://dx.doi.org/10.3390/nu10101531>
 17. Ashwini S, Ezhilarasan D, Anitha R. Cytotoxic Effect of *Caralluma fimbriata* Against Human Colon Cancer Cells [Internet]. Vol. 9, *Pharmacognosy Journal.* 2017. p. 204–7. Available from: <http://dx.doi.org/10.5530/pj.2017.2.34>
 18. Ashwini S, Anitha R. Antihyperglycemic Activity of *Caralluma fimbriata*: An In vitro Approach. *Pharmacogn Mag.* 2017 Oct;13(Suppl 3):S499–504.
 19. Sharma P, Mehta M, Dhanjal DS, Kaur S, Gupta G, Singh H, et al. Emerging trends in the novel drug delivery approaches for the treatment of lung cancer. *Chem Biol Interact.* 2019 Aug 25;309:108720.
 20. Lakshmi T, Ezhilarasan D, Nagaich U, Vijayaragavan R. *Acacia catechu* Ethanolic Seed Extract Triggers Apoptosis of SCC-25 Cells. *Pharmacogn Mag.* 2017 Oct;13(Suppl 3):S405–11.
 21. Menon S, Ks SD, R S, S R, S VK. Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism. *Colloids Surf B Biointerfaces.* 2018 Oct 1;170:280–92.
 22. Perumalsamy H, Sankarapandian K, Veerappan K, Natarajan S, Kandaswamy N, Thangavelu L, et al. In silico and in vitro analysis of coumarin derivative induced anticancer effects by undergoing intrinsic pathway mediated apoptosis in human stomach cancer. *Phytomedicine.* 2018 Jul 15;46:119–30.
 23. Ezhilarasan D, Lakshmi T, Vijayaragavan R, Bhullar S, Rajendran R. *Acacia catechu* ethanolic bark extract induces apoptosis in human oral squamous carcinoma cells [Internet]. Vol. 8, *Journal of Advanced Pharmaceutical Technology & Research.* 2017. p. 143. Available from: http://dx.doi.org/10.4103/japtr.japtr_73_17
 24. Mehta M, Deeksha, Tewari D, Gupta G, Awasthi R, Singh H, et al. Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases. *Chem Biol Interact.* 2019 Aug 1;308:206–15.
 25. Ezhilarasan D. Oxidative stress is bane in chronic liver diseases: Clinical and experimental perspective. *Arab J Gastroenterol.* 2018 Jun;19(2):56–64.

26. Ezhilarasan D, Sokal E, Najimi M. Hepatic fibrosis: It is time to go with hepatic stellate cell-specific therapeutic targets. *Hepatobiliary Pancreat Dis Int.* 2018 Jun;17(3):192–7.
27. Gheena S, Ezhilarasan D. Syringic acid triggers reactive oxygen species-mediated cytotoxicity in HepG2 cells. *Hum Exp Toxicol.* 2019 Jun 1;38(6):694–702.
28. Rajeshkumar S, Venkat Kumar S, Ramaiah A, Agarwal H, Lakshmi T, Roopan SM. Biosynthesis of zinc oxide nanoparticles using *Mangifera indica* leaves and evaluation of their antioxidant and cytotoxic properties in lung cancer (A549) cells [Internet]. Vol. 117, *Enzyme and Microbial Technology.* 2018. p. 91–5. Available from: <http://dx.doi.org/10.1016/j.enzmictec.2018.06.009>
29. Rajeshkumar S, Agarwal H, Venkat Kumar S, Lakshmi T. Brassica oleracea Mediated Synthesis of Zinc Oxide Nanoparticles and its Antibacterial Activity against Pathogenic Bacteria [Internet]. Vol. 30, *Asian Journal of Chemistry.* 2018. p. 2711–5. Available from: <http://dx.doi.org/10.14233/ajchem.2018.21562>
30. Idris H, Elzein AM, Elxein HO. Evaluation of Zinc and Copper Levels in Sudanese Patients with Celiac disease in Red Sea State. *pjmhsonline.com* [Internet]. Available from: http://pjmhsonline.com/2019/oct_dec/pdf/1120.pdf
31. Lewicka I, Kocylowski R, Grzesiak M, Gaj Z, Oszukowski P, Suliburska J. Selected trace elements concentrations in pregnancy and their possible role—Literature review. *Ginekol Pol.* 2017;88(9):509–14.
32. Nielsen FH. Micronutrients in parenteral nutrition: boron, silicon, and fluoride. *Gastroenterology.* 2009 Nov;137(5 Suppl):S55–60.
33. Karthiga P, Rajeshkumar S, Annadurai G. Mechanism of Larvicidal Activity of Antimicrobial Silver Nanoparticles Synthesized Using *Garcinia mangostana* Bark Extract. *J Cluster Sci.* 2018 Nov 1;29(6):1233–41.
34. San Mauro-Martin I, Ruiz-León AM, Camina-Martín MA, Garicano-Vilar E, Collado-Yurrita L, Mateo-Silleras B de, et al. [Chromium supplementation in patients with type 2 diabetes and high risk of type 2 diabetes: a meta-analysis of randomized controlled trials]. *Nutr Hosp.* 2016 Feb 16;33(1):27.
35. Lakshmi T, Krishnan V, Rajendran R, Madhusudhanan N. *Azadirachta indica*: A herbal panacea in dentistry - An update. *Pharmacogn Rev.* 2015 Jan;9(17):41–4.
36. Heffernan SM, Horner K, De Vito G, Conway GE. The role of mineral and trace element supplementation in exercise and athletic performance: A systematic review. *Nutrients* [Internet]. 2019; Available from: <https://www.mdpi.com/2072-6643/11/3/696>
37. Kaur B, Henry J. Micronutrient status in type 2 diabetes: a review. *Adv Food Nutr Res.* 2014;71:55–100.
38. Forrester JE, Sztam KA. Micronutrients in HIV/AIDS: is there evidence to change the WHO 2003 recommendations? *Am J Clin Nutr.* 2011 Dec;94(6):1683S – 1689S.
39. Elmadfa I, Meyer AL. The Role of the Status of Selected Micronutrients in Shaping the Immune Function. *Endocr Metab Immune Disord Drug Targets.* 2019;19(8):1100–15.

40. Gombart AF, Pierre A, Maggini S. A Review of Micronutrients and the Immune System-Working in Harmony to Reduce the Risk of Infection. *Nutrients* [Internet]. 2020 Jan 16;12(1). Available from: <http://dx.doi.org/10.3390/nu12010236>
41. Milisav I, Ribarič S, Poljsak B. Antioxidant Vitamins and Ageing. *Subcell Biochem.* 2018;90:1–23.
42. Porter K, Hoey L, Hughes CF, Ward M, McNulty H. Causes, Consequences and Public Health Implications of Low B-Vitamin Status in Ageing. *Nutrients* [Internet]. 2016 Nov 16;8(11). Available from: <http://dx.doi.org/10.3390/nu8110725>
43. de Paula TP, Kramer CK, Viana LV, Azevedo MJ. Effects of individual micronutrients on blood pressure in patients with type 2 diabetes: a systematic review and meta-analysis of randomized clinical trials. *Sci Rep.* 2017 Jan 13;7:40751.
44. Dennert G, Zwahlen M, Brinkman M. Selenium for preventing cancer. of systematic reviews [Internet]. 2011; Available from: <https://europepmc.org/article/pmc/3692366>
45. Padmanabhan H, Brookes MJ, Iqbal T. Iron and colorectal cancer: evidence from in vitro and animal studies. *Nutr Rev.* 2015 May;73(5):308–17.
46. Nguyen PH, Young M, Gonzalez-Casanova I, Pham HQ, Nguyen H, Truong TV, et al. Impact of Preconception Micronutrient Supplementation on Anemia and Iron Status during Pregnancy and Postpartum: A Randomized Controlled Trial in Rural Vietnam. *PLoS One.* 2016 Dec 5;11(12):e0167416.
47. Mousa A, Naqash A, Lim S. Macronutrient and Micronutrient Intake during Pregnancy: An Overview of Recent Evidence. *Nutrients* [Internet]. 2019 Feb 20;11(2). Available from: <http://dx.doi.org/10.3390/nu11020443>
48. Kogan S, Sood A, Garnick MS. Zinc and Wound Healing: A Review of Zinc Physiology and Clinical Applications. *Wounds: a compendium of clinical* [Internet]. 2017; Available from: <https://europepmc.org/abstract/med/28448263>