RSSDI Indian Diabetes

EDUCATOR JOURNAL

Theme of the Month

Diabetes and Micronutrients

To keep Members Diabetes Care team abreast about
DSME /DSMS - (Diabetes Self management Education / Support) Concepts

2015 2016 2017 2018 2019 2020 2021 2022

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T2DM: Type 2 Diabetes Mellitus; **HbA1c:** Hemoglobin A1c.

1. SWITCH STUDY (*Data on file). **2.** *Diabetes Obes Metab* 2017; 19:1188-1192, Endocrine Journal 2014, 61 (12), 1163-1170.

Information

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1 st time in India
To keep the members of diabetes care team abreast with DSME and DSMS concepts

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*DSME: Diabetes Self-Management Education, DSMS: Diabetes Self-Management Support

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RSSDI Indian Diabetes
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FOREWORD

Research Society for the Study of Diabetes in India (RSSDI) founded by Prof MMS Ahuja in the year 1972 is the biggest scientific association of healthcare professionals involved in promoting diabetes education and research in India. RSSDI is happy to collaborate with USV to support their endeavour to make India the 'Diabetes care capital of the world'. Through this collaboration, RSSDI would like to strengthen the cadre of diabetes educators by empowering them with recent updates in diabetes management helping bridge the gap between the physician and the patient. Today, the rule of 50% is prevailing in terms of awareness, detection, treatment and control in T2DM.Our aspiration is to achieve 90-90-90-90 i.e.90% of people with diabetes should be made aware, 90% should be detected, 90% of those detected should be treated, and 90% of those treated should reach their goals.

Indian Diabetes Educator Journal (IDEJ) is the first of its kind in India, and the longest running monthly diabetes educator journal since April 2015 & continues its endeavour to spread awareness, knowledge and enable healthcare teams to manage individuals with diabetes and empower them for self-care. RSSDI IDEJ will continue to keep the members of diabetes care team abreast with concepts of Diabetes Self-Management Education/Support (DSME/S) with a reach of 44000 doctors and diabetes educators digitally.

Medical nutrition therapy is a cornerstone in the management of diabetes. The 'Hidden Hunger' which refers to a deficiency of micronutrients is commonly seen in people with diabetes. This month's IDEJ aims to propagate the importance of micronutrients in the pathogenesis and management of diabetes and its complications. Understanding the role of vitamins, minerals, and antioxidants in diabetes management can help diabetes educators to empower people with diabetes to be able to meet their daily requirements of these essential nutrients.

We sincerely thank our contributors for making this issue delightful reading for our readers. We dedicate this journal to all the healthcare professionals who are working relentlessly towards making "India–The Diabetes Care Capital of the World."

Sincere Regards,

Dr. Sanjay Agarwal
RSSDI Secretary

*DSME: Diabetes Self-Management Education, DSMS: Diabetes Self-Management Support

Expert Contributors
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Article: Role of Micronutrients in Prevention and Management of Diabetes

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Article: Role of Vitamin D in Type 2 Diabetes and Diabetic Kidney Disease

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Article: Prevention of Nutrient Losses from Food

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Article: Role of Micronutrients in Wound Healing in Diabetic Foot

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Article: Bioavailability of Micronutrients via the Intestinal Microbiome

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Article: Impact of Metformin on Micronutrient Status

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Article: Frequently Asked Questions

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Article: Use of Dietary Supplements for Diabetes

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Article: Role of Antioxidants in Diabetes

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Article: How to Incorporate Micronutrients in the Diet?

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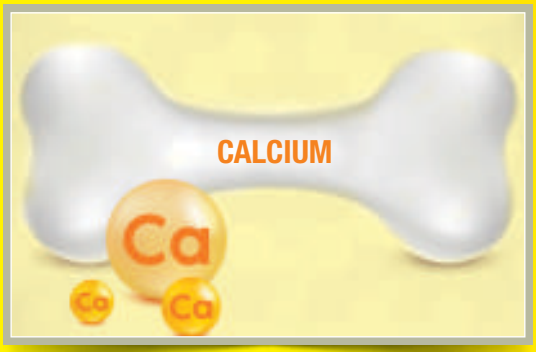
Micronutrients are vitamins and minerals required by our body in small dosages for important physiological functions crucial to maintain health. They play a central part in the body's metabolism and maintenance of tissue function and thus may be beneficial in diabetes. Though all micronutrients are essential for the human body, there are certain micronutrients that need special attention in diabetes. Some micronutrients act as cofactors in glucose metabolic pathways, pancreatic β-cell function, and the insulin signaling cascade; therefore, their deficiency may play a role in the development of type 2 diabetes.

Calcium (Ca)

Calcium homeostasis plays a role in insulin resistance and secretion. Ca homeostasis impaired in diabetes contributes to defective cell regulation in erythrocytes, platelets, and skeletal and cardiac muscles. This affects insulin secretion and action. Low Ca levels have been shown to increase the risk of metabolic syndrome and diabetes. On the other hand, some studies have found increased diabetes risk with high serum Ca levels. A complex association between Ca levels and the pathogenesis of diabetes is observed. In individuals with diabetes, uncontrolled blood glucose levels are found to be associated with low serum Ca levels. But, given the fact that Ca is important for muscle and bone health, its sufficiency must be ensured due to the increased risk of fractures and sarcopenia in individuals with diabetes.



Vitamin D (vit D)

Vitamin D insufficiency and deficiency both have been reported in individuals with diabetes. The role of vit D in insulin secretion and function comprises – the presence of vit D receptors in human pancreatic β-cells, the detection of 1-α-hydroxylase activity, and insulin gene transcription responsiveness to vit D in pancreatic β-cells. Pancreatic β-cell dysfunction is observed with vit D deficiency in animals, which is then restored with supplementation. Many epidemiologic studies have demonstrated an inverse relationship between 25-hydroxyvitamin D levels and the prevalence of type 2 diabetes. Improved

insulin sensitivity has been observed with vit D supplementation among individuals with insulin resistance. In some studies, the beneficial effect of vit D supplementation on glycemic control in individuals with diabetes has been reported while some suggest no beneficial effects. However, vit D deficiency is very common among most individuals, let alone individuals with diabetes, and its sufficiency should be evaluated in routine care.

Magnesium (Mg)

Magnesium acts as a co-factor for the movement of glucose into the cell. It is also involved in the cellular activity of insulin and carbohydrate metabolism. Hence, low Mg intake can be considered a risk factor for type 2 diabetes. Deficiency in Mg also inhibits cellular defenses against oxidation damage accelerating the progression to diabetes-related complications. Studies have shown that Mg intake reduces the risk of type 2 diabetes and metabolic syndrome by alleviation of insulin resistance. Low Mg levels are reported to be very common among individuals with type 2 diabetes. Mg is also a cofactor in the downstream actions of the insulin cascade. Given the imperative benefits, adequate Mg intake is important for both the prevention and management of type 2 diabetes.

Chromium (Cr)

Chromium is an essential trace element. Dietary Cr acts as a physiological enhancer of insulin activity and is termed a glucose tolerance factor (GTF). Cr is involved in increased insulin binding, increased insulin receptor number, and increased insulin receptor phosphorylation, significantly improving glucose metabolism in diabetes. An inverse association is also observed between serum Cr levels and HbA1c levels. Cr also improves oxidative stress secondary to hyperglycemia. Mild glucose intolerance may require only 200 mg/day of Cr supplementation whereas higher glucose intolerance may require more.

Zinc (Zn)

Zinc is another vital micronutrient needed for the processing, storage, secretion, and action of insulin in mammalian pancreatic cells and its deficiency augments cytokine-induced damage in the autoimmune attack, resulting in islet cell destruction in type 1 diabetes. It may contribute to diabetes progression through genetic polymorphisms in the Zn transporter 8 gene and in metallothionein (MT)-encoding genes associated with type 2 diabetes.

Zn reduces cytokine production and partially functions as an antioxidant and its supplementation results in the reduction of reactive oxygen species production, beneficial in diabetes mellitus. Disturbances in Zn homeostasis are associated with insulin resistance and diabetes. Diabetes is also responsible for increased urinary loss and decreases in total body Zn. A more profound effect of decreased Zn levels is found among individuals with type 2 diabetes than individuals with type 1 diabetes. More research is needed on the impact of serum Zn levels on diabetes and its complications.

While these are certain micronutrients closely associated with diabetes, other micronutrients are also important as a part of overall well-being. Including diet diversity through whole grains, a variety of vegetables, fruits, nuts, and seeds, can also contribute to adequate micronutrient intake and is also recommended as part of a lifestyle intervention in the management of diabetes.

Resources:

1. Dubey P, Thakur V, Chattopadhyay M. Role of Minerals and Trace Elements in Diabetes and Insulin Resistance. *Nutrients*. 2020;12(6):1864. Published 2020 Jun 23. doi:10.3390/nu12061864.
2. Via M. The malnutrition of obesity: micronutrient deficiencies that promote diabetes. *ISRN Endocrinol.* 2012;2012:103472. doi:10.5402/2012/103472.

Role of Vitamin D in Type 2 Diabetes and Diabetic Kidney Disease

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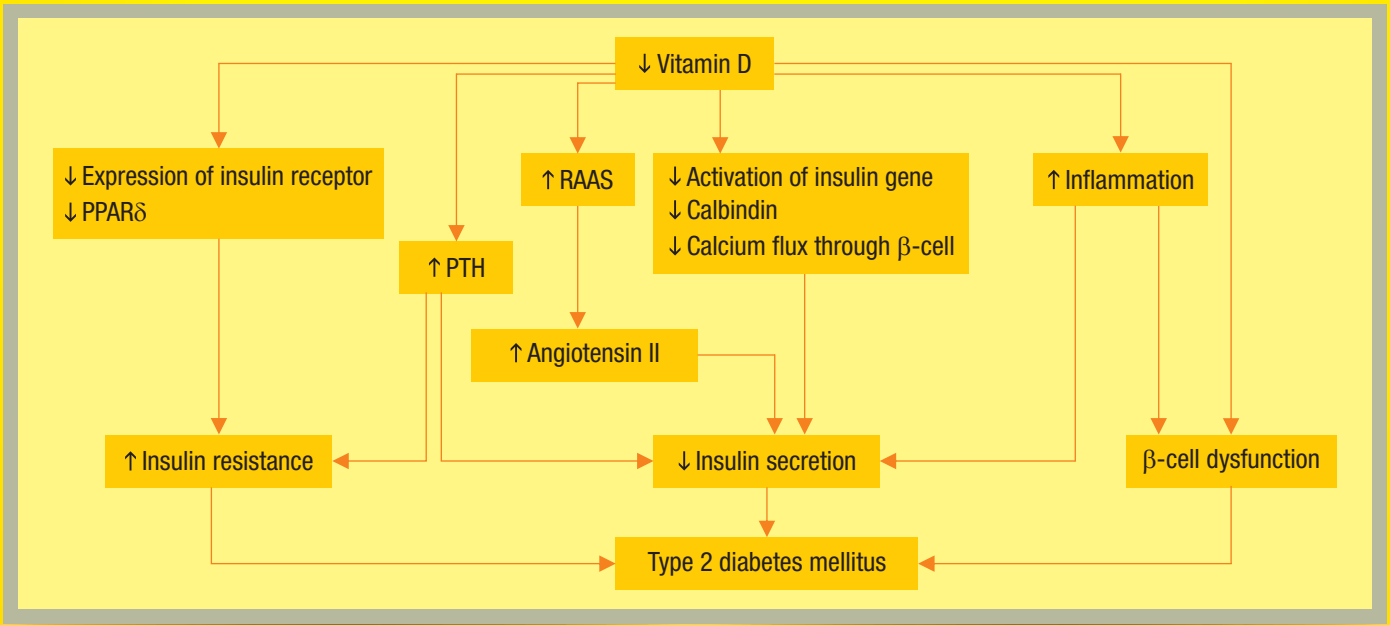
The prevalence of Diabetes mellitus (DM) and its complication of diabetic kidney disease (DKD) is on the rise. Moreover, vitamin D insufficiency is acknowledged as a global health issue. Also, hypovitaminosis D has lately been implicated in the initiation and development of DM and DKD. There is mounting evidence that people with DM or DKD frequently have an inverse vitamin D status.

Vitamin D and type 2 DM (T2DM)

Vitamin D insufficiency is linked to insulin secretion, insulin resistance, and pancreatic β-cell malfunction because vitamin D receptors in pancreatic β-cells are crucial to the development of T2DM. Through regulating the production and effects of cytokines, vitamin D administration restores glucose-stimulated insulin secretion and encourages β-cell survival. Calcium concentration and flux through β-cells have an impact on insulin secretion as well. By controlling intracellular calcium, vitamin D controls the activity of calbindin, a systolic calcium-binding protein present in pancreatic β-cells, and modulates insulin release that is induced by depolarization. Parathyroid hormone (PTH), whose level is controlled by vitamin D, is connected to the pancreas production and secretion of insulin. The expression of insulin receptors is induced by vitamin D, which also controls insulin sensitivity. Vitamin D improves insulin sensitivity by encouraging the expression of the nuclear receptor fatty acid sensor known as peroxisome proliferator-activated receptor (PPAR) delta, which is a member of the PPAR family and controls fatty acid levels in skeletal muscle



and adipose tissue. While secondary hyperparathyroidism is brought on by secondary vitamin D deficiency, elevated PTH levels are also linked to diabetes. Additionally, low levels of 1,25-dihydroxy vitamin D [1,25(OH)2D] boost renal-renin production and turn on the RAAS system. Finally, angiotensin-II hinders glucose absorption by inhibiting insulin's ability to work in vascular and skeletal muscle tissues. High levels of inflammation decrease glucose control as cytokine-induced apoptosis affects β-cells in the pancreas. By directly regulating cytokine expression and activity, vitamin D may lessen the consequences of systemic inflammation and defend against β-cell cytokine-induced apoptosis.

Vitamin D and DKD

Low levels of vitamin D turn on the RAAS system and eventually injure the renal tissues. Because the RAAS system plays a role in the etiology of DKD, it is frequently inhibited in people with T2DM. According to a recent meta-analysis, RAAS inhibitors plus active vitamin D analogs reduced proteinuria by 16% compared to traditional RAAS-blocking medication. According to multiple studies, people with DKD had considerably lower 25-hydroxyvitamin D [25(OH)D] plasma levels, which over time caused vitamin D shortage or insufficiency due to a number of causes, including (i) a decrease in the number of functioning nephrons, (ii) overexpression of 25-hydroxyvitamin D-24-hydroxylase (CYP24A1- an enzyme responsible for 25(OH)D and 1,25(OH)2D catabolism) in diabetes individuals causes enhanced degradation of the main vitamin D metabolite, (iii) the cytochrome P_{450}, family 27, subfamily B, member 1, (CYP27B1- provides instructions for production of an enzyme called 1-α-hydroxylase) activity is likely lowered as a result of elevated fibroblast growth factor-23 (bone-derived hormone suppressing phosphate reabsorption and vitamin D hormone synthesis in the kidney) levels, which also result in elevated CYP24A1 transcription, (iv) vitamin D binding proteins (megalin and cubilin) are a few of the proteins lost in urine that are crucial for maintaining vitamin D homeostasis. All of these elements contribute to impaired vitamin D homeostasis, a drop in 25(OH)D and 1,25(OH)2D levels, and secondary hyperparathyroidism.

Resources:

1. Nakashima A, Yokoyama K, Yokoo T, Urashima M. Role of vitamin D in diabetes mellitus and chronic kidney disease. *World J Diabetes*. 2016;7(5):89-100. doi:10.4239/wjd.v7.i5.89.
2. Galuška D, Pácal L, Kaňková K. Pathophysiological Implication of Vitamin D in Diabetic Kidney Disease. *Kidney Blood Press Res*. 2021;46(2):152-161. doi:10.1159/000514286.

Prevention of Nutrient Losses from Food

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Cooking is a culinary skill that enhances the flavor of food. But when food is exposed to heat, light, and oxygen during the process of food preparation, there may be certain nutrient losses. Cooking also increases the availability of some phytonutrients, decreases anti-nutrient factors, and improves digestion. Hence, to enjoy delicious and nutrient-dense food, we must master the art of smart cooking. Here are some ways in which nutrient losses can occur and some tips to prevent them.

Washing

Water soluble vitamins like Vitamin B and Vitamin C are easily lost when vegetables comprising these vitamins are soaked and the soaking water is drained away. Repeated washing of grains like rice and pulses and washing cut vegetables also leads to loss of nutrients.

Prevention

- In order to preserve the water-soluble vitamins and minerals in the vegetables, avoid soaking them beforehand.
- Wash the vegetables before chopping them.

- Whey, or the leftover water from making paneer, provides an extremely high-quality protein. It should be had or consumed either plain or with lime, salt and pepper added for flavor or whey can be added while kneading the dough for chapati.
- Soaking pulses and grains helps reduce anti-nutritional factors like phytates, tannins, and enzyme inhibitors when the water used to soak is discarded. This increases the availability and absorption value of nutrients from these foods.

Boiling

Certain vitamins are heat labile, meaning that too much heat will cause them to be destroyed. The most unstable of them are thiamine (B_1), folate, vitamin B_{12}, and vitamin C, which are all rapidly destroyed by heat. The maximum loss of these essential elements occurs during prolonged cooking, higher temperatures, baking, canning, and dehydration.

Prevention

- Cook food for the shortest amount of time necessary.
- Steer clear of repeated reheating.
- Pressure cooking and steaming are the greatest cooking techniques for retaining nutrients because they speed up the cooking process and don't require additional water.
- When boiling, add the raw vegetable after the water has reached a rolling boil.

Air

Vitamin C oxidizes when exposed to air, which is essentially oxygen. With higher cooking temperatures, longer cooking times, and chopping or mashing vegetables, oxidative losses rise. Vitamin A is also susceptible to oxidation.

Prevention

- The salads should be cut just before serving.
- To prevent exposure to air, serve salads and gravies in covered dishes.
- Avoid chopping veggies into extremely little pieces since each one will come into contact with oxygen and lose its vitamins.
- Cabbage or green leafy vegetables, if used in salads, must be steamed or blanched to lower oxalates and microbial growth.

Light

Vitamins including riboflavin (Vitamin B_2), vitamin E, and vitamin K are light sensitive, so sun drying and cooking food in light-exposed pots degrades these vitamins.

Prevention

- Keep food covered in all instances.

Alkaline medium

The cooking medium becomes alkaline when soda is added. It intensifies the color of leafy greens and speeds up cooking, but it severely depletes them of vitamins B_1, B_2, B_6, C, and K.

Prevention

- Avoid using soda when cooking. Instead, add a pinch of sugar to keep the color.

Resource:

1. Salis Sheryl. Smart Cooking. In: *Diet in Diabetes Simplified.* Vol 2. 2nd ed. Chennai, Tamil Nadu: Notion Press; 2020:85-100.

Role of Micronutrients in Wound Healing in Diabetic Foot

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Diabetic foot ulcer (DFU) is a chronic consequence of uncontrolled diabetes mellitus and a major cause of amputation and prolonged hospitalization. The majority of individuals with DFU are malnourished,

which leads to inappropriate metabolic micronutrient status causing impairment in the wound healing process. Micronutrients play an important role in the form of trace elements and vitamins and influence the course followed by the healing wound.

Role of micronutrients in wound healing

Micronutrients	Role in wound healing in DFU
Vitamin A	Vitamin A contributes to fibroplasia, angiogenesis stimulation, collagen synthesis, and epithelial differentiation and proliferation. It has a unique ability to reverse the inhibitory effects of glucocorticosteroids on wound healing.
Vitamin C	Vitamin C plays a crucial role in numerous biological processes that contribute to wound healing, including collagen production, immune system control, and cartilage and bone maintenance.
Vitamin D	Vitamin D significantly reduces the ulcer length, width, depth, and erythema rate. It also plays an important role in bone homeostasis. Moreover, it decreases wound fibrosis.
Vitamin E	Vitamin E promotes the generation of fibroblasts and keratinocytes which speeds up the closure of wounds.
Zinc	Zinc is a cofactor for several transcription factors and enzyme systems, such as zinc-dependent matrix metalloproteinase, which play a significant role in wound healing. It promotes wound healing due to its effects on insulin resistance, inflammation, and oxidative stress.
Magnesium	Magnesium plays a significant role in insulin sensitivity and glucose homeostasis. It interacts with ATP in the processing of collagen formation and is involved in protein formation and tissue development. In addition, it reduces the risk of developing DFU.
Copper	Copper is a crucial cofactor in protein synthesis and collagen formation in wound healing. Thus deficiency of copper may be a cause for impaired wound healing.
Iron	Iron is required for hydroxylation in collagen synthesis. It reduced the risk of developing DFU.

Nutrition plays an important role in the wound-healing process in an individual with DFU. Thus, adequate daily nutritional demands should be provided as part of the best standard care.

Resources:

1. Da Porto A, Miranda C, Brosolo G, Zanette G, Michelli A, Ros RD. Nutritional supplementation on wound healing in diabetic foot: What is known and what is new?. *World J Diabetes.* 2022;13(11):940-948. doi:10.4239/wjd.v13.i11.940V.
2. Pena G, Kuang B, Cowled P, *et al.* Micronutrient Status in Diabetic Patients with Foot Ulcers. *Adv Wound Care* (New Rochelle). 2020;9(1):9-15. doi:10.1089/wound.2019.0973.
3. Kulprachakarn K, Ounjaijean S, Wungrath J, Mani R, Rerkasem K. Micronutrients and Natural Compounds Status and Their Effects on Wound Healing in the Diabetic Foot Ulcer. *Int J Low Extrem Wounds.* 2017;16(4):244-250. doi:10.1177/1534734617737659.

What's Trending?
Bioavailability of Micronutrients via the Intestinal Microbiome

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Micronutrients, which include vitamins and minerals, are essential for human health and are crucial regulators of basic biosynthetic cellular reactions, including immune and energy functions, growth, bone health, fluid regulation, and other biological processes.

Micronutrient deficiency is regarded as a global health issue as it is linked to serious health issues, especially in children, who are more susceptible to pathogen infections, the development of allergies, inflammatory diseases as well as delayed physical and mental development. Numerous findings also show evidence that micronutrient deficiency may contribute to the progression of some human cancers. The human body cannot synthesize all necessary micronutrients, which thus need to be obtained exogenously from three main resources: **dietary components, oral supplements, or synthesis by commensal gut bacteria.** Therefore, food fortification programs and oral supplementation of micronutrients have been carried out in most countries.

Micronutrient bioavailability is the fraction of a micronutrient that is available to the body for use and storage. Micronutrients are absorbed through a variety of pathways some of which are specific and can be both active or passive. For example, the absorption of vitamins A and D takes place by passive diffusion in the small intestine, whereas the absorption of vitamins C and B_7 (biotin) is mediated by Na^+-dependent carriers.

Micronutrients and gut microbiota

The gut microbiome is the community of trillions of microorganisms living in the gastrointestinal tract, that is known to interact with dietary substances in a bidirectional manner, affecting both their composition and functional structure as well as their metabolism and absorption, which in turn affects their bioavailability. Micronutrients, in particular, can influence the diversity and makeup of the gut microbiome, having either positive or negative effects on the host's health. Contrarily, commensal bacteria in the human gut have the ability to affect nutrient absorption and produce vital vitamins (such as vitamin K and biotin, among others), possibly having a significant impact on the micronutrient status.

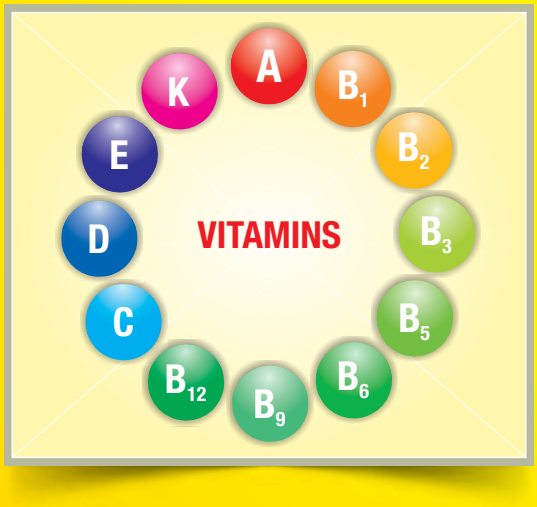
Micronutrients-gut microbiota interaction

The micronutrient and microbiome relationship is a two-way interaction. On the one hand, micronutrients are consumed by gut microbes for nutrition and functioning. On the other hand, the gut microbiota facilitates the uptake and absorption of minerals like iron and calcium and generates substantial amounts of a variety of vitamins, particularly vitamin K and B group vitamins.

Mineral metabolism and intestinal microbiome

The gut microbiota has an impact on how minerals are metabolized. This includes (i) directly affecting mineral absorption in the gastrointestinal tract during digestion and (ii) producing a variety of enzymes that are only produced by colonic microbes and assist in releasing minerals from foods. Two studies revealed similar findings of a unique beneficial role for a molecule produced by bacteria *C. elegans* in promoting the host's iron homeostasis, bringing a surprising benefit from commensal bacteria to the host. The dynamic link between the gut microbiota and mineral bioavailability is clearly demonstrated in bone health. Vitamin D-regulated calcium-binding proteins, such as calbindin D9k, can help increase calcium active absorption in part. However, under conditions of low calcium intake, microbiota plays a significant role in calcium bioavailability. Asemi *et al.* (2013) found that pregnant women who consumed probiotic yogurt with *Bifidobacterium lactis* and *Lactobacillus acidophilus* maintained serum calcium levels better than those who consumed conventional yogurt. Many studies also show that microbiota may control bone loss via a variety of mechanisms, including micronutrient bioavailability, in addition, several other studies show the microbiota's significance in preventing bone loss.

Vitamins metabolism and intestinal microbiome



Some bacterial genera normally adapted to the human gastrointestinal tract environment, including *Bifidobacterium*, *Bacteroides*, and *Enterococcus*, are well-known to biosynthesize water-soluble B vitamins and vitamin K. Magnúsdóttir *et al.* (2015) systematically evaluated the in silico (experiments performed by computer) biosynthetic capability of common human gut bacteria for the production of eight B vitamins and demonstrated that the studied gut microbes produced 40-65% of each of those vitamins. Recent clinical trials and *in vivo* research have explained the function of the microbiota in the host's vitamin balance. For example, several members of the bacterial phylum firmicutes identified using 16S ribosomal RNA sequencing of human stool samples, such as clostridia class, clostridia order, and part of the *Ruminococcacus*, *Coprococcus, Mogibacterium, and Blautia*

genera, were positively correlated with the vitamin D levels in serum. In a human cohort, butyrate-producing bacteria were associated with increased expression of the vitamin D receptor protein.

The gut microbiome can variously impact the bioavailability of micronutrients as well as be affected by micronutrient supplementation, thereby impacting health even in the long run. Although several mechanisms have been proposed, a thorough study of the microbiome-micronutrient two-way association is significant, as it can shed light on the design of microbiome-based precision intervention strategies aimed at enhancing overall health and micronutrient status.

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Impact of Metformin on Micronutrient Status

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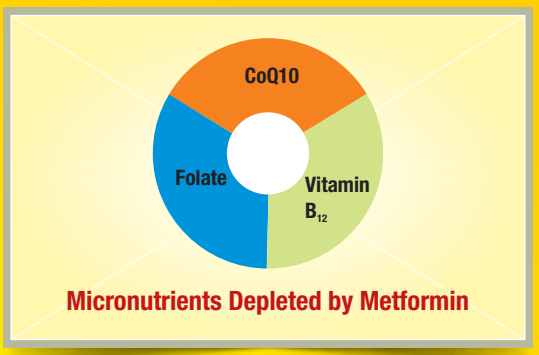
Metformin is typically one of the first-line medications for type 2 diabetes mellitus (T2DM), which has a good safety profile and is efficient and affordable. There is plenty of evidence, that the usage of metformin is associated with vitamin B_{12} deficiency. Prolonged use of metformin may have an adverse effect on the levels of the other micronutrients too such as vitamins B_1, D, folic acid, and magnesium in addition to upsetting the microbiome.

Nutrients	Mechanisms that result in metformin-induced deficiency of nutrients
Vitamin B_1 (Thiamine)	Prevents the body from absorbing thiamine by blocking the human thiamine transporter in the small intestine.
Folic acid	Folate is an essential co-factor in the conversion of homocysteine (Hcy) to methionine and plays a role in the purine base synthesis of DNA. Patients with T2DM who use metformin have been reported to have lower levels of folate and vitamin B_{12}, which normally cause a slight increase in Hcy and an increased cardiovascular disease risk.
Vitamin B_{12} (Cobalamin)	Changes in the motility of the small bowel might stimulate bacterial overgrowth. Alterations in levels of intrinsic factor (IF) that cause inactivation or competitive inhibition in the absorption of vitamin B_{12}. According to research, metformin lowers the body's stores of chromium and calcium. The uptake of vitamin B_{12} relies on calcium availability in the body. Calcium-associated vitamin B_{12}-IF complex absorption is inhibited in the terminal ileum.
Magnesium	The Mg^{2+} (re)absorption in the intestine and kidney is fine-tuned by the TRPM6 channel. TRPM6 gene expression is reduced in kidney and intestinal cells after long-term metformin use.

Moreover, it has been demonstrated that metformin decreases the body's coenzyme Q10 (CoQ10) levels, raising the risk of heart problems. Given that people with T2DM are already likely to have suboptimal levels of these micronutrients and that these deficiencies are varyingly linked to diabetic complications like impaired endothelial, microvascular, vascular, and neurological function, it may be appropriate to think about supplementation when necessary to lessen these side effects of metformin. The researchers advise that metformin-using individuals with T2DM get vitamin B_{12} concentrations tested at least annually.



Micronutrients Depleted by Metformin

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Frequently Asked Questions

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1. I am a 59-year-old, and I have been living with diabetes for the past 15 years. Lately, I have started developing symptoms of numbness and tingling sensation in my extremities. I am told these are early signs of diabetic neuropathy. Is there any way that I can lessen the symptoms through diet?

Ans. The term "neuropathy" is used to describe a number of disorders that affect the nerves. Long-standing diabetes often results in neuropathy. B vitamins are renowned for their ability to assist normal nervous system functioning. It has been observed through studies that the vitamins B_1, B_6, and B_{12} are particularly helpful for managing neuropathy. Thiamine (vitamin B_1) is essential for the regeneration of nerves because it helps nerve cells use carbohydrates for energy and defend them from oxidative stress, which normalizes pain perception and lowers hyperexcitability. Pyridoxine (vitamin B_6) protects the sheath that surrounds nerve terminals. It is also essential for the production of neurotransmitters because it prevents the release of neurotoxic glutamate and restores the function of sensory nerves. Cobalamin (vitamin B_{12}) significantly and actively contributes to remyelination and the upkeep of myelin sheaths, which in turn greatly enhances nerve cell survival. Studies have proven that a vitamin B_{12} deficiency can lead to neuropathy. Metformin use can also lead to vitamin B_{12} deficiency. Common food sources of vitamin B are – eggs, seafood, whole grain cereals, legumes, green leafy vegetables, low-fat dairy products, mushrooms, nuts, and seeds.

2. My 26-year-old son is overweight and has been recently diagnosed with prediabetes. I am taking a lot of efforts to manage his diet and lifestyle to avoid progression to diabetes. Being a working woman, I use microwaves sometimes to cook and reheat food. Is this going to be harmful to my son? Will microwave cooking destroy the nutrients in the food?

Ans. The use of microwaves for cooking or reheating is quite common and is fast and convenient. However, a lot of people worry about its side effects and its negative impact on the nutritional value of food. But the fact is that all cooking methods reduce the nutrient value to some extent and microwave cooking does not do more harm than any other traditional cooking way. Some studies even show that microwaves generally preserve nutrients better. This is because the best cooking method to preserve nutrient value is one that cooks quickly, with the shortest amount of time and the use of liquid. Microwaving meets these criteria. Also, microwaves are generally safe because they use electromagnetic waves to heat the food up. The only precaution you must take for safety is to use only microwave-safe containers and keep the microwave in good condition. Overall, it is safe, effective, and convenient to use the microwave.

3. I am a 32-year-old woman. My husband has had diabetes for the last 3 years. I give him a bowl of moong sprouts as an evening snack. Does sprouting have any additional benefits in terms of nutritional value?

Ans. The process of sprouting has a myriad of health benefits. Sprouting makes digestion easier. Germination promotes the release of enzymes that help predigest starch and improve digestion. Sprouted grains and legumes have a higher concentration of vitamin C, B vitamins, and antioxidants. The bioavailability of vitamins and minerals is also better in sprouted grains, as the process of sprouting helps to release enzymes that break down antinutritional factors like phytates, which otherwise bind with minerals and vitamins and make them unavailable for absorption. Sprouting also reduces cooking time, so the automatic retention of nutrients is better. So overall, they are a powerhouse of nutrition.

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Abridged Prescribing Information

Indication: It is indicated as an adjunct to diet and exercise to improve glycaemic control in adults with type 2 diabetes mellitus.
Dosage and Administration: The recommended dose is one tablet daily. Each tablet contains a fixed dose of dapagliflozin, Sitagliptin and Metformin Hydrochloride.
Adverse Reactions: Most common adverse reactions reported are: Dapagliflozin- Female genital mycotic infections, nasopharyngitis, and urinary tract infections. Sitagliptin- Upper respiratory tract infection, nasopharyngitis and headache. Metformin- Diarrhea, nausea/vomiting, flatulence, asthenia, indigestion, abdominal discomfort, and headache.
Warnings and Precautions: Dapagliflozin: Volume depletion; Ketoacidosis in Patients with Diabetes Mellitus; Urosepsis and Pyelonephritis; Hypoglycaemia; Genital Mycotic infections
Sitagliptin: General- Sitagliptin should not be used in patients with type 1 diabetes or for the treatment of diabetic ketoacidosis. Acute pancreatitis: Hypoglycaemia when used in combination with other anti-hyperglycaemic medicinal product; Renal impairment; Hypersensitivity reactions including anaphylaxis, angioedema, and exfoliative skin conditions- Stevens-Johnson syndrome; Bullous pemphigoid. Metformin Hydrochloride: Lactic acidosis; In case of dehydration (severe diarrhoea or vomiting, fever or reduced fluid intake), metformin should be temporarily discontinued and contact with a healthcare professional is recommended.
Contraindications: Hypersensitivity to the active substance of Dapagliflozin, Sitagliptin & Metformin or to any of the excipients listed. Any type of acute metabolic acidosis (such as lactic acidosis, diabetic ketoacidosis). Diabetic pre-coma; Severe renal failure (eGFR<30mL/min); Acute conditions with the potential to alter renal function such as: Dehydration, Severe infection, Shock; Acute or chronic disease which may cause tissue hypoxia such as: Cardiac or respiratory failure, Recent myocardial infarction, Shock, Hepatic Impairment, Acute Alcohol intoxication, alcoholism
Use in a special population: Pregnant Women: Due to lack of human data, drug should not be used during pregnancy. Lactating Women: It should not be used during breastfeeding. Paediatric Patients: The safety and efficacy of drug has not yet been established. No data are available. Geriatric Patients: In Patients > 65 years, it should be used with caution as age increases.

Additional information is available on request.
Last updated: January 03, 2023

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1. Glimepiride use is associated with reduced cardiovascular mortality in patients with type 2 diabetes and chronic heart failure, a prospective cohort study | European Journal of Preventive Cardiology | Oxford Academic (oup.com) 2. Ther Adv Endocrinol Metab 2020, Vol 11:1-12 DOI: 10. 1177/2042018820925000 *Data on file * As compared to non-glimepiride group
EET: Epoxyeicosatrienoic acid; sEH: soluble Epoxide Hydrolase; AHAs: antihyperglycemic agents; T2DM: Type 2 Diabetes Mellitus

Priscribing information

Information: Metformin hydrochloride (as prolonged release) and glimepiride tablets. Glycomet-GP 0.5/Glycomet-GP 0.5 Forte/ Glycomet-GP 1/ Glycomet-GP 1/850/ Glycomet-GP 2/ Glycomet-GP 2/850/ Glycomet-GP 3/ Glycomet-GP 3/850/ Glycomet-GP 4/ Glycomet-GP 4/850/ Glycomet-GP 1 Forte/ Glycomet-GP 2 Forte/ Glycomet-GP 3 Forte/ Glycomet-GP 4 Forte Abridged Prescribing Information **Composition:** Glycomet GP 0.5mg: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500mg and glimepiride IP 0.5mg • Glycomet GP 0.5 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP 0.5mg • Glycomet GP 1: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500 mg and glimepiride IP 1 mg. • Glycomet GP 1/850: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 850 mg and glimepiride IP 1 mg. • Glycomet GP 2: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500 mg and glimepiride IP 2 mg. • Glycomet GP 2/850: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 850 mg and glimepiride IP 2 mg • Glycomet GP 3: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500 mg and glimepiride IP 3 mg. • Glycomet GP 3/850: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 850 mg and glimepiride IP 3 mg. • Glycomet GP 4: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500 mg and glimepiride IP 4 mg. • Glycomet GP 4/850: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 850 mg and glimepiride IP 4 mg. • Glycomet GP 1 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP 1mg. • Glycomet GP 2 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP 2mg. • Glycomet GP 3 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP 3mg. • Glycomet GP 4 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP mg **Indication:** For the management of patients with type 2 diabetes mellitus when diet, exercise and single agent (glimepiride or metformin alone) do not result in adequate glycaemic control. **Dosage and Administration:** The recommended dose is one tablet daily during breakfast or the first main meal. Each tablet contains a fixed dose of glimepiride and Metformin Hydrochloride. The highest recommended dose per day should be 6 mg of glimepiride and 2000mg of metformin. Due to prolonged release formulation, the tablet must be swallowed whole and not crushed or chewed. **Adverse Reactions:** For Glimepiride: hypoglycaemia may occur, which may sometimes be prolonged. Occasionally, gastrointestinal (GI) symptoms such as nausea, vomiting, sensations of pressure or fullness in the epigastrium, abdominal pain and diarrhea may occur. Hepatitis, elevation of liver enzymes, cholestasis and jaundice may occur; allergic reactions or pseudo allergic reactions may occur occasionally. For Metformin: GI symptoms such as nausea, vomiting, diarrhea, abdominal pain, and loss of appetite are common during initiation of therapy and may resolve spontaneously in most cases. Metallic taste, mild erythema, decrease in Vit B12 absorption, very rarely lactic acidosis, Hemolytic anaemia, Reduction of thyrotropin level in patients with hypothyroidism; Hypomagnesaemia in the context of diarrhea, Encephalopathy, Photosensitivity, hepatobiliary disorders. **Warnings and Precautions:** For Glimepiride: Patient should be advised to report promptly exceptional stress situations (e.g., trauma, surgery, febrile infections), blood glucose regulation may deteriorate, and a temporary change to insulin may be necessary to maintain good metabolic control. Metformin Hydrochloride may lead to Lactic acidosis; in such cases metformin should be temporarily discontinued and contact with a healthcare professional is recommended. Sulfonylureas have an increased risk of hypoglycaemia. Long-term treatment with metformin may lead to peripheral neuropathy because of decrease in vitamin B12 serum levels. Monitoring of the vitamin B12 level is recommended. Overweight patients should continue their energy-restricted diet, usual laboratory tests for diabetes monitoring should be performed regularly. **Contraindications:** Hypersensitivity to the active substance of glimepiride & Metformin or to any of the excipients listed. Any type of acute metabolic acidosis (such as lactic acidosis, diabetic ketoacidosis, diabetic pre-coma). Severe renal failure (GFR60ml/min). In pregnant women. In lactating women.Acute conditions with the potential to alter renal function (dehydration, severe infection, shock, intravascular administration of iodinated contrast agents); acute or chronic disease which may cause tissue hypoxia (cardiac or respiratory failure, recent myocardial infarction, shock); hepatic insufficiency; acute alcohol intoxication; alcoholism. **Use in a special population:** Pregnant Women: Due to a lack of human data, drugs should not be used during pregnancy. Lactating Women: It should not be used during breastfeeding. Pediatric Patients: The safety and efficacy of drugs has not yet been established. Renal impairment: A GFR should be assessed before initiation of treatment with metformin containing products and at least annually thereafter. In patients at increased risk of further progression of renal impairment and in the elderly, renal function should be assessed more frequently, e.g. every 3-6 months.

Additional information is available on request.

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Use of Dietary Supplements for Diabetes

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Diabetes, especially type 2 diabetes mellitus, is one of the most prevalent conditions globally. While medication, nutritional intervention, and exercise are regarded as the primary options for management, the use of dietary supplements is becoming popular. Dietary supplements are one type of oral complementary and alternative medicine therapy. A dietary supplement is a "product taken by mouth that contains a dietary element designed to enhance the diet," according to the Dietary Supplement Health and Education Act (DSHEA) of 1994. These food components could include "vitamins, minerals, herbs, amino acids, and other botanicals and substances such as enzymes, organ tissues, glandular, and metabolites." These supplements come in a variety of shapes and sizes, including tablets, capsules, soft gels, liquids, powders, and bars. It is crucial to remember that dietary supplements are not regarded as medications. Rather, they must be identified as dietary supplements and fall under the general category of "foods." The following are some of the most popular supplements.

Common diabetes dietary supplements

Alpha lipoic acid (ALA)	The antioxidant known as alpha lipoic acid, also known as lipoic acid or thioctic acid, functions similarly to the B complex vitamins. When administered intravenously to patients with diabetic neuropathy, ALA can help to relieve some peripheral neuropathy symptoms and reduce blood glucose levels. **Sources:** Liver, spinach, broccoli, brussels sprouts, peas, potatoes, and yeast are foods that contain ALA. **Dosage:** 600–1200 mg of a tablet daily **Side effects:** Although ALA side effects are uncommon, they could include hypoglycemia (if taken with insulin or insulin secretagogues), rash, thiamine shortage in vulnerable individuals, and potential interactions with thyroid medication.
Bitter gourd	According to some studies, the bitter gourd's fruit and seeds can lower blood glucose levels via increasing glucose uptake by tissues, increasing the production of muscle and liver glycogen, enhancing glucose oxidation, and activating an enzyme called AMPK. AMPK controls fuel metabolism and encourages glucose uptake. **Sources:** There are several ways to consume bitter gourd, including as a vegetable, juice, or in pill form. **Dosage:** There is no standard dosage schedule due to the various variances in the types of bitter gourd consumed. However, doses of 50 to 100 ml (about 3-6 tablespoons) have been applied. **Side effects:** Eating bitter gourd as a vegetable is probably safe. Bitter gourd allergies can cause a rash, itching, shortness of breath, and gastrointestinal upset in some people who are sensitive to it. It might interact with chemotherapeutic treatments, immune system suppressants, and lipid-lowering pharmaceuticals.

Chromium supplementation	Chromium is a crucial trace mineral required for the metabolism of glucose. It increases the impact of insulin in order to work. Chromium is a popular dietary supplement for people with diabetes and those trying to lose weight, usually in the form of chromium picolinate. **Sources:** Dried basil, dried garlic, dried grape juice, broccoli **Dosage:** 400–800 g/day of chromium supplementation **Side effects:** Thrombocytopenia, hemolysis, renal and hepatic failure, skin reactions, and mood disturbances may result from excessively high chromium ingestion.
Cinnamon supplementation	Ceylon and cassia cinnamon are the two varieties. The kind of cinnamon that is supposedly utilized to manage diabetes and gastrointestinal pain is ceylon cinnamon. The chemical hydroxychalcone which is believed to improve insulin activity is the active component of cinnamon. **Sources:** Ground cinnamon is frequently sprinkled over food or used as a spice in baking. In addition to being added to a beverage or food, it also comes in capsule and essential oil form. **Dosage:** 1 g (1/2 teaspoon) per day **Side effects:** Contact dermatitis and uncommon but probable allergic reactions. Moreover, anyone receiving insulin or using an insulin secretagogue may experience hypoglycemia. Caution should be taken when using cinnamon if you have liver disease. High coumarin dosages found in cassia cinnamon may cause or exacerbate liver damage.
Fenugreek supplementation	Fenugreek is commonly used in the management of diabetes. Fenugreek seeds are believed to decrease gastric emptying and consequently, the digestion and absorption of carbohydrates since they contain fiber. Moreover, the seeds may decrease triglycerides and cholesterol as they are high in soluble fiber. **Sources:** Fenugreek is available as a tea and in capsule form. **Dosage:** 5 to 100 g/day **Side effects:** Gastrointestinal distress may result from consuming fenugreek seeds or capsules (gas, bloating, diarrhea). Fenugreek should not be taken by pregnant women since it may trigger uterine contractions. Fenugreek may interact with drugs that thin the blood.
***Gymnema* supplementation**	Originating in central and southern India, *Gymnema* (*Gymnema sylvestre*) is a woody plant. The herb is also known as gurmar, which translates to "sugar destroyer" since chewing the leaves impairs one's ability to taste sweetness. It involves enhanced glucose absorption and insulin release from β-cells, and it is used to manage both type 1 and type 2 diabetes. **Sources:** A water-soluble extract of *Gymnema* that is standardized to contain 24% gymnemic acid is available. Moreover, it can be consumed as tea or in capsule form. **Dosage:** *Gymnema* extract is typically used in doses of 400–600 mg per day, divided as follows: 100 mg three to four times per day as a capsule and 0.5-1 teaspoon per day as a tea-making powder. **Side effects:** If taken combined with insulin or insulin secretagogues, it may cause hypoglycemia. The capacity to taste sweet or bitter flavors may also be affected.

Resource:

1. Amy P. Campbell; Diabetes and Dietary Supplements. *Clin Diabetes*. 1 January 2010; 28 (1): 35–39. https://doi.org/10.2337/diaclin.28.1.35

Role of Antioxidants in Diabetes

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Diabetes can lead to oxidative stress which can damage proteins, lipids, and DNA in addition to triggering the activation of various cellular pathways and is a result of an imbalance between the production and buildup of **reactive oxygen species.** These reactive oxygen species in a higher concentration in the body with a minimal amount of antioxidant enzymes lead to oxidative stress. Antioxidants are substances that can prevent the cells from damage that can be caused by oxidative stress. Antioxidants can be **endogenous** (produced by the body) or **exogenous** (taken from outside). Both types of antioxidants can aid to rule out the formation of free radicals by scavenging or encouraging their breakdown. A few antioxidants are discussed below:

Vitamin E

A lipophilic antioxidant, available in tocopherol and tocotrienol form is a naturally occurring antioxidant that is believed to aid in the treatment of hyperglycemia and can prevent microvascular and macrovascular problems in people with diabetes. Sources include almonds, avocados, leafy greens (beet, mustard, turnip), peanuts, pumpkin seeds, and sunflower seeds.

Vitamin C

Another powerful antioxidant scavenging free radicals is vitamin C. In population-based research, it was shown that regular dietary intake of vitamin C lowers the risk of type-2 diabetes. Microalbuminuria, erythrocyte sorbitol levels, and insulin resistance are all significantly improved by vitamin C due to its antioxidant capacity. Sources are amla, lemon, orange, papaya, guava, strawberries, and tomatoes.

Alpha lipoic acid (ALA)

Alpha lipoic acid can be used to treat cellular damage brought on by free radical triggering. It possesses the ability to restore other antioxidants such as vitamins C, E, and glutathione. ALA is also known to improve glucose metabolism in people with diabetes. Plasma insulin sensitivity can be increased by the oral supplementation of ALA. Reactive oxygen species generated during the peroxidation of lipids can be neutralized by ALA, protecting the cells from harm. Regular ALA intake lowers hyperglycemia and complications such as diabetic nephropathy. The body produces ALA naturally but its intake can be enhanced with dietary supplements and it is also found in tomatoes, broccoli, and spinach in some amounts.

Selenium

Naturally present in many foods, selenium is an important trace element and a component of selenoproteins and enzymes. It exists in both organic (selenomethionine and selenocysteine) and inorganic forms (selenate and selenite). Selenoproteins have antioxidant properties that aid in breaking down peroxides, which can damage tissues and DNA, leading to inflammation and other health issues. Selenium supplementation with low doses has shown a beneficial effect on glucose metabolism. It does this by mimicking the role of insulin, though the precise method is still unknown. According to reports, selenium can activate a protein that is responsible for the insulin signaling cascade. This antioxidant also plays a significant role in immune function with many clinical studies that prove its efficacy in treating several diseases. Its sources include Brazil nuts, fish, shellfish, beans and lentils, brown rice, and barley.

Antioxidants have the capacity to change reactive compounds into less reactive molecules. The function of β-cells can be secured by antioxidants which try to defend the β-cells by combating oxidative stress. As a result, it can reduce diabetes-related complications and aid in the restoration of insulin sensitivity.

Resources:

1. Suresh V, Reddy A, Muthukumar P, Selvam T. Antioxidants: Pharmacothearapeutic Boon for Diabetes. Antioxidants - Benefits, Sources, Mechanisms of Action [Internet]. 2021 Sep 8; Available from: http://dx.doi.org/10.5772/intechopen.98587 https://www.intechopen.com/chapters/77150
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Diabetes Educator Tip of the Month

Contributed by
Name: Saili Randive

PG Dip Dietetics, CDE

Food Pairings Which Increase Nutrient Absorption

Food pairing or synergy is the concept of interaction between nutrient absorption and bioavailability in the human body. Such interactions can give positive as well as negative health impacts. However, pairing foods to obtain potential health benefits can be practiced with the help of evidence-based studies, which are available for certain active functional components present in the food we eat for disease prevention and obtaining good health. Below are some of the following beneficial pairings.

Green tea and lemon

Catechins present in green tea are associated with enhanced immunity with lower incidences of cardiovascular disease and cancer. The addition of lemon to green tea enhances the absorption of epigallocatechin gallate ten folds more than it would have if green tea was consumed all by itself.

Turmeric and black pepper

Curcumin is the active ingredient in turmeric, which is known for its anti-inflammatory, anti-cancer, and tumor-protective properties. Whereas black pepper shows piperine as the active component, when combined synergistically with curcumin, black pepper enhances the absorption of curcumin 1000 times.

Boiled eggs with salads

Salads with greens are rich in carotenoids like lutein, zeaxanthin, β-carotene, and α-carotene. Zeaxanthin and lutein are present in egg yolk as well. Consumption of boiled eggs along with salads containing tomatoes, green leafy vegetables, and carrots enhances the absorption of carotenoids 3 to 9-fold.

Green leafy vegetables with lemon

Squeezing lemon (vitamin c) on green leafy veggies enhances the absorption of non-heme iron by increasing its bioavailability, thus helping in combating iron deficiency anemia.

Yogurt and banana

A combination of prebiotics (food for good bacteria) and probiotics (beneficial live microorganisms) are known to be beneficial for gut health. The inulin present in bananas serves as food for the good gut bacteria in yogurt. Together they help in building immunity, improving digestion, and increasing the absorption of some minerals as well.

For cardiovascular health

Garlic with fish

Garlic and fish when paired synergistically, improve cardiovascular health and help in improving immunity levels as well.

Tomatoes with olive oil

Tomatoes are rich in carotenoids like lycopene which is fat soluble. Tomatoes when cooked with olive oil, the absorption of lycopene is enhanced. Lycopene helps improve serum lipid profile.

For diabetes management

Onion and garlic

Methiin and S-allyl cysteine sulphoxide are the active components found in onion and garlic which stimulate insulin production from the pancreas and thus help in regularising blood glucose levels.

Vitamin D and vitamin K supplements

Supplementation of vitamin D and vitamin K aid in decreasing blood glucose levels, by increasing insulin receptor gene expression and encouraging insulin release from pancreatic cells, which improves blood glucose metabolism.

For cancer protection

Apples with apple peels

Phloridzin, quercetin, chlorogenic acid, and catechin are some of the phytochemicals found in apples. The apple peel exhibits anticancer properties. Consuming apples with skin reduces lipid oxidation, lowers cholesterol, and prevents the growth of cancer cells in cancer patients.

Good dietary choices with the synergistic pairing of nutrients enhance one's health holistically by boosting immunity and nutrient bioavailability.

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10. Wolfe KL, Liu RH. Apple peels as a value-added food ingredient. *J Agric Food Chem.* 2003;51(6):1676–83.

How to Incorporate Micronutrients in the Diet?

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Using the healthy plate method is the easiest way to create well-balanced healthy meals that can help manage blood glucose levels.

Fill a quarter of your plate with brown rice, sweet potato, whole-grain pasta, bread, corn, or whole-wheat tortillas.	Fill half of your plate with colorful vegetables like broccoli, green beans, spinach, beets, carrots, zucchini, or tomatoes. Prepare them without fat by steaming them.	Fill a quarter of your plate with chicken, fish, lean meat, low-fat cheese, tofu, or egg whites. Remove any visible fat or skin before cooking.	Add 8 oz. of non-fat or low-fat 1% milk or 6 oz. of non-fat or low-fat yogurt and a small piece of fruit.	Add 1-2 teaspoons of heart-healthy fat, such as vegetable oil or trans-fat-free margarine.

Fig 1. Healthy plate by Joslin Diabetes Centre

The recommended healthy plate by Joslin Diabetes Centre is shown in figure 1. It suggests an individual with diabetes should consume:

- Half a plate filled with non-starchy vegetables.
- Quarter of a plate containing cereals/whole grains.
- Quarter of a plate containing protein sources.

To ensure intake of all micronutrients, one must consume all five food groups – cereals and grains, pulses and legumes, dairy and its products, fruits, vegetables, nuts, and oil seeds. Foods belonging to each of these groups provide individually different micronutrients and hence, a variety of these foods must be emphasized. For example, different vegetables have varied phytochemicals corresponding to the color of the vegetable and each of these phytochemicals has diverse health benefits.

Important micronutrients in diabetes management and their sources are listed in the table below:

Calcium	Milk and its products, sesame seeds, poppy seeds, almonds, ragi, amaranth, edamame, dark green leafy vegetables
Vitamin D	Sunlight exposure, mushrooms, egg yolk, and fatty fish
Magnesium	Legumes, almonds, peanuts, whole grains
Chromium	Whole grains, nuts, vegetables, poultry, egg, lean meat
Zinc	Seafood, egg, mushroom, milk and its products, nuts, seeds, legumes

Resources:

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Dia-Games

Multiple choice questions

1. **Which of the vitamins are easily lost when vegetables are soaked and washed repeatedly?**
   a. Vitamin A & E
   b. Vitamin B & C
   c. Vitamin A & B
   d. Vitamin D & E
2. **Which of these vitamins helps in the absorption of iron in the body?**
   a. Vitamin D
   b. Vitamin B
   c. Vitamin C
   d. Vitamin K
3. **The best cooking method to reduce nutrient losses is one that……**
   a. Has minimum cooking time
   b. Uses less fluid
   c. Uses lesser temperature
   d. All of above
4. **In which cinnamon a compound called coumarin is present which can be toxic to the liver in large quantities?**
   a. Cassia
   b. Ceylon
5. **Turmeric should be paired with which spice for better curcumin absorption?**
   a. Cumin seeds
   b. Fennel seeds
   c. Carom seeds
   d. Pepper

Answers
1. B, 2. C, 3. D, 4. A, 5. D

NOTES

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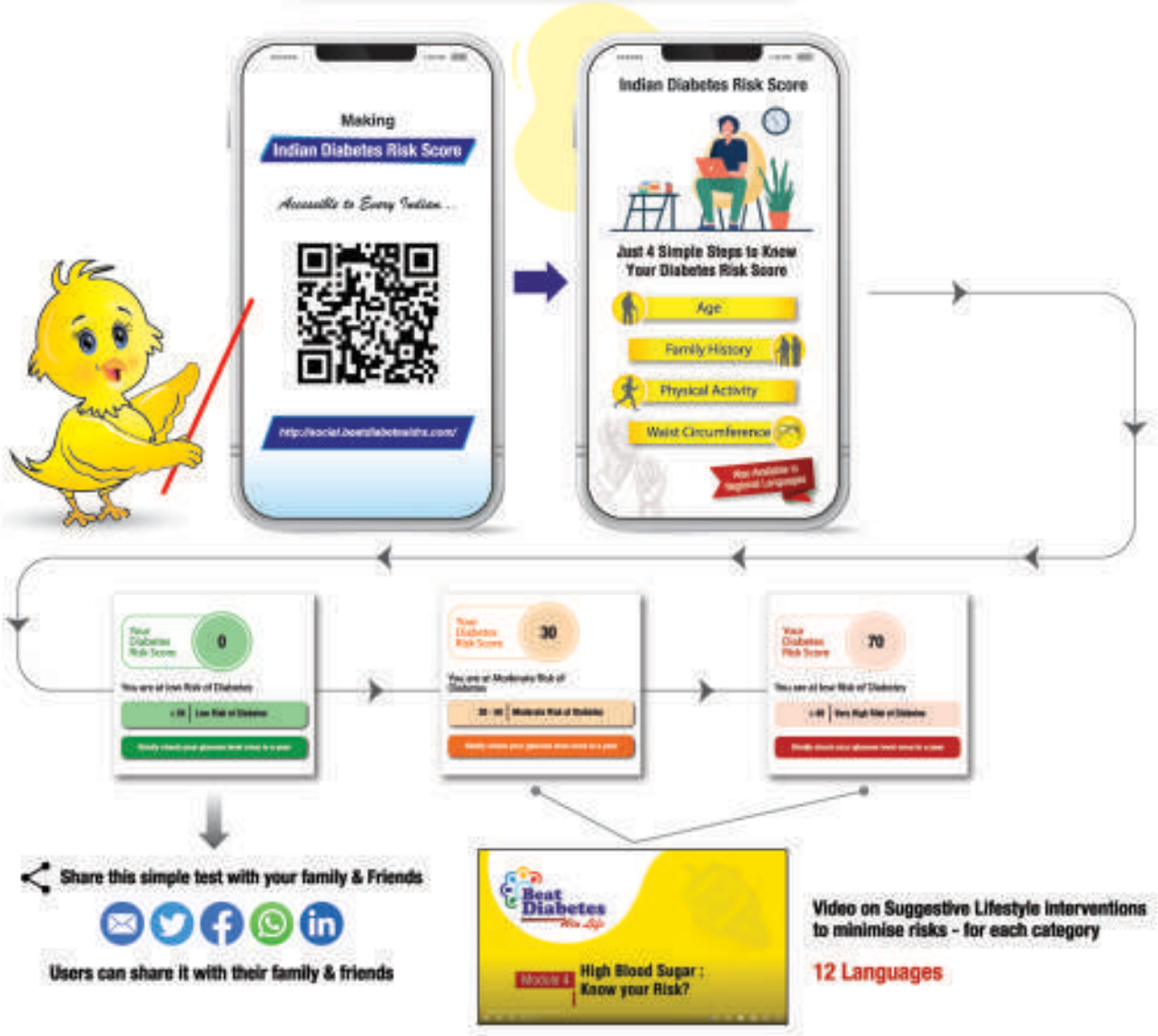
Indian Diabetes Risk Score



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Complications

Stages

Ages

BMI

Comorbidities

MODY

In T2DM Across Continuum,

START with,

Glycomet®-GP 1

Metformin Hydrochloride 500 mg SR + Glimepiride 1 mg

Glycomet®-GP 2

Metformin Hydrochloride 500 mg SR + Glimepiride 2 mg

Add Early Along with other AHAs

DPP4i

SGLT2i

TZDs

Insulin

AGIs

GLP1-RAs

* Data on File

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Priscribing information

Information: Metformin hydrochloride (as prolonged release) and glimepiride tablets. Glycomet-GP 0.5/Glycomet-GP 0.5 Forte/ Glycomet-GP 1/ Glycomet-GP 1/850/ Glycomet-GP 2/ Glycomet-GP 2/850/ Glycomet-GP 3/ Glycomet-GP 3/850/ Glycomet-GP 4/ Glycomet-GP 4/850/ Glycomet-GP 1 Forte/ Glycomet-GP 2 Forte/ Glycomet-GP 3 Forte/ Glycomet-GP 4 Forte Abridged Prescribing Information **Composition:** Glycomet GP 0.5mg: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500mg and glimepiride IP 0.5mg.• Glycomet GP 0.5 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP 0.5mg.• Glycomet GP 1: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500 mg and glimepiride IP 1 mg. • Glycomet GP 1/850: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 850 mg and glimepiride IP 1 mg. • Glycomet GP 2: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500 mg and glimepiride IP 2 mg. • Glycomet GP 2/850: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 850 mg and glimepiride IP 2 mg.• Glycomet GP 3: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500 mg and glimepiride IP 3 mg. • Glycomet GP 3/850: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 850 mg and glimepiride IP 3 mg. • Glycomet GP 4: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 500 mg and glimepiride IP 4 mg. • Glycomet GP 4/850: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 850 mg and glimepiride IP 4 mg. • Glycomet GP 1 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP 1mg. • Glycomet GP 2 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP 2mg. • Glycomet GP 3 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP 3mg. • Glycomet GP 4 Forte: Each uncoated tablet contains metformin hydrochloride IP (as prolonged release form) 1000mg and glimepiride IP mg. **Indication:** For the management of patients with type 2 diabetes mellitus when diet, exercise and single agent (glimepiride or metformin alone) do not result in adequate glycaemic control. **Dosage and Administration:** The recommended dose is one tablet daily during breakfast or the first main meal. Each tablet contains a fixed dose of glimepiride and Metformin Hydrochloride. The highest recommended dose per day should be 8 mg of glimepiride and 2000mg of metformin. Due to prolonged release formulation, the tablet must be swallowed whole and not crushed or chewed. **Adverse Reactions:** For Glimepiride: hypoglycaemia may occur, which may sometimes be prolonged. Occasionally, gastrointestinal (GI) symptoms such as nausea, vomiting, sensations of pressure or fullness in the epigastrium, abdominal pain and diarrhea may occur. Hepatitis, elevation of liver enzymes, cholestasis and jaundice may occur; allergic reactions or pseudo allergic reactions may occur occasionally. For Metformin: GI symptoms such as nausea, vomiting, diarrhea, abdominal pain, and loss of appetite are common during initiation of therapy and may resolve spontaneously in most cases. Metallic taste, mild erythema, decrease in Vit B12 absorption, very rarely lactic acidosis, Hemolytic anemia, Reduction of thyrotropin level in patients with hypothyroidism, Hypomagnesemia in the context of diarrhea, Encephalopathy, Photosensitivity, hepatobiliary disorders. **Warnings and Precautions:**: For Glimepiride: Patient should be advised to report promptly exceptional stress situations (e.g., trauma, surgery, febrile infections), blood glucose regulation may deteriorate, and a temporary change to insulin may be necessary to maintain good metabolic control. Metformin Hydrochloride may lead to Lactic acidosis; in such cases metformin should be temporarily discontinued and contact with a healthcare professional is recommended. Sulfonylureas have an increased risk of hypoglycaemia. Long-term treatment with metformin may lead to peripheral neuropathy because of decrease in vitamin B12 serum levels. Monitoring of the vitamin B12 level is recommended. Overweight patients should continue their energy-restricted diet, usual laboratory tests for diabetes monitoring should be performed regularly. **Contraindications:** Hypersensitivity to the active substance of glimepiride & Metformin or to any of the excipients listed. Any type of acute metabolic acidosis (such as lactic acidosis, diabetic ketoacidosis, diabetic pre-coma). Severe renal failure (GFR≤30ml/min). In pregnant women. In lactating women.Acute conditions with the potential to alter renal function (dehydration, severe infection, shock, intravascular administration of iodinated contrast agents); acute or chronic disease which may cause tissue hypoxia (cardiac or respiratory failure, recent myocardial infarction, shock); hepatic insufficiency; acute alcohol intoxication; alcoholism. **Use in a special population:** Pregnant Women: Due to a lack of human data, drugs should not be used during pregnancy. Lactating Women: It should not be used during breastfeeding. Pediatric Patients: The safety and efficacy of drugs has not yet been established. Renal impairment: A GFR should be assessed before initiation of treatment with metformin containing products and at least annually thereafter. In patients at increased risk of further progression of renal impairment and in the elderly, renal function should be assessed more frequently, e.g. every 3-6 months.

Additional information is available on request.

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In case of any adverse events, kindly contact: pv@usv.in For the use of registered medical practitioner, hospital or laboratory.

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