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Review Article

Effectiveness of Surya Namaskar and Diet to Surmount the Deficiency of Vitamin B12 and Vitamin D

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A B S T R A C T

Vitamins are the essential nutrients required for normal functioning of the body. Vitamin B12 is a water-soluble vitamin white Vitamin D is a fat-soluble vitamin, that is why vitamin D can be stored in the body but Vitamin B12 can't. The deficiency of Vitamin 12 causes neurological and hematological symptoms, while Vitamin D deficiency causes bone and joint-related issues. Surya namaskar (Sun salutation) is India's ancient and sacred yogic technique for expressing gratitude to the Sun. Surya Namaskar is a set of twelve (12) asanas or poses. It is done preferably in the morning, during sunrise facing towards the rising Sun. There are various benefits of Surya Namaskar for different systems of the body including respiratory, cardiovascular, endocrine, musculoskeletal, nervous system, and as well as gastrointestinal systems. Every cell and tissue of the body gets revitalized and regenerated because of practicing regular Surya Namaskar therefore, the experts recommend Surya Namaskar for a healthy life. It maintains health and makes the body free from diseases. It gives strength, flexibility, and vitality to the body. When it is done at a slow pace, it relaxes muscles and is a form of meditation. Surya Namaskar and diet are the best sources to balance vitamins. It helps to keep the mind stress-free, calm and illuminated. Thus, a regular practice of Surya Namaskar is recommended to keep the body and mind healthy. Though the Surya Namaskar steps are very scientific and practical from ancient times but still need an advanced modern scientific justification to spread globally.

Keywords: Vitamin D, Vitamin B12, Diet, Yoga, Surya Namaskar

Introduction

Vitamins are micronutrients that our bodies require in relatively small quantities but are indispensable for numerous physiological processes. They act as catalysts, facilitating various biochemical reactions that are vital for cellular function and overall health. While each vitamin has its unique functions, they often work synergistically to ensure optimal health and vitality.[1]

The discovery of vitamins revolutionised our understanding of nutrition and paved the way for significant advancements in preventive medicine. From the pioneering work of scientists like Casimir Funk, who coined the term "vitamin"

(later shortened to vitamin), to groundbreaking research uncovering the roles of individual vitamins in preventing deficiency diseases, the journey of understanding vitamins has been one of constant exploration and discovery.

Vitamins come in two main categories: fat-soluble vitamins (such as vitamins A, D, E, and K), which are absorbed with dietary fats and stored in the body's fatty tissues, and water-soluble vitamins (such as the B vitamins and vitamin C), which dissolve in water and are not stored in the body to the same extent as fat-soluble vitamins.[2]

Each vitamin plays a unique role in promoting health and preventing disease. For example, vitamin A is crucial for vision and immune function, vitamin D is essential for bone health and immune function, vitamin C is a powerful antioxidant with immune-boosting properties, and the B vitamins are involved in energy metabolism and nerve function.

While vitamins are primarily obtained through diet, certain factors such as dietary habits, lifestyle choices, medical conditions, and environmental factors can influence our vitamin status. Deficiencies in specific vitamins can lead to a range of health issues, from fatigue and weakened immunity to more severe conditions like anaemia, neurological disorders, and even developmental abnormalities.[3]

Vitamin B12

Vitamin B12, commonly referred to as the anti-pernicious anaemia component, is a crucial vitamin that is mostly obtained through diet and is frequently combined with food supplements. Currently, four types of vitamin B12 are used for supplementation: cyanocobalamin, hydroxocobalamin, 5'-deoxy adenosylcobalamin, and methylcobalamin. The frequency of vitamin B12 deficiency is often higher in underdeveloped countries, among elderly vegetarians and vegans, pregnant women, and newborns breastfed by mothers with B12 deficiency.[4]

Functions of Vitamin B12

Vitamin B12 deficiency causes neurological and hematological problems since it is necessary for cellular activity.[5]

Absorption of Vitamin B12

Complex mechanisms involving three transport proteins intrinsic factor (IF), haptocorrin (HC), and transcobalamin (TC)—as well as the corresponding membrane receptors are responsible for the absorption and transportation of vitamin B12. B12 is liberated from food carrier proteins in the stomach and attaches itself to HC. B12 is transferred to IF in the duodenum as a result of the breakdown of HC by pancreatic proteases and a pH shift. In the distal ileum, the two parts of the receptor that mediate B12 absorption are cubilin and amnion less. A portion of liver B12 travels via the enterohepatic circulation and is eliminated in bile.[6]

Malabsorption of Vitamin B12

Inherited conditions such as intrinsic factor deficiency, Imerslund-Gräsbeck disease, Addison's pernicious anaemia, obesity, bariatric surgery, and gastrectomy are the primary causes of B12 malabsorption. Additionally, there are conditions such as bacterial overgrowth, parasitic infestations, tropical sprue, celiac disease, pancreatic insufficiency, inflammatory bowel illnesses, chronic radiation enteritis of the distal ileum, and short bowel can contribute to vitamin B12 malabsorption.[6]

Investigation

When investigating a suspected vitamin B12 deficiency, healthcare professionals typically use a combination of medical history, physical examination, and laboratory tests. Table 1 contains the symptoms of Vit. B12 deficiency, here are the common investigations used:

- **Medical history:** Any relevant medical history, dietary habits (especially if a person is vegan or vegetarian), and any medications that might interfere with B12 absorption.
- **Physical examination:** physical conditions such as pale or jaundiced skin, neurological symptoms like numbness or tingling, or signs of anaemia can be indicators of vitamin B12 deficiency.
- **Blood tests:** Blood tests are the primary method for diagnosing vitamin B12 deficiency. These tests may include serum B12 levels, complete blood count (CBC), homocysteine and methylmalonic acid (MMA) levels.

Recommended Dietary Allowances for Vitamin B12

Recommended dietary allowance (RDA) for vitamin B12 is 2.2 µg/d. During pregnancy, this requirement increased by +0.25 µg/d while in lactation by +1.0 µg/d (ICMR & NIN, 2020).

Table 1.Symptoms of Vitamin B12 Deficiency

Physical Symptoms	Neurological & Psychiatric Symptoms
Anaemia (pernicious anaemia)	Mild irritability and memory loss such as shaky gait, weakness, and dementia,
Numbness or tingling in your hands and feet	Having a hard time remembering things
Vision problems	Getting confused easily
Difficulty in walking and balance problems	Depression or mood change
Shortness of breath and dizziness	Sensory disturbance

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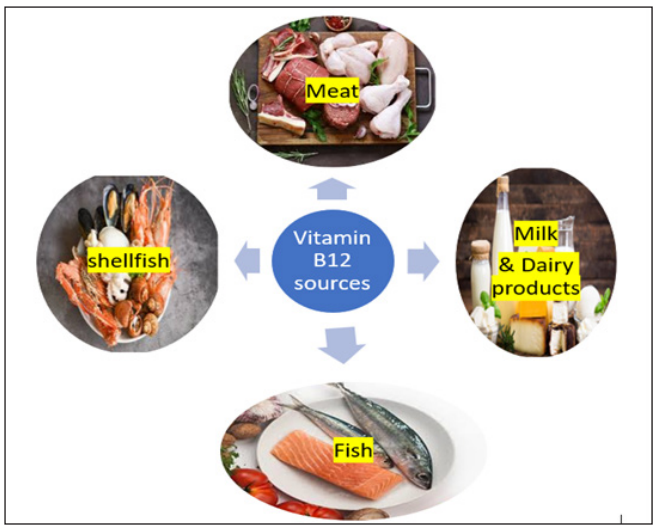

Figure 1.Sources of Vitamin B12

Fig 1 contains the sources of Vitamin B12 can be obtained from a diet of animal products such as meat, milk, eggs, fish, and shellfish. In healthy individuals, the average bioavailability of vitamin B12 from fish, sheep, and chicken meat was 42%, 56%-89%, and 61%-66%, respectively. Vitamin B12 from eggs does not appear to be absorbed as well as that from other animal dietary sources (< 9%). For vegetarians and older adults, fortified breakfast cereals are a very good source of vitamin B12.[7]

What are Fortified Foods?

Foods that contain additional nutrients that aren't naturally present in them are referred to as fortified. These foods are aimed to boost nutrition and provide additional health advantages. For instance, fruit juices may include calcium, and milk is frequently fortified with vitamin D. Figure 2

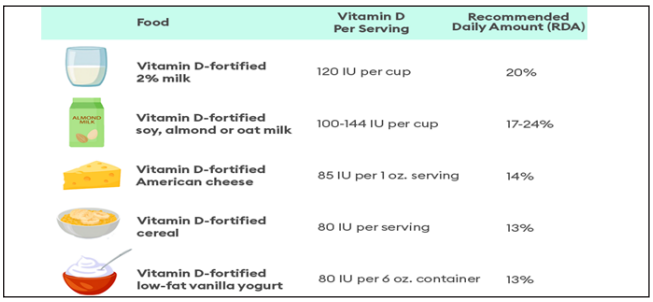

Figure 2.Fortified Foods

Management of B12 Deficiency

- **Vitamin B12 Supplementation:** The primary management for vitamin B12 deficiency is supplementation with vitamin B12 (cobalamin). This can be administered orally or by injection, depending on the severity of the deficiency and the individual's ability to absorb vitamin B12.
- **Oral supplementation:** For mild deficiencies or maintenance therapy, oral vitamin B12 supplements are often prescribed. These supplements are available in various forms, including tablets, capsules, and sublingual (under the tongue) formulations. Cyanocobalamin and methylcobalamin are common forms of vitamin B12 used in supplements.
- **Injections:** In cases of severe deficiency or malabsorption disorders, vitamin B12 injections may be necessary. These injections deliver high doses of vitamin B12 directly into the muscle or subcutaneous tissue and are typically administered weekly or monthly until vitamin B12 levels are normalised.
- **Dietary Changes:** In addition to supplementation, increasing dietary intake of vitamin B12-rich foods can help maintain adequate levels over the long term. Foods high in vitamin B12 include meat (beef, poultry, pork), fish (salmon, trout, tuna), shellfish (clams, mussels, crab), dairy products (milk, cheese, yoghurt), eggs, and fortified cereals and plant-based milk alternatives.
- **Monitoring:** Regular monitoring of vitamin B12 levels and response to treatment is important to ensure that deficiency is adequately corrected and to adjust treatment as needed. This may involve periodic blood tests to assess vitamin B12 levels and other relevant markers, such as complete blood count (CBC) and methylmalonic acid (MMA) levels.

Vitamin D

Vitamin D is a fat-soluble vitamin that is made in human skin when it is exposed to ultraviolet light. It can also be found naturally in a few foods and added as a supplement to other foods. Vitamin D is not active until it has been metabolised in the body. There are two types of vitamin D: vitamin D2 is generated by plants and differs from vitamin D3 in that it has a methyl group in C24 and a double bond in C22–C23. Vitamin D3 is the more essential form and is created in the skin of mammals.[8]

Target tissues get the majority of the transport of vitamin D and its metabolites from the site of synthesis. The vitamin-D-binding protein (DBP), also known as group-specific component (Gc-globulin), is primarily in charge of this transport since it binds 85% of the circulating 25(OH)D3 and 1,25(OH)2D3. It helps to maintain appropriate blood levels of vitamin D because of its strong binding affinity for vitamin D and its metabolites. A number of human diseases, such as IBD, psoriasis, TB, diabetic nephropathy and retinopathy, and cancer, may be monitored, prevented, and treated with vitamin D and its binding proteins.[9]

Functions of Vitamin D

Vitamin D functions more like a prohormone or multifunctional hormone. This is due to the fact that vitamin D supports numerous bodily functions. Enhancing effects on the immunological system, cardiovascular system,

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endocrine system, and other metabolic pathways have been demonstrated for calcitriol.[10]

Vitamin D and calcium are necessary to keep bones healthy. Supplementing with calcium and vitamin D may be one way to treat osteoporotic individuals' impaired fracture repair. Because the calcium required for fracture callus mineralisation is increasingly mobilised from the remote skeleton in support of fracture healing when the calcium and vitamin D status is insufficient, calcium and vitamin D shortage increases systemic bone loss following fracture. Post-traumatic bone loss can be avoided by taking calcium and vitamin D supplements after a fracture and continuing them for the duration of the healing process. Furthermore, a number of experimental research show that supplementing with calcium and vitamin D improves bone regeneration.[11]

Vitamin D Deficiency

A residence's high latitude, clothes, sunscreen use, and deliberate avoidance of direct sunlight can all significantly reduce its generation. In fact, there are over a billion vitamin D-deficient people around the globe, and many of them are misdiagnosed. The chronic deficit is connected to an increased risk of multiple sclerosis, cancer, hypertension, and type 1 diabetes in addition to rickets, osteomalacia, and osteoporosis. Vitamin D supplementation may therefore be helpful, but it should only be taken under the guidance of medical professionals due to the potential for overdosing, which can result in intoxication and serious health consequences.[12] subclinical vitamin D deficiency is more common and linked to osteoporosis as well as an increased risk of fractures or falls. Since breast milk does not contain enough vitamin D, it has been claimed that 96% of children who had rickets were breastfed. Fig 3 As early as the first few days of life, infants who were breastfed exclusively or in part were advised by the American Academy of Paediatrics in 2008 to take 400 international units of vitamin D daily.[13]

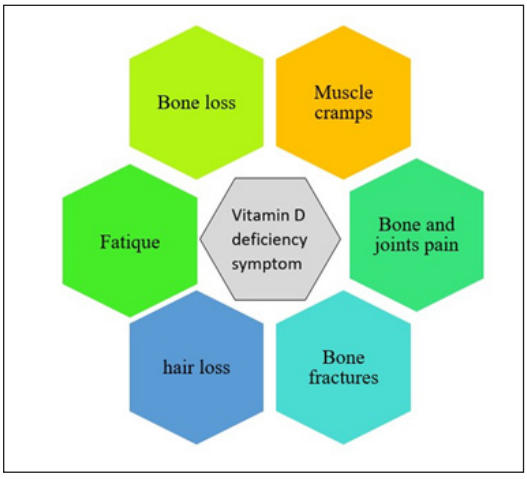

Figure 3.Symptoms of Vitamin D Deficiency

Investigation

- **Medical History:** Any relevant medical history, such as conditions affecting nutrient absorption (like celiac disease or inflammatory bowel disease), dietary habits, sun exposure, and medications a person is taking.
- **Physical Examination:** There are several physical examinations to check for signs of vitamin D deficiency, such as bone tenderness or deformities, muscle weakness, or softening of the bones (osteomalacia).
- **Blood Tests:** Blood tests are the primary method for diagnosing vitamin D deficiency. These tests may include serum 25-hydroxyvitamin D [25(OH)], calcium and phosphorus levels, parathyroid hormone (PTH), and alkaline phosphatase (ALP).

RDA for Vitamin D

An Estimated Average Requirement (EAR) of 400 IU and an RDA of 600 IU are recommended while emphasising the importance of outdoor physical activity as a means of achieving adequate vitamin D in a tropical country like India. The increased requirement is attributed to a progressive decrease in sunlight exposure necessitating dietary sources to meet the requirement.[7]

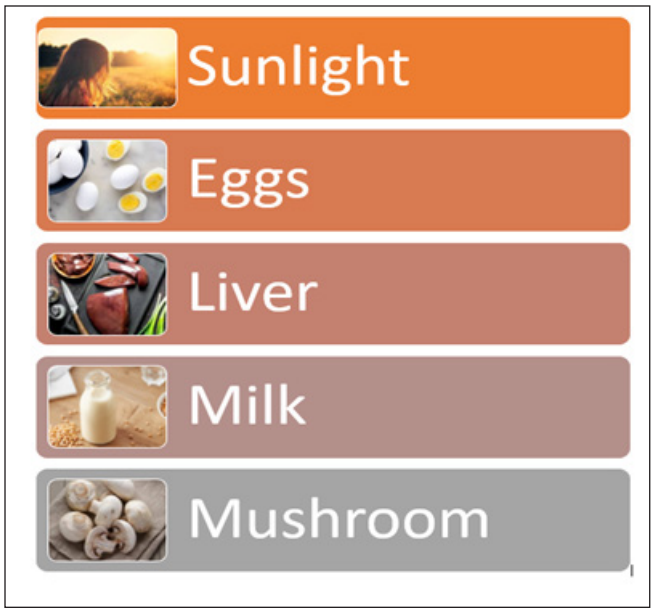

Figure 4.Sources of Vitamin D

Fig 4, It can be made by the skin endogenously when exposed to UV B rays, or it can be consumed through food sources such as fortified foods and animal and plant-based supplements. The two primary forms of vitamin D are D3 (cholecalciferol) and D2 (ergocalciferol). In addition to the D3 and D2 forms of vitamin D, 25-hydroxy vitamin D also contributes significantly to dietary vitamin D intake. It is present in a lot of goods derived from animals. Fortified food can contain D3 or D2 forms or vitamin D metabolite 25-hydroxy vitamin D. Vitamin D (D denotes D3 and/ or

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D2) is contained in relatively few foods (> 4 µg/100 g). Examples of such foods are many fish (5–25 µg/100 g), but not all mushrooms (21.1–58.7 µg/100 g), Reindeer lichen (87 µg/100 g), and fish liver oils (250 µg/100 g). Additional food sources include dark chocolate (4 µg/100 g), cheese, eggs, and beef liver (1.3–2.9 µg/100 g), and fortified foods such as yoghurt, milk, fat spreads, orange juice, breakfast grains, and plant-based drinks. Vitamin D supplements are typically advised since it is difficult to meet the European Food Safety Authority's recommended daily intake of 15 µg of vitamin D by diet alone.[15]

Management of Vitamin D Deficiency

The Management of vitamin D deficiency typically involves supplementation and lifestyle modifications. Here are the key aspects:

- **Vitamin D Supplementation:** The most common form of treatment for vitamin D deficiency is supplementation with vitamin D3 (cholecalciferol) or vitamin D2 (ergocalciferol). The choice of supplement and dosage will depend on the severity of the deficiency and individual factors such as age, weight, and underlying health conditions. Consultants will decide the appropriate dosage of medicines and their intake guidelines.
- **Oral Supplements:** Vitamin D supplements are available over the counter in various forms, including tablets, capsules, and liquid drops. Consultants may prescribe high-dose supplements for a short period if the deficiency is severe.
- **Injection:** In rare cases of severe deficiency or when oral supplementation is not effective, vitamin D injections (such as intramuscular injections) may be administered under medical supervision.
- **Sun Exposure:** Safe exposure to sunlight is essential for vitamin D synthesis in the skin. Spending time outdoors, particularly during midday when the sun's rays are most intense, can help increase vitamin D levels. However, it's important to balance sun exposure to avoid sunburn and skin damage, especially in individuals with fair skin or a history of skin cancer.
- **Dietary Changes:** Consuming foods rich in vitamin D can help support your vitamin D levels. Natural food sources of vitamin D include fatty fish (such as salmon, mackerel, and tuna), egg yolks, fortified dairy products (such as milk, yoghurt, and cheese), fortified cereals, and fortified orange juice. While dietary sources alone may not provide sufficient vitamin D for those with a deficiency, they can complement supplementation and sun exposure.
- **Regular Monitoring:** After initiating treatment, your healthcare provider may recommend periodic blood tests to monitor your vitamin D levels and adjust your treatment plan accordingly. This ensures that your vitamin D levels reach and maintain optimal levels over time.
- **Address Underlying Conditions:** If vitamin D deficiency is secondary to an underlying medical condition (such as malabsorption disorders or kidney disease), healthcare providers may also address and manage the underlying condition to improve vitamin D absorption and utilisation.

Yoga

While yoga cannot directly address a deficiency in vitamin it can support overall health and well-being, which may indirectly help improve symptoms associated with a deficiency. Yoga practice can reduce stress, improve circulation, and enhance digestion, which are all factors that can influence nutrient absorption and overall health.[16]

Certain yoga poses may be particularly beneficial for enhancing circulation and promoting digestion, which could support the body in absorbing nutrients more effectively. Poses that involve twisting, such as seated spinal twists (Ardha Matsyendrasana), can stimulate digestion and improve nutrient absorption. Poses that increase blood flow to the digestive organs, like forward bends such as Paschimottanasana (Seated Forward Bend), may also be helpful.

Additionally, practising yoga regularly can help manage stress, which is important because chronic stress can impair digestion and nutrient absorption. Yoga practices such as meditation, deep breathing exercises, and restorative poses can all help reduce stress levels.

Surya Namaskar

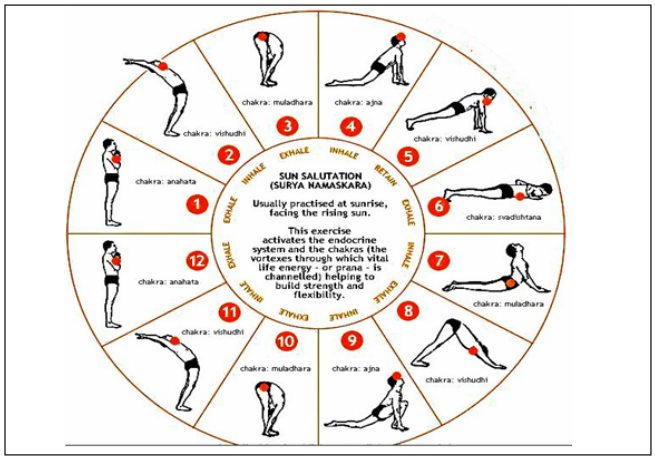

Figure 5.Stepe of Surya Namaskar

Surya Namaskar, or sun salutation, is indeed a powerful and transformative sequence of yoga poses that holds deep significance in the practice of yoga. Fig 5 This ancient practice is revered for its ability to harmonise the body, mind, and spirit through a sequence of 12 dynamic postures.[17]

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Each posture in the Sun Salutation sequence is carefully designed to stretch, strengthen, and energise different parts of the body, promoting flexibility, balance, and vitality. As practitioners flow through the sequence, they synchronise their movements with rhythmic breathing, creating a meditative and deeply mindful experience.

Beyond the physical benefits, Surya Namaskar carries spiritual significance as well. The practice is often performed as a form of reverence to the sun, a symbol of consciousness, enlightenment, and the source of all life on Earth. With each pose, practitioners cultivate a sense of gratitude, reverence, and connection to the divine energy that sustains all living beings.[18]

Surya Namaskar serves as a holistic practice that nourishes not only the body but also the mind and spirit. It offers a pathway to inner transformation, self-discovery, and inner peace. Whether practised as a standalone routine or as part of a broader yoga practice, Sun Salutation is a beautiful and profound way to start the day with vitality, mindfulness, and a deep sense of connection to the universe.

Surya Namaskara, also known as Sun Salutation, is a sequence of yoga postures that are performed in a flowing manner. While Surya Namaskara is primarily known for its physical benefits such as increased flexibility, strength, and improved circulation, it can also have indirect effects on overall health and well-being, including potential impacts on vitamin deficiency.[19]

Here's how Surya Namaskara might influence vitamin deficiency

- **Exposure to Sunlight:** Surya Namaskara is typically performed early in the morning facing the rising sun. This exposure to sunlight can stimulate the production of vitamin D in the skin. Vitamin D is crucial for the absorption of calcium and phosphorus in the body, which are essential for bone health. Therefore, regular practice of Surya Namaskara, especially when done outdoors, can help prevent vitamin D deficiency.
- **Improved Digestion:** The various movements and stretches involved in Surya Namaskara can stimulate the digestive organs, promoting better digestion and absorption of nutrients, including vitamins, from the food you eat. Enhanced digestion can contribute to overall nutrient absorption, potentially reducing the risk of various deficiencies, including those of vitamins.
- **Stress Reduction:** Surya Namaskara, like other forms of yoga, can help reduce stress and promote relaxation. Chronic stress can affect nutrient absorption and metabolism, potentially leading to deficiencies. By managing stress levels, Surya Namaskara may indirectly support overall nutrient status, including vitamins.
- **General Well-Being:** Regular physical activity, such as Surya Namaskara, is associated with improved overall health and well-being. When you feel better physically and mentally, you may be more inclined to maintain a balanced diet rich in essential vitamins and nutrients, thus reducing the risk of deficiencies.

However, it's essential to note that while Surya Namaskara can have positive effects on overall health, it's not a substitute for a balanced diet. To prevent or address specific vitamin deficiencies, it's crucial to consume a varied and nutrient-rich diet or consult with a healthcare professional for personalised advice and supplementation if necessary.

Contraindications

1. Pregnant women should not perform Surya Namaskara as it puts pressure on the back and abdomen, harming both mothers and foetus.
2. Avoid performing it while menstruating.
3. It can be avoided if there is a wrist injury.
4. Heart patient and high blood pressure patients should consult their doctor.
5. In case of any back problem, perform under proper guidance.
6. As it involves knee movements, it must be performed with caution in case of knee stiffness or arthritis.

Conclusion

A diet rich in vitamin B12 and vitamin D along with regular Suryanamaskar practice can effectively combat deficiency of these two vitamins through increased sun exposure and improved dietary intake. While Surya Namaskar does not directly impact vitamin B12 and vitamin D levels, it helps in proper digestion and utilisation of food and improves the health and activity of different organs. Coupled with a diet inclusive of vitamin B12 and vitamin D-rich foods, it can help maintain adequate nutritional status of these vitamins. For those with restricted diets, particularly vegetarians and vegans, fortified foods and supplements are crucial to prevent deficiencies. This integrated approach promotes overall health and well-being, addressing common nutritional deficiencies comprehensively.

Conflict of Interest: None

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