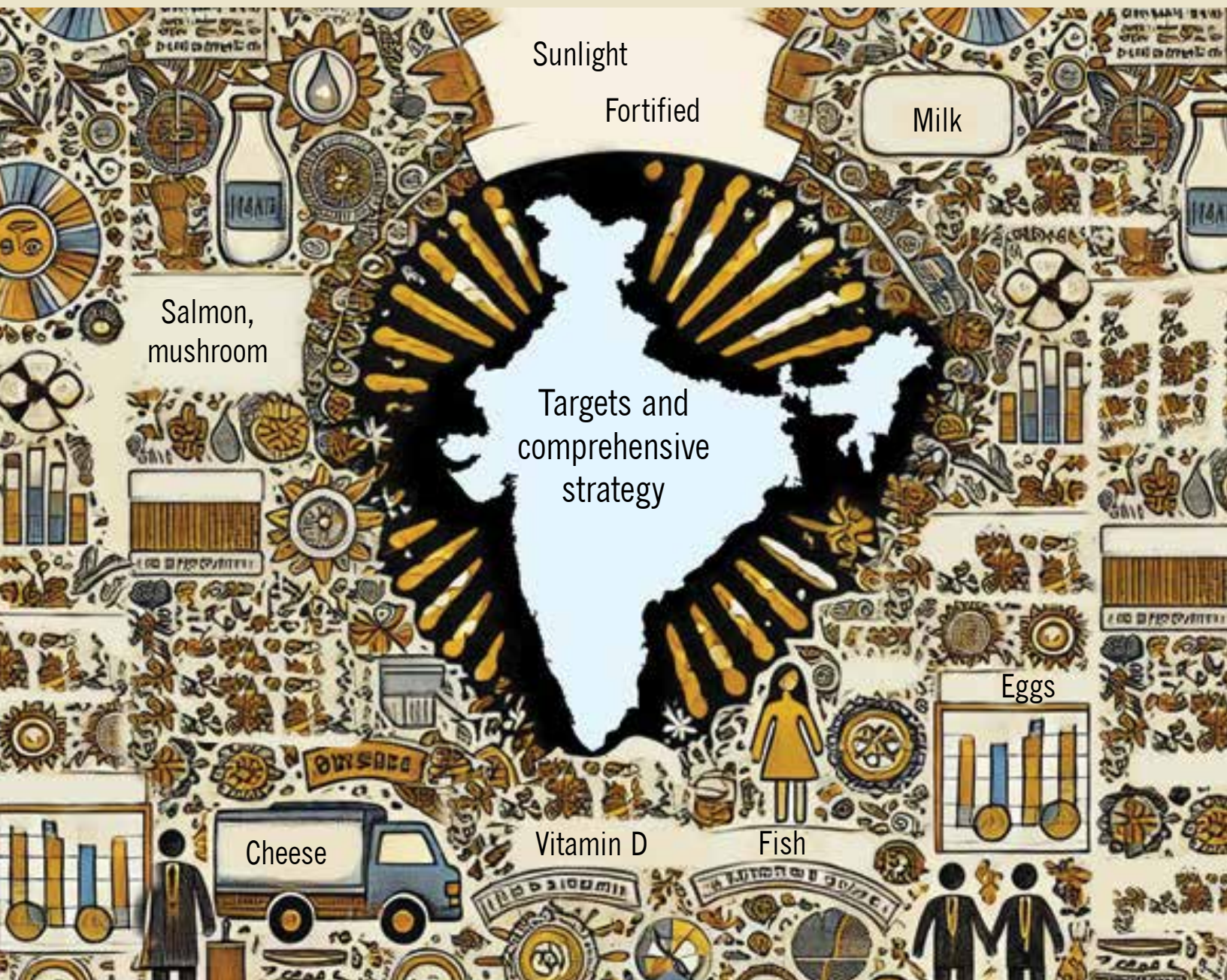


EXECUTIVE SUMMARY



# ROADMAP TO ADDRESS VITAMIN D DEFICIENCY IN INDIA

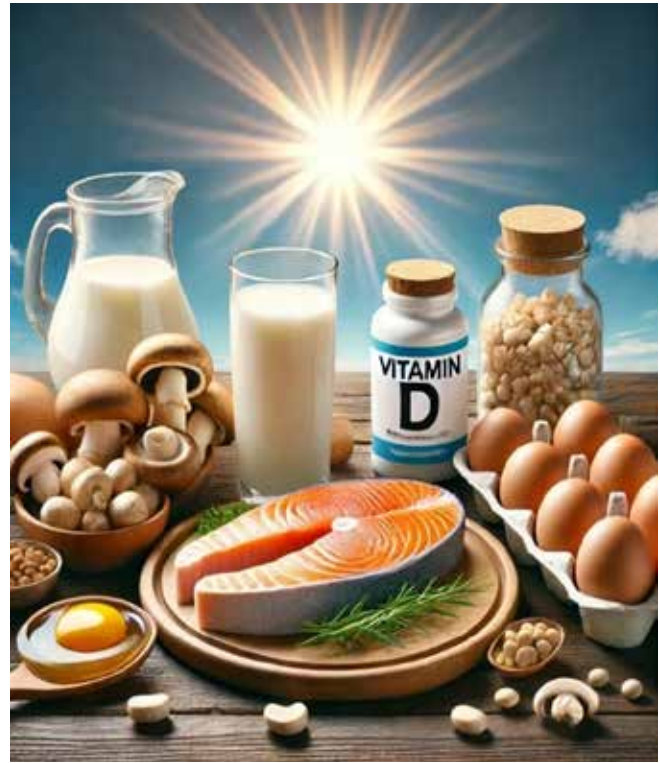


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# Executive Summary

**I**NDIA, with the world's largest population, suffers from widespread micronutrients deficiency. Among them, Vitamin D deficiency has emerged as a silent epidemic, impacting all sections of the population across age groups, irrespective of where they are located and what they do, from children, sportspersons, jawans, outdoor workers to doctors, nurses and other healthcare workers. The consequences are alarming: 46 per cent of children (aged 0–10 years) suffer from rickets, while 80-90 per cent of the elderly suffer from osteoporosis, which increases the risk of fractures and long-term disability. This deficiency threatens national productivity, reduces worker efficiency and is likely to significantly increase healthcare expenditure. While the prevalence of the deficiency is well-known, there are limited efforts to address it as there is no comprehensive roadmap to address Vitamin D deficiency. This report aims to fill that lacuna and help the government develop a comprehensive work plan and create a roadmap to eradicate Vitamin D deficiency, and help India achieve the United Nations Sustainable Development Goals (UNSDGs) 2030, particularly SDG 3 of good health and well-being and SDG 2.2, of eradicating all forms of malnutrition by 2030.

After examining the initiatives taken by national and international organisations and the best practices of other countries, and a comprehensive review of literature on Vitamin D deficiency that focuses on its economic and health impact and the impact of policy interventions, the report presents an overview of the status of the deficiency in India. It then looks at the likely impact, identifies the reasons behind the deficiency, examines the existing policies, and makes recommendations to address the deficiency, so as to create “*Vitamin D Kuposhan Mukht Bharat*”. The report is based on secondary data and information analysis, meta-analysis of literature, key informant interviews (KIIs) and a stakeholder consultation.



Vitamin D, also known as the Sunshine Vitamin or Calciferol, exists in two forms: D<sub>2</sub> (Ergocalciferol) and D<sub>3</sub> (Cholecalciferol). It is primarily obtained through sun exposure, as well as from foods like fatty fish, eggs, mushrooms, beef liver, cheese, fortified products such as milk, margarine, yogurt, juices, and cereals and supplements.

## Key Findings of the Study

1. One in five Indians are Vitamin D deficient.
2. There is regional variation in the prevalence of Vitamin D deficiency, ranging from 9.4 per cent in North India to as high as 38.81 per cent in East India.

3. Children, adolescents, pregnant women and the elderly are the most vulnerable to Vitamin D deficiency in India.
4. Women across all age groups are more vulnerable than men.
5. The indoor lifestyle of urban Indians is contributing to rising prevalence of Vitamin D deficiency.
6. Some initiatives, like milk and edible oil fortification and inclusion of Vitamin D in the list of essential medicines have been taken by the government. The Indian Council of Medical Research – National Institute of Nutrition (ICMR-NIN) released the “Dietary Guidelines for Indians” in 2024, which specifies the requirement and need for adequate sun exposure. They have also launched the Survey for Assessment of Markers of Population Health Activity, Diet and Anthropometry (SAMPADA), earlier known as the Diet and Biomarkers Survey in India (DABS-I), a national survey covering 36 states and union territories with a sample size of 2.5 lakh (subsample of 30,000 for analysis of micronutrient deficiency), which will be the first major survey in India providing the current status of micronutrient deficiencies, including Vitamin D insufficiency.

### Reasons for Vitamin D Deficiency

The absorption of Ultraviolet B (UVB) rays from the sun is the primary source of Vitamin D. Despite the popular belief that India receives ample sunlight throughout the year, existing studies and consultations show that rising pollution levels, urbanisation and modern lifestyle changes have reduced sun exposure. High air pollution in cities blocks UVB radiation from reaching the skin, hindering natural Vitamin D synthesis. Additionally, regions with extreme climates, such as intensely hot summers or cold winters, discourage outdoor activities, reducing sun exposure. Urbanisation and rapid population growth have led to densely packed residential areas, with many individuals residing in high-rise buildings or overcrowded tenements where limited sunlight penetrates living spaces. The modern lifestyle has further reduced sunlight exposure, as most people spend long hours indoors.

Cultural and social norms also play a significant role in increasing the prevalence – these include the pref-

erence for fair skin and the use of umbrellas, sunscreen and full-body coverings to avoid tanning. The naturally higher melanin content in Indian skin further reduces the efficiency of Vitamin D production, requiring prolonged sun exposure to synthesise adequate levels. Studies suggest that individuals with darker skin may require three to six times longer exposure to produce the same amount of Vitamin D as those with lighter skin tones.

Diet further compounds the issue, as there are few foods, such as green vegetables, fish, eggs, mushrooms, beef liver and cheese, with high Vitamin D content; these are also often expensive and out of reach for the poor. Additionally, traditional cooking methods, such as prolonged boiling of milk and other dairy-based beverages like tea and coffee, may reduce the Vitamin D content. Furthermore, a significant proportion of the Indian population, particularly in the southern and eastern regions, is lactose intolerant, limiting their milk consumption and reducing both calcium and Vitamin D intake.

It is difficult to identify the deficiency in the early stages and the cost of testing and treatment is high. Health issues after the coronavirus pandemic along with the growing incidence of non-communicable diseases in the country such as obesity, metabolic disorders, chronic kidney disease and malabsorption syndrome impair the body’s ability to synthesise and utilise Vitamin D effectively.

There is a lack of awareness among the population on how to address the deficiency and there are no clear guidelines or package of practices to address it through the public food procurement and distribution system. Further, policy initiatives are voluntary rather than mandatory.

### Learning from Global Best Practices

Globally, Vitamin D deficiency is a widespread health issue affecting populations across diverse demographic, economic and geographic groups. Several countries and international organisations have implemented a range of interventions to address the deficiency. While international organisations have laid down guidelines, countries have adopted different measures, such as mandatory fortification of food products with Vitamin D, building awareness through mass media campaigns, setting dietary requirements, regular data collection to monitor and evaluate the Vitamin D status of a population and to examine the

**TABLE A**  
**Potential Food Vehicles and Their Fortifiable Micronutrients**

<i>Food Vehicle</i>	<i>Vitamins and Minerals (Fortificant) that can be Added</i>
Wheat Flour	Iron, Zinc, Selenium, Vitamins A, D, B <sub>1</sub> (Thiamine), B <sub>2</sub> (Riboflavin), B <sub>3</sub> (Niacin), B <sub>6</sub> (Pyridoxine), B <sub>9</sub> (Folate or Folic Acid), and B <sub>12</sub> (Cobalamin)
Maize Flour	Iron, Zinc, Vitamins A, D, B <sub>1</sub> (Thiamine), B <sub>2</sub> (Riboflavin), B <sub>3</sub> (Niacin), B <sub>6</sub> (Pyridoxine), B <sub>9</sub> (Folate or Folic Acid), and B <sub>12</sub> (Cobalamin)
Rice	Iron, Zinc, Selenium, Vitamins A, D, B <sub>1</sub> (Thiamine), B <sub>2</sub> (Riboflavin), B <sub>3</sub> (Niacin), B <sub>6</sub> (Pyridoxine), B <sub>9</sub> (Folate or Folic Acid), and B <sub>12</sub> (Cobalamin)
Oil	Vitamins A, D, and E
Milk	Vitamins A, D, Iron, and Folic Acid

*Source:* Extracted from United Nations Children’s Fund. Large-scale Food Fortification for the Prevention of Micronutrient Deficiencies in Children, Women and Communities: Guidance Note. New York: UNICEF, 2023. UNICEF, New York. Link: <https://www.unicef.org/media/151001/file/Large-scale%20food%20fortification%20for%20the%20prevention%20of%20micronutrient%20deficiencies%20in%20children,%20women%20and%20communities.pdf> (Last accessed on January 26, 2025).

impact of government initiatives such as supplementation programmes targeted at different population groups to increase Vitamin D intake.

The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) issued the “Guidelines on Food Fortification with Micronutrients” in November 2006, providing a comprehensive framework for implementing and regulating food fortification programmes globally. Furthermore, WHO and FAO also advocate the global standardisation of reporting mechanisms, enabling policymakers to adapt interventions based on robust data. The United Nations Children’s Fund (UNICEF) issued a guidance note on “Large-scale Food Fortification for the Prevention of Micronutrient Deficiencies in Children, Women, and Communities”, in December 2023, which outlines potential Vitamin D food vehicles for large-scale fortification (LSFF) (see Table A). These evidence-based recommendations serve as a foundation for nations to develop and implement cost-effective, scalable and sustainable Vitamin D fortification policies.

At a country level, there are four key interventions:

- **Fortification:** Countries like Chile, Ethiopia, Pakistan, Canada, Finland, Norway and Sweden have mandated the fortification of dairy products, ensuring consistent population-wide coverage. Mandatory fortification offers uniform coverage, reducing health disparities and ensuring equitable access to fortified foods.
- **Targeted supplementation:** Targeted supplementation is essential for high-risk groups, particularly infants, young children, pregnant women

and the elderly. The United Kingdom (UK), for example, introduced the “Healthy Start” scheme in 2006, providing free Vitamin D supplements to eligible pregnant women, new mothers and young children.

- **Awareness:** Countries like Finland, Canada, and the UK have launched dietary awareness programmes, which includes making people aware of the various dietary sources of Vitamin D and encouraging the consumption of Vitamin D-rich foods.
- **National surveillance and adaptive policy measures:** Effective national surveillance systems are needed to monitor the impact of Vitamin D interventions and refine policies based on evidence-driven insights. For example, the UK’s Scientific Advisory Committee on Nutrition (SACN) conducts nationwide Vitamin D surveys, tracks supplementation programmes and evaluates the effectiveness of fortification measures.

## Addressing Vitamin D Deficiency in India

In India, too, there are examples of best practices that may not have been focused on addressing Vitamin D deficiency but have successfully addressed other deficiencies like Iodine. These can serve as examples to create a comprehensive work plan to address Vitamin D deficiency. While different government agencies are aware of the rising incidence of Vitamin D deficiency and many are trying to come up with measures to tackle it, a co-ordinated effort engaging mul-

tiple stakeholders does not exist. Besides, there is no proactive and comprehensive vision document and a roadmap with clearly defined targets and an estimate of funding requirements. The absence of a comprehensive treatment package implies that patients with Vitamin D deficiency with the same symptoms may receive different treatments depending on the healthcare provider they consult. The total health expenditure in FY 2022-23 was estimated to be INR 9,04,461 crore, which translates to 3.8 per cent of the GDP and the per capita total health expenditure has been increasing since FY 2019-20. However, a significant portion of funding is allocated to issues like tobacco control rather than to address micro-nutrient deficiencies. Lack of government data, gaps in public awareness, lack of structured information flow, limited food fortification practices, and the high costs associated with supplementation further exacerbate the issue of Vitamin D deficiency. While one in five Indians suffer from this deficiency, core ministries such as the Ministry of Health and Family Welfare, Ministry of Women and Child Development and the Ministry of Ayush are yet to launch any programmes or campaigns targeting the deficiency.

The report identifies gaps in food fortification, which include the voluntary nature of fortification, the lack of incentives for product reformulation, the limited number of products allowed for fortification (only milk and oil), the exclusion of milk from the food given to children under the mid-day meal system, the omission of the unorganised/informal sector from fortification drive, etc. Staples are not fortified with Vitamin D; therefore, fortification hardly reaches the masses through the public distribution system (PDS). Some states, like Tamil Nadu, Odisha, West Bengal, Andhra Pradesh, etc., have included eggs in their school meals, while Maharashtra and Gujarat provide milk in their mid-day meals. Such good initiatives have not been scaled up. Similarly, *Project Dhoop*, launched by Food Safety and Standards Authority of India (FSSAI) in collaboration with National Council of Educational Research and Training (NCERT), New Delhi Municipal Corporation (NDMC), and North Municipal Corporation of Delhi (MCD) schools, has not been scaled up.

Approximately 30 per cent of the Indian population is vegetarian and the limited availability of non-animal-based foods rich in Vitamin D and high cost of plant-based Vitamin D-rich foods make it difficult to

address the deficiency through diet. As per the report, “What India Eats”, by ICMR-NIN in 2020, only 8.7 per cent in rural and 14.3 per cent in urban areas consume milk and milk products as per the recommended intake.

An overdose of Vitamin D can lead to health issues; hence, adding Vitamin D supplements in community meals requires due diligence. Additionally, there is limited research and development (R&D) on cost effective fortification through plant-based sources or on developing low-cost testing kits for identifying the deficiency.

Affordability of testing and treatment is a key issue. While government hospitals provide subsidised Vitamin D tests at rates between INR 200 to INR 500, private diagnostic laboratories charge significantly higher fees, often exceeding INR 1,500. In case of supplements, despite being in the national list of essential medicines, the price is very high. For example, the average price of a cholecalciferol tablet of 1000 IU has been fixed by the National Pharmaceutical Pricing Authority (NPPA) at INR 4.31 but the price of a pack of 10 tablets of cholecalciferol can range between INR 48 to INR 130. There are three reasons for this. First, the pricing calculation is not based on the cost of production but on the average price. Second, a high goods and service tax (GST) of 18 per cent pushes the price up and third, the NPPA only fixes the price of cholecalciferol derived from animal sources and not that of ergocalciferol, a plant-based alternative.

The report notes that the upcoming nationwide comprehensive survey led by the ICMR-NIN will be crucial in driving evidence-based policymaking and strengthening national intervention strategies. The report gives nine key recommendations to address the deficiency, starting with a co-ordinated multi-stakeholder effort towards developing a comprehensive Vision Document to eradicate Vitamin D deficiency, outlining clear targets, goals, and strategies. To ensure effective collaboration, the document must clearly delineate the roles and responsibilities of the central and state governments, private sector partners, academic institutions and community organisations. Furthermore, it should include a robust monitoring and evaluation framework to track progress, measure impact and refine strategies over time. Dedicated budget provisions must also be proposed to support research, capacity-building initiatives and public engagement activities.

Given the lack of awareness, a nationwide “*Vitamin D Kuposhan Mukh Bharat*” campaign should be launched to educate the public on the importance of Vitamin D, highlight dietary sources for adequate intake and suggest effective ways to boost Vitamin D levels. This campaign can be promoted through social media, newspapers, television and radio, with customised messaging in local languages to ensure an impact on communities. The Ministry of Education can play a supportive role in integrating nutritional education into the curriculum and promoting awareness of the importance of a balanced diet and micronutrient intake. Schools can implement engaging lessons on Vitamin D in science or health classes, covering its role in the body, dietary sources and the health risks associated with inadequate intake. Visual campaigns, such as posters and infographics, can be used to disseminate key information effectively. Involving parents through workshops on the significance of Vitamin D in collaboration with local health organisations will further enhance community awareness. The Ministry of Education, in collaboration with the Ministry of Youth Affairs and Sports, and the Ministry of Ayush, can organise weekly outdoor activities like yoga sessions and nature walks for kids to ensure that they get adequate exposure to sunlight.

Government entities, such as the FSSAI, can collaborate with organisations like the Global Alliance for Improved Nutrition (GAIN), the WHO, Endocrine Society of India, and other relevant stakeholders to build a multistakeholder platform. This platform could be instrumental in organising conferences, seminars, and workshops aimed at building awareness around Vitamin D deficiency and other nutritional issues.

Food fortification efforts may be strengthened with fortification of staples such as wheat and rice, along with dairy products other than milk and edible oils and to ensure that fortified foods reach the vulnerable through government programmes and the public distribution system. Currently, the FSSAI permits only plant-based sources of Vitamin D for food fortification. Allowing Vitamin D derived from animal by-products, such as lanolin (wool grease), could significantly reduce the reliance on costly imports of plant-based Vitamin D. However, the use of animal-based sources of Vitamin D should be subject to mandatory disclosure.

Targeted supplementation programmes must be embedded into maternal health initiatives, childhood

**FIGURE ES.1**  
Some Roadblocks in Addressing Vitamin D Deficiency in India

Limited Co-ordination Across Multiple Agencies	Lack of Comprehensive Vision Document with Clear Targets	Gaps in Food Fortification
High cost of Testing and Treatment	Limited Multistakeholder Partnerships	Limited Scaling up of Success Stories
Lack of Awareness of Vitamin D Deficiency	Dietary Challenges	Limited Data for Data-driven Policy Making

Source: Compiled by the authors.

**FIGURE ES.2**  
Recommendations and Way Forward

Enhance Inter-Ministerial Partnerships and Co-ordination	Develop a Comprehensive Vision Document	Launch a Nationwide “ <i>Vitamin D Kuposhan Mukh Bharat</i> ” Campaign
Bridge the Gaps in Food Fortification	Focus on Supplementation as a Targeted Intervention	Reduce the Cost of Treatment and Testing
Strengthen Funding and Research to Combat Vitamin D Deficiency	Strengthen the Data Infrastructure	Foster Multistakeholder Partnerships

Source: Compiled by the authors.

immunisation schedules and geriatric healthcare services to protect high-risk groups. Additionally, to improve affordability, the GST on Vitamin D supplements should be reduced. The 10 per cent import duty on Vitamin D supplements (D<sub>2</sub> and D<sub>3</sub>) and testing kits should be lowered to 5 per cent to enhance affordability and accessibility. There should be more R&D for domestic production of cost-effective testing solutions, which along with product reformulation, can be incentivised through subsidies. Some areas of research should include 1) the efficacy of co-fortification with Vitamin D and A, 2) bio-addition of Vitamin D in foods, 3) safety and effectiveness of delivering Vitamin D with childhood vaccinations and 4) preserving Vitamin D in cooking.

Existing programmes/schemes can be leveraged to address the deficiency. For instance, the PM POSHAN

scheme, which has an estimated budget allocation of INR 12500 crore (for FY 2025-26), can be utilised to integrate Vitamin D-rich food items such as milk and eggs into mid-day meals. This initiative would benefit approximately 11.80 crore children across India. Another example is “*Anaemia Mukta Bharat*” campaign under which blood samples are already collected for screening and testing of anaemia. This process can be expanded to include testing for Vitamin D deficiency, ensuring that individuals screened for anaemia are also assessed for Vitamin D levels.

To conclude, given the widespread prevalence of Vitamin D deficiency, no single policy or agency can solve this problem; hence, there is a need for multiple

initiatives, partnerships and collaborations to drive the efforts towards “*Vitamin D Kuposhan Mukta Bharat*,”. As India navigates its way towards *Viksit Bharat* in 2047, a robust healthcare system becomes not just a necessity but the foundation for a healthier and more productive nation. Furthermore, good health is foundational for the young generation to achieve their aspirations and contribute to society. The emphasis on health is important given that India is emerging as an economic powerhouse driven by its youthful population. Addressing the deficiency will not only boost productivity but also reduce healthcare needs and enhance life expectancy, thereby moving towards a *Swastha Bharat*.

**V**itamin D deficiency has been one of the enigmatic micronutrient deficiencies considered earlier as essentially nonexistent except in countries closer to the north pole due to inadequate sunlight. But its extensive prevalence in India and several other sunlight adequate locations raises several questions starting right from validity of biomarkers, environmental pollution and modern lifestyles. Since dietary sources are minimal, supplementation and fortification become a way forward. Clarity even on these interventions is lacking with a multitude of recommendations from RDA levels to mega doses. ICRIER's effort to capture the scientific information available so far through extensive review of published work primarily in India as well as other countries is intended to prepare a guidance document for policy and further research. My compliments to the authors and all the contributors.

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**T**he consequences of Vitamin D deficiency extend beyond rickets in children. Vitamin D strengthens the immune system and reduces the risk of diabetes mellitus, tuberculosis, hypertension and common cancers. While the prevalence of the disease in India is well-known, there are limited efforts to address it as there is no comprehensive action plan to address Vitamin D deficiency. Some steps like milk and edible oil fortification, inclusion of Vitamin D in the essential medicines list and inclusion of the requirement and need for adequate sun exposure in the ICMR-NIN 2024 "Dietary Guidelines for Indians" have been initiated. However, there is a need for multiple initiatives with multiple partners to work synergistically together to drive efforts to overcome vitamin D deficiency in the country. It is commendable that ICRIER has worked towards developing a roadmap towards a "Vitamin D Kuposhan Mukh Bharat".

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