

## RECENT ADVANCES IN ENDOCRINOLOGY

**The Neovitamins: Metavitamins and Vitaminoids**Sanjay Kalra<sup>1</sup>, Shivani Sidana<sup>2</sup>, Madhur Verma<sup>3</sup>, Nitin Kapoor<sup>4</sup>**Abstract**

Many nutrients share some characteristics with vitamins, but do not meet the entire criteria for definition. Metavitamins (like Vitamin A, D, K) may be defined as nutrients which serve a role as vitamins, as well as beyond (meta-) that traditionally is expected from vitamins. Vitaminoids (like choline and inositol) are nutrients which meet some, but not all, of the characteristics of a vitamin. These are sourced from nutritional products, have a well-defined physiological and biochemical role, have a recommended daily allowance, and may lead to dysfunction or disease if taken in inadequate or excessive amounts. As newer physiologic and pharmacologic properties are uncovered, the term "neovitamin" may apply to molecules that are discovered to have vitaminoid properties. These may cause, contribute to, confound, co-occur with, or be a consequence of metabolic disease. We must evaluate and optimize these nutrients while addressing metabolic health.

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**Vitamins**

Vitamins are essential micronutrients, defined as organic substances, required in trace amounts to maintain growth and metabolic processes, as they cannot be synthesized by the body. Vitamins act as catalysts, cofactors or coenzymes, serving a regulatory purpose in homeostasis. While they do not provide calories or energy, they ensure that the organism survives as well as thrives. Recognized vitamins including fat soluble A, D, E and K, as well as water soluble vitamin B (8 types) and C. Discovered over the past century, these 'vital amines' as they were known initially, are an

integral part of our nutritional landscape.<sup>1</sup>

**Neonutrients**

Many more nutrients have been identified over the past few decades. Through these share some characteristics with vitamins, they do not meet the entire criteria for definition. Some of these have vitamin-like activities, while others exhibit actions beyond those classically attributed to other vitamins. We term these as vitaminoids and metavitamins, respectively. As newer physiologic and pharmacologic properties are uncovered, the term "neovitamin" may apply to molecules that are discovered to have vitaminoid properties.

**Metavitamins**

Metavitamins may be defined as nutrients which serve a role as vitamins, as well as beyond (meta-) that traditionally expected from vitamins. The classic example is vitamin D, which works as a hormone that undergoes activation in the skin, kidney and liver, before action on receptors located throughout the body. Vitamin A metabolites, especially retinoic acid, act as hormones with intracrine activity. It activates various nuclear receptors, and also works with transthyretin (TTR) to convert T4 to T3 in the thyroid. Vitamin K also has 'hormonoidal' action, it activates the Pregnane X Receptor pathway, which is active in metabolism of drugs and regulation of inflammation.<sup>2</sup>

**Vitaminoids**

Vitaminoids are nutrients which meet some, but not all, of the characteristics of a vitamin. These are sourced from nutritional products, have a well-defined physiological and biochemical role, have a recommended daily allowance, and may lead to dysfunction or disease if taken in inadequate or excessive amounts. Historically, they may have been labelled as vitamins or pseudo vitamins.<sup>3</sup> However, they do play a clearcut role in health and homeostasis.

Vitaminoids include structural analogue of vitamins, which do not have demonstrable vitamin activity in human beings. One example is pseudo vitamin B12, which is commonly found in spirulina.

**Choline**

Choline, though an essential nutrient, is not classified as vitamin. It contributes to health by being a structural

<sup>1</sup>Department of Endocrinology, Bharti Hospital, Karnal, India; University Centre for Research & Development, Chandigarh University, Mohali, India;

<sup>2</sup>Department of Endocrinology, All India Institute of Medical Sciences, Bathinda, India; <sup>3</sup>Department of Community/Family Medicine, All India Institute of Medical Sciences, Bathinda, India; <sup>4</sup>Department of Endocrinology, Diabetes and Metabolism, Christian Medical College, Vellore, India; Non-communicable disease unit, Baker Heart and Diabetes Institute, Melbourne, Victoria, Australia.

**Correspondence:** Sanjay Kalra. e-mail: [brideknl@gmail.com](mailto:brideknl@gmail.com)  
ORCID ID: 0000-0003-1308-121X

component of cell membranes, rather than acting as a cofactor. It is used for the synthesis of phospholipids, (phosphatidylcholine, sphingomyelin), and acetylcholine. Choline stimulates the release of gonadal hormones, and is a precursor to acetylcholine. Thus, it has hormonoid actions as well. It is also an intra cellular signalling hormone.<sup>4</sup>

### Inositol

Inositol, too, contributes to structural integrity of cells, apart from acting as a second messenger for insulin, FSH and TSH.<sup>5</sup> The National Cancer Institute describes choline and inositol as 'nutrients in the vitamin B complex that the body needs in small amounts to function and stay healthy'.<sup>6,7</sup>

### Metaphysiologic Perspective

These vitaminoids are similar to vitamins in their contribution to health, and in the necessity to achieve optimal outcomes through a dietary intake. They differ from vitamins as they can be synthesized in minute quantities by the human body, and they contribute to structural integrity apart from being involved in immune and metabolic regulation.<sup>8</sup> Thus, they may accurately be termed as metavitamins (function 'beyond' that of conventionally accepted physiology) or as semi essential vitamins (similar to semi essential amino acids).

Metavitamins and vitaminoids are important from an endocrine and metabolic perspective. The increasing burden of metabolic disease, including diabetes, hypertension and obesity, is associated with an imbalanced diet. Multiple dietary factors, such as improper planning, procurement, preparation, preservation, pattern and presentation of food, contribute to metabolic dysfunction.<sup>9</sup> While it is impossible to identify or isolate any single conventional nutrient deficiency, it is well understood that multiple nutrients may affect, or be affected, by such disease.

Metavitamins and vitaminoids, along with conventional vitamins, may cause, contribute to, confound, co-occur with, or be a consequence of metabolic disease. It becomes imperative, therefore, for us to explore and evaluate these nutrients, while addressing metabolic health. Vitamins, vitaminoids and metavitamins, which may be associated with endocrine and metabolic disease, must be explored for their therapeutic and preventive potential.

### Clinical Perspective

A proactive focus on balanced diet, complete in all respects is required in order to prevent and process metabolic disease.<sup>10</sup> This will automatically ensure sufficiency of metavitamin and vitaminoid intake. In cases where intake or absorption cannot meet the demands of metabolism, nutraceutical supplementation may be required. These can be done using rationally created, evidence-based combinations. Ongoing research, including pharmacovigilance, is required to ensure efficacy, efficiency and error-free usage of metavitamin and vitaminoid-based nutraceuticals. Enhanced focus on this aspect of nutrition will help build the discipline of endocrine nutrition, including metabolic nutrition.

Our changing environment has contributed to evolution of epigenetic alterations. This may be addressed by nutritional and lifestyle approaches. Chief amongst these may be the vitamin family. We suggest an open-minded, scientific approach of enquiry and exploration towards vitamins, metavitamins and vitaminoids.

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