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Guest Editorial

Dual Nutrition Burden in India: Challenges and Opportunities

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This thematic issue of the *Proceedings of the Indian National Science Academy* on "Dual Nutrition Burden in India: challenges and opportunities" carries articles contributed by eminent nutrition scientists to document

- elimination of severe forms of under-nutrition and nutritional deficiencies and reduction in moderate under-nutrition,
- persistence of chronic moderate under-nutrition and anaemia
- rising trends in the prevalence of over-nutrition and obesity in all age groups

in India and discusses strategies for the prevention, detection and management of both under- and over-nutrition to achieve the nutrition targets of the Sustainable Development Goal by 2030.

The year 2018 is very important for the nutrition research community in India. The National Institute of Nutrition, Hyderabad is celebrating its centenary; Dr. C. Gopalan "The Father of Nutrition Science in India" is celebrating his birth centenary, and the Nutrition Society of India, a brain child of Dr. C. Gopalan, is celebrating its Golden Jubilee. This thematic issue commemorates these significant events.

In 1918 Sir Robert McCarrison started work in the Beri-Beri Enquiry Unit, housed in a single room at the Pasteur Institute, Coonoor. By 1925, this Unit had grown and was designated as a Deficiency Disease Enquiry. In 1928, the Nutrition Research Laboratories (NRL) was established at the same premises with Dr. McCarrison as its first Director. NRL was shifted to Hyderabad in 1958. On its Golden Jubilee in 1968, NRL was renamed as National Institute of Nutrition (NIN). The Centenary Year of Nutrition Research in India is an appropriate occasion to review the contribution of research carried out by Indian scientists for improvement of nutritional status of Indians.

By a remarkable coincidence, Coluthur Gopalan was born in Salem, Tamil Nadu in 1918. He completed his MD in Medicine in 1943, and in 1946 he became the first Indian to receive the Nuffield Foundation Scholarship. In two and a half years he obtained his Ph.D in Nutrition in the U.K. and returned to India. His long and illustrious career in Nutrition began in NRL. Dr. Gopalan took over as Director of the NRL in 1962, and became Director General of Indian Council of Medical Research in 1973. After his retirement in 1979, he established the Nutrition Foundation of India (NFI) and is currently its President. He was awarded Padma Bhushan by the Government of India for his stellar contribution to Nutrition Sciences in India. He is a Fellow of the Royal Society (FRS). In 2013, the International Union of Nutrition Sciences recognised him as a 'Living Legend in Nutrition'.

The Nutrition Society of India (NSI) was formed in 1967 and is celebrating its Golden Jubilee Year in 2018. NSI is dedicated to disseminating information about current nutritional status, appropriate strategies to improve nutritional status and nutrition intervention programmes in the country. NSI is the recognized Indian representative of the International Union of Nutritional Sciences (IUNS), and of the Federation of Asian Societies of Nutrition.

Currently, the dual nutrition burden affects all countries of the world and all age groups. Globally in 2014, one twelfth of under-five children are wasted and similar number over-nourished; among adults, one in 16 adults are under-nourished and more than a third

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over-nourished. Over-nutrition is associated with increased risk of non-communicable disease and premature mortality. Concerned over the potential adverse health consequences and the urgent need to combat the dual nutrition burden, the United Nations (UN) General Assembly in 2012 set targets to be achieved by 2025 by all countries: 30% reduction in the incidence of low birth weight (LBW); increase in the rate of exclusive breastfeeding (EBF) in the first six months up to at least 50%; 40% reduction in the number of under-five children who are stunted; reduction in the rate of childhood wasting to under 5%; ensuring that there is no increase in the prevalence of childhood over-weight; and 50% reduction in prevalence of anaemia in women of reproductive age.

In 2017 the UN General Assembly proclaimed 2016-2025 as the UN Decade of Action on Nutrition. In addition to the targets set earlier by the World Health Assembly in 2012, the World Health Organization's Action Plan for the Decade included targets for nutrition enablers to achieve the Sustainable Development Goals (SDG) target of reduction in premature mortality due to NCD: halting the rise in obesity and diabetes, and achieving 30% reduction in salt intake and 25% reduction in high blood pressure.

The article 'Nutrition transition in India' (Ramachandran and Kalaivani pp. 821-833) shows that under-nutrition was the major problem seven decades ago. Over time there was a slow but steady decline in under-nutrition. The last two decades have witnessed increase in over-nutrition and associated non-communicable diseases (NCD) in India. Dual nutrition burden can be seen within the same family (over-nourished mother and wasted under-five child), and in the same individual at the same time (a stunted child with high body mass index-for-age, or an over-nourished woman with anaemia) and in the same individual over the years (stunted child becoming over-nourished adult). It is, therefore, essential to assess the nutritional status of each individual before initiating any intervention. Body mass index (BMI) and BMI-for-age in children indicates current nutritional status, and have to be used for assessment of nutritional status in the dual nutrition burden era.

Concerned with the emergence of the dual nutrition burden and the urgent need to accelerate the pace of improvement in nutritional status, NITI Aayog formulated the National Nutrition Strategy (NNS) in 2017. The article 'POSHAN Abhiyaan' (Paul *et al* pp. 835-841), summarises recent efforts to combat the dual nutrition burden by addressing supply-side challenges and focussing on demand generation for nutrition services. NNS envisages convergent action for improving the four proximate determinants of nutrition - income and livelihoods, food, drinking water and sanitation, and uptake of health services to accelerate decline of under-nutrition in India. The National Nutrition Mission (NNM) launched in March 2018, aims to bring about synergy between existing programmes for improving nutritional status of the vulnerable segments of the population. The NNM has set the targets to be achieved per year - reduction in low birth-weight by 2%, stunting by 2%, under-nutrition by 3 % and anaemia (among young children, women and adolescent girls) by 3%.

In the dual nutrition burden era, energy requirement is one of the most widely debated topics. Given that energy requirements are computed on the basis of energy expenditure, accurate estimation of daily energy expenditure is of critical importance. The article 'Are we eating too much?'(Swaminathan *et al* pp. 809-819), describes the current methods of estimating energy expenditure, the fallacies that could arise in estimating it by using the product of basal metabolic rate and the physical activity level, and the factorial method of computing the energy cost of deposition of tissues during pregnancy and child growth. The authors conclude that the current energy requirement recommendations may have to be reconsidered in the context of the dual nutrition burden.

The article 'Low Birth Weight' (Gopalan pp. 843-851) shows that there has not been any substantial decline in the incidence of low birth weight (LBW). This article outlines the measures for dealing with obstetric problems and under-nourished pregnant women which can prevent LBW rates in these populations. She also points out that the LBW babies in India are mature and hence can survive if given warmth, breast-feeding and freedom from infections. She concludes that India's approach based on research of Indian scientists of providing appropriate intensive care for those born prior to 37 weeks and those with birth weight below 2 kg has paid off with India achieving the Millennium Development Goal targets for reduction in Infant Mortality Rate despite continued high LBW rates and very high under-nutrition rates.

Optimal breast-feeding and infant and young child feeding practices are critical to infant survival, health, nutrition and development. The article on 'Infant and young child feeding" (Gupta and Thakur pp. 853-865) shows that currently 54% of Indian women exclusively breast-feed their infants up to 6 months of age; this is higher than the SDG target for 2025 (set at 50%). India should strive to ensure near-universal breast-feeding during the first six months of age to give the best start to infant nutrition. In India, complementary feeding is often delayed and also inadequate both in quality and quantity. The authors have highlighted the need to strengthen implementation of existing policies as well as to scale-up programmatic interventions to reach all mothers to ensure optimal feeding for their infants.

The Food and Agriculture Organisation has accepted that the small stature of South Asian children is not a reflection of food insecurity. Yet even today, India is being ranked low in global developmental indices and global hunger indices because the size of under-five children is being used as the indicator of food insecurity and poor development. The article 'Undersized Indian Children' (Sachdev pp. 867-875) explains the problem associated with labelling all children with lower anthropometric measurements as 'under-nourished' and trying to improve their nutritional status through food supplementation programmes. Evidence is presented to show that only some nutrients or food-based interventions, including those during pregnancy, increase anthropometric indices of the offspring; this improvement too was modest (reduction by 5%-10% of the deficit) and not sustainable. The article reiterates that a narrow focus on nutrients-based solutions will fail to accelerate progress and advocates comprehensive and equitable development of the population over time.

The article 'Size at birth: effect on adult onset disease' (Ramji pp. 877-880) reviews the major contributions made by the New Delhi Birth Cohort and other global studies towards improving the understanding of the inter-linkages among birth weight, under-nutrition in infancy and early childhood, gain in weight and BMI-for-age in later childhood, and increased risk of obesity, hypertension and diabetes in adult life. The author has concluded that the alarming increase in the burden of adult cardiovascular diseases and Type 2 diabetes in Low and Middle Income Countries, including India, is not only a result of the economic and nutrition transition these nations are experiencing, but also related to the high burden of LBW infants who undergo foetal programming which when superimposed by accelerated weight gains in childhood and early adulthood, increase the risk for the adult chronic disorders.

The article 'Lessons from birth cohort studies in India' (Fall pp. 881-889) summarizes the research findings from Indian cohort studies exploring NCD risk in relation to childhood nutritional status. Among those who had a low birth weight, or were underweight in infancy, NCD risk is increased even by relatively modest levels of gain in childhood BMI-for-age; the upward crossing of BMI centiles is associated with an increased risk of adult type 2 diabetes, hypertension, dyslipidaemia, elevated pro-inflammatory factors and metabolic syndrome. Maternal gestational diabetes is an important risk factor for adiposity, glucose intolerance and abnormal cardiovascular stress responses in the children.

Over the decades there has been a substantial reduction in the overt clinical manifestations of micro-nutrient deficiencies. However, estimation of biochemical parameters indicates that a majority of Indians have iron, vitamin A and Vitamin D deficiencies. Iron-deficiency anaemia has been a widespread and persistent public health problem in India for some decades. The article 'Effective interventions to improve iron status' (Nair and Augustine pp. 891-897) explores the three elements of iron bioavailability: the host's gastric acid milieu for iron solubilization, the extent to which habitual diets are able to keep iron in a soluble state, and the hepcidin-mediated inhibition of iron absorption. Studies have shown that, alongside food fortification strategies, simple dietary diversification strategies such as inclusion of vitamin C rich fruits in habitual diets will help to build iron stores and reduce the prevalence of anaemia.

Data from National Family Health Surveys (NFHS) suggest that there has been no consistent reduction in anaemia in the last two decades. The article 'Prevalence of anaemia in India' (Kalaivani and Ramachandran pp. 899-912) compares data on Hb levels from District Level Household Surveys (DLHS) 4 and Annual Health Survey Clinical Anthropometric and Biochemical Component (AHS

CAB) with DLHS 2 carried out a decade earlier, and reports that there was improvement in Hb status in all the vulnerable groups. However, even in 2014-15, a majority of Indians in all age groups and both sexes were anaemic. A three-pronged strategy to increase iron intake in all households: through dietary diversification and use of iron-fortified iodized salt; IFA supplementation to vulnerable groups; and testing and timely treatment of pregnant women with anaemia, will be required to accelerate the pace of reduction in the prevalence of iron-deficiency anaemia and enable the country to achieve the SDG target of reducing the prevalence of anaemia in women of reproductive age by 50%.

Given the low nutrient intake in large segments of the population, high prevalence of micro-nutrient deficiencies and well documented adverse health consequences of such deficiencies, food fortification is the preferred mode of public health intervention to combat nutrient deficiencies,. The article on 'Food fortification' (Ramachandran pp. 913-922) provides an overview of the public health related food fortification scenario in the country. Iron fortified iodised salt (Double Fortified Salt DFS) is emerging as a useful tool to combat both anaemia and iodine deficiency in India. The presence of centralised production facilities and the pre-existing programme for salt fortification with iodine, provide a ready platform to launch DFS. Near-universal and sustained household use of DFS will achieve population-wide increase in the intake of iron and enable a steady and sustained improvement in the iron and haemoglobin status of the population.

The article 'Vitamin D Deficiency in sun-drenched India' (Harinaryan pp. 923-935) deals with paradox of the widespread prevalence of vitamin D deficiency in sun-drenched India. Experimental studies have shown that Indians do synthesize enough vitamin D on exposure to sunlight. Therefore, the widespread vitamin D deficiency may be due to a generally sun-avoiding attitude, the prevailing dress code and deficiency of dietary calcium. Vitamin D deficiency has been shown to be associated not only with osseous diseases but also with the risk of non-communicable diseases. Vitamin D supplementation in appropriate doses should improve vitamin D status and prevent health problems.

Food safety is of vital importance for human health, the national economy, and global food trade. The paper 'Management of Food Safety Risks in India' (Vasanthi and Bhat pp. 937-943) shows that in the Indian context, a variety of food toxicants, contaminants and adulterants have been shown to be responsible for food-borne disease outbreaks. Food toxicants and contaminants can have adverse economic and health implications. In the modern globalized era when food travels across continents, keeping the food safe and secure from contamination risk during the entire food chain is a shared responsibility of producers, processors, traders and the Government. The article reviews the existing institutional set up, standards and regulations, and various aspects of food safety risk management in India in the context of meeting the SDG targets.

Currently non-communicable diseases account for a majority of morbidity and mortality in adults in India. The article 'Diet, Nutrition and Cardio-vascular Disease (Jose *et al.* pp. 945-953) touches upon a wide range of factors that have an impact on the prevalence of cardiovascular diseases (CVDs) in India. The authors explore the roles of national agricultural policies, social factors including individuals' education and income, migration and urbanization of populations, local food environments, diet and nutrition in increasing the prevalence of CVD. They conclude that targeted public health interventions relevant for the Indian population, policy changes and community interventions based on societal needs may be necessary to achieve the SDG targets by 2030.

The article 'Nutrition and its link with diabetes' (Shobana *et al.* pp. 955-963) reviews epidemiological and clinical studies in India which have shown that unhealthy eating habits, high dietary glycemic load, low consumption of vegetables and low levels of physical activity have been the major factors responsible for the rise in diabetes rates. The authors suggest that creating healthier food choices and making them available, accessible and affordable, and increasing physical activity are two important steps

for the prevention and management of diabetes. These interventions, when implemented on large scale, would slow down, if not halt, the epidemic of Type 2 diabetes in Indians.

What are the take home messages from these exhaustive reviews?

The first and the foremost is the fact that in India over 80% in the 0-18 year group and over 60% of adults are normally nourished. If these Indians continue to have appropriate life-styles, dietary practices and physical activity, they will remain normally nourished and healthy.

Under-nutrition continues to be a major problem in Annual Health Survey states with poor infrastructure and poor performance in nutrition sector. This should be viewed as an opportunity to effectively implement time tested cost effective interventions of food supplementation and treatment of infections to achieve rapid reduction in wasting.

In the DLHS 4 states prevalence of over-nutrition and associated NCD are high; longevity is also high. It is a challenge to ensure life-long life style modifications for reducing over-nutrition and life-long medications for NCD. India's nutrition and health systems in these states can leverage the strengths built up over decades, scale-up and improve implementation of interventions. Citizens can adopt healthy lifestyles and comply with treatment regimens. If these are successfully accomplished, this challenge will indeed become an opportunity for improving the quality of life of Indian citizens.

I am grateful to INSA for having given me the opportunity to organize this thematic issue on "Dual nutrition burden in India: opportunities and challenges". All the authors have contributed excellent reviews and co-operated well to ensure timely processing of the manuscripts. The reviewers were meticulous; in addition to their comments and suggestions, most of them made corrections in track change mode to facilitate revisions by authors. Professor Lakhotia and his editorial team were always ready to guide, and quickly responded to queries with clear and concise replies. They all helped to make my editorial task a very pleasant and memorable one.