# Editorial



# Research in nutrition & health interactions: achievements & challenges

India with 2.5 per cent of the global land mass is home to 17 per cent of the global population. In 1947, the country faced major nutrition and health challenges; Bengal famine occurred four years earlier. Majority of Indians were poor, with inadequate food intake and chronically undernourished; undernutrition was associated with more deaths than famine. The prevalence of infections was high due to poor environmental hygiene and lack of safe drinking water. Mortality rates were high and life expectancy at birth was 33 years<sup>1</sup>. Fertility rates were high; there were dire predictions that rapid population growth would 'aggravate the situation and lead to dissolution of India as a viable nation'.

India considered its population as a major potential resource for national development and recognized the importance of optimal nutrition and health for human resource development. Article 47 of the Constitution of India states that 'the State shall regard raising the level of nutrition and standard of living of its people and improvement in public health among its primary duties'<sup>1</sup>. India's founding fathers believed that 'It is only through research, science and technology that India can find solutions to the numerous massive problems that the country is facing' and promoted investment in research and development. The Indian Council of Medical Research had the responsibility of spearheading and coordinating the effort to define dimensions and determinants of nutritional and health problems, evolving, evaluating and recommending feasible interventions that could be translated into national programmes to improve the health and nutritional status of the population.

The present editorial is an attempt to review (i) dividends that the country obtained from the research & development (R & D) investments for evolving India specific intervention programmes in nutrition and health sectors; (ii) how these helped India achieve

the Millennium Development Goal (MDG) targets and move forwards for achieving Sustainable Development Goal (SDG) targets for health and nutrition; and (*iii*) R & D challenges ahead.

## Food is the first requirement

In 1950s and 60s, India lived 'a ship-to-mouth existence'. Investment in R & D on high-yielding varieties of rice and wheat and in lab-to-land agriculture extension education ushered in the Green Revolution; India achieved self-sufficiency in food production within a decade<sup>2</sup>. This enabled India to initiate food for work programme and provide food grains at subsidised cost through the public distribution system. In 2013, India enacted the National Food Security Act (NFSA) providing subsidised food grains to two third of the population as a legal entitlement<sup>3</sup>. During the COVID epidemic, provisions under NFSA were utilized to provide free food grains and two hot cooked meals to all persons who needed them; this prevented acute food insecurity, especially among labourers who were left jobless. India achieved MDG targets for poverty alleviation and food security. Global and Indian projections suggest that despite adverse impact of climate change, India is likely to remain food secure till 2030<sup>4</sup>.

### Nutrition infection interactions

Research studies in 1950s and 60s documented a high prevalence of infections, especially in children. Undernutrition predisposed to infection and infections in turn aggravated undernutrition. Infections were not treated due to the lack of healthcare facilities. Severe or repeated infections resulted in death in young children<sup>5</sup>. Efforts were made to build up primary health services for early detection and effective management of undernutrition in children, protection against unwanted fertility, prevention and treatment of micronutrient deficiencies, and nutrition and

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health education to improve utilization of available services.

By 1990, the rural and urban three-tier healthcare system was built up. Periodic evaluations have identified issues in content, quality and coverage of services and appropriate midcourse corrections have also been taken.

Research studies in Coonoor showed that children suffering from kwashiorkor recovered if treated for infection and fed frequently with low cost, high energy and high protein diets; case fatality rate was below 10 per cent<sup>6</sup>. Case fatality rates declined as Indian clinicians followed these guidelines. However, there was often a relapse when these children returned to their food insecure home. With improvement in food security and access to healthcare, kwashiorkor cases became rare.

Under the Integrated Child Development Services (ICDS) programme, food supplements were provided to bridge the gap between nutrient intake and nutrient requirements in pregnant women and preschool children. Currently, ICDS covers the entire country. Monitoring to detect issues related to the content, quality of food and sustained coverage of children under ICDS and undertake midcourse corrections have been operationalized.

Recent research studies on nutrition-infectioninteraction showed that the prevalence of undernutrition and morbidity due to infection in under-five children continued to be high<sup>7</sup>. The risk of infections in undernourished children was not higher either because small statured children do not have functional decompensation and increased susceptibility to infection<sup>7</sup> or infections in normally nourished children were also high. The deterioration in nutritional status following infection was transient in children who accessed health and nutrition services care<sup>7</sup>.

#### Dual nutrition burden in India

Dual nutrition burden is a phase of nutrition transition, characterized by persistent undernutrition and rising overnutrition. Concurrently, there is a health transition with persistent high morbidity due to communicable diseases (CDs) and maternal and child health problems and rise in overnutritionrelated non-communicable diseases (NCDs). Indian clinicians and epidemiologists have documented the magnitude of dual nutrition and health burden over the last three decades<sup>8</sup>. Conventionally, interventions to improve health and nutritional status focussed on the identification of families below the poverty line and providing them with goods (subsidised food grains) and services (health and nutrition) free of cost. Studies over the last two decades have documented that there are substantial intra-family differences in nutritional status<sup>9</sup>. Hence, in the current dual nutrition burden era, it is imperative that nutritional status of each individual is assessed and individual specific intervention is provided.

## Dual nutrition burden in children

In 1960s, low birth weight (LBW) and high infant mortality rate (IMR) were the major concerns. Research studies carried out in Delhi showed that mature but small Indian neonates survived if given essential care, warmth and breastfeeding. Only neonates who were born prior to 37 wk, weighed <2 kg at birth or were ill, were at a high risk of mortality and required intensive care<sup>10</sup>. These results were confirmed by several centres in India. Based on this evidence, India specific guidelines for providing newborn care were drawn up and implemented through the existing health system. Follow up studies documented that the small neonates grew along a lower trajectory of growth during childhood and became short statured adults. Children who crossed their body mass index (BMI) trajectory upwards during childhood were at a higher risk of overnutrition, diabetes and hypertension in adult life, suggesting that in India, dual nutrition burden begins in  $utero^{11}$ .

In 1950s, low dietary intake and infections were the major causes of undernutrition in children. Genetic factors, parental stature and birth weight were the other determinants of stature. Over years, there has been improvement in dietary intake and access to health care. Currently, food intake is no longer the major factor that modifies stature of children in India. FAO recognizes that in south Asia, small stature is not due to food insecurity<sup>12</sup>.

In India, undernutrition rates in children are computed using the World Health Organization (WHO) child growth standards<sup>13</sup>. The mean height and weight of Indian children lie along the -2SD(standard deviation) trajectory of the WHO growth charts. Hence, undernutrition rates defined as <-2SDof WHO growth standards continue to be high. These small statured children appear to be functionally normal, grow along their own low growth trajectory, survive and thrive with essential primary care. These

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undernourished children do not show functional decompensation such as higher morbidity rates and IMR and under five mortality rates (U5MR) are low (the south Asian enigma)<sup>14</sup>. Nearly eight per cent of Indian children with weight for height <-3SD are categorized as suffering from severe acute malnutrition (SAM)<sup>15</sup>. Research studies indicate that such SAM children living in community settings and not accessing healthcare in nutrition rehabilitation centres do not have high U5MR. It is possible that many of the children currently classified as SAM children may be small children growing along their low trajectory or those with chronic moderate undernutrition (<-2SD of weight for height of Indian children) and may not be at high risk of morbidity and mortality. There is a need to undertake studies to document the BMI for age levels below which functional impairment occurs so that children can be screened for functional impairment, identified and provided the needed care.

Over the last 40 years, there has been a slow but steady decline in severe and moderate undernutrition (weight-for-age and height-for-age) in pre-school children. As the reduction in stunting and underweight were similar over time, wasting rates in children have remained essentially unaltered between 16 and 19 per cent<sup>4</sup>. In school age children, between 25 and 30 per cent of children are undernourished<sup>4</sup>. Although India had high LBW rates (30%) and high undernutrition rates (>30%) in pre-school children, the country had achieved the IMR and U5MR targets set by MDG by using India specific guidelines for health care in children. Although the country will not achieve SDG targets for reduction in LBW, stunting and wasting, it is likely to achieve SDG targets for IMR and U5MR<sup>16</sup>.

Reported overnutrition rates in pre-school children (Z scores for BMI  $\geq$ 2) are  $\leq$ 3 per cent and in schoolage children are about 10 per cent<sup>17</sup>. This apparent increase in overnutrition is mainly because the WHO has defined overnutrition in school-age children as Z scores for BMI >117. Research studies have shown that Indian children and adults have higher adiposity as compared to Caucasians for any given BMI and show decreased insulin sensitivity and dyslipidaemia at a lower BMI and age. Studies are needed to document the level of anthropometric indicators and body composition measurements at which functional decompensation as assessed by insulin sensitivity and dyslipidaemia occur in Indians. These may be useful for assessing children at risk of overnutrition and NCDs in adult life. In India, overnutrition rate in children is still

low. Research studies suggest that adequate physical activity and preventing habitual consumption of energy dense food stuffs may halt rise in overnutrition. Early detection and effective management of overnutrition in childhood will pay rich dividends for reduction in adult adiposity and NCD risks.

#### Dual nutrition and disease burden in adults

In 1947, majority of Indians were undernourished because they were physically active and had inadequate food intake. Over time, there has been a slow but steady decline in undernutrition rates mainly due to improvement in household food security. Studies indicate that currently average energy intake is about 100 kcal/day higher than the requirement in adults. In the last two decades, there had been a steep decrease in physical activity and relatively smaller reduction in energy intake resulting in a steady and sustained increase in overnutrition and increase in risk of NCDs<sup>4</sup>. Research studies have shown that increase in discretionary physical activity halts further rise in overnutrition. With improved access to services for prevention, early detection and effective management of overnutrition, it might be possible to halt the increase in overnutrition and NCD over the next decade.

### Way forward

India is in the midst of a nutrition and health transition. In the last seven decades, Indian research community has, (*i*) defined dimensions, determinants, time trends and interstate differences in nutritional and health problems; (*ii*) evolved and evaluated interventions; operationalized proven interventions which were then implemented as national programmes, and (*iii*) India's intervention programmes based on India specific health risk assessment in relation to nutritional status (for example, birth weight and IMR and undernutrition and U5MR) have enabled India to achieve the MDG targets for IMR and U5MR.

Over the next decade, assessment and grading of nutritional status using globally accepted standards for anthropometric indicators and blood biomarkers will have to continue to ensure the early detection of emerging problems.

There will be a need to invest in research studies to define functional parameters which will be useful in the assessment of health risk in this dual nutrition burden era, evaluate their usefulness as screening tests in the healthcare setting and undertake translational research on how to implement such screening, early detection and effective management of health problems through the existing system.

Behavioural research studies are needed to assess how to improve acceptance and utilization of screening of apparently healthy persons for the early detection and management of nutritional and health problems; and to improve compliance with lifestyle modification and lifelong medication required for improving health outcomes in persons with NCD.

Continued investment in R & D in health and nutrition can enable Indians to achieve optimal health and nutrition and improve their quality of life.

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