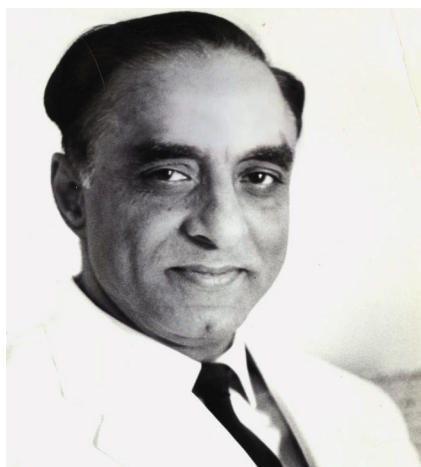


Coluthur Gopalan: a legend in nutrition science

Kamala Krishnaswamy and Mahtab S. Bamji



Coluthur Gopalan.

Coluthur Gopalan is an internationally acclaimed nutrition scientist, currently President of the Nutrition Foundation of India, New Delhi. During his career in nutrition research, spanning more than six decades, he held eminent positions including those of Director, National Institute of Nutrition, Hyderabad, and Director General of the Indian Council of Medical research (ICMR). He was a trail-blazer in his chosen profession, and helped to shape the nutrition agenda of policy makers in successive governments. An international nutrition journal 2010 described him as 'a distinguished and accomplished combination of physician, nutritionist, teacher, and researcher, policy-shaper, executive and activist'.

The Gopalan family

Now in his mid-90s, Gopalan lives with his daughter Malini in Chennai and continues to read, think and breathe nutrition! After more than 72 years of married life, his wife, Seetha (whose friendship many of us cherished), passed away in early 2013. Malini has a post-graduate degree in physics and is a fully qualified, practicing company secretary. She has inherited her father's gift for writing and is a freelance writer. His son, Sarath Gopalan, a consultant paediatric gastroenterologist based in New Delhi, is also Deputy Director at Nutrition Foundation of India. Gopalan's four grandchildren

and four great-grandchildren stay in close touch with him, and he often shares his reminiscences with them.

The early years

Gopalan was born on 29 November 1918 in Salem, Tamil Nadu, where his mother's family lived. His father was in the police service in Madras, and that is where Gopalan grew up under the watchful eyes of a disciplinarian father and a lenient and indulgent mother. It was a conventional, orthodox Tamil Brahmin joint family, and the household was always bustling like a beehive with siblings, cousins, aunts, uncles and a stream of more distant relatives and visitors.

At the age of about 10, Gopalan moved from a local school to the Madras Christian College High School, already famous then for its quality of education. There, he was exposed to a microcosm of the wider world, with its eclectic student population and visionary teaching faculty, headed by Kuruvi Jacob, who went on to become a legend in the field of education. Jacob was generous in his praise of Gopalan's school performance, and encouraged him to aim high.

Somewhere along the way, with Gopalan continuing to show exceptional intelligence as well as diligence in academics, the decision was made to go for a career in medicine. Who exactly made the decision? Father or son? It does not matter, because it turned out to be the right one, and neither of them ever regretted it.

The medical college years at Madras Medical College rolled by. The teaching faculty consisted mainly of British doctors, many of them inspirational teachers.

Apart from the demanding schedule of college classes and hospital rounds, Gopalan was keenly aware that the country was going through a political upheaval. The days of the British Raj were obviously numbered. As a teenager, Gopalan remembers attending numerous public meetings in which gifted orators such as Satyamurthy exhorted Indians to throw away the yoke and seek freedom. On many of his frequent trips to the Marina beach with friends, he would spot

Rajaji (C. Rajagopalachari, who later became the first Governor-General of Independent India) strolling on the sands with a friend, or sometimes alone.

Gopalan's medical college years were spent on the cusp of important events. The World War II was going on. India was poised to attain independence. And Alexander Fleming serendipitously discovered the first antibiotic in 1940!

A couple of years after Gopalan obtained M D from Madras University in 1943, he was called for an interview for a government scholarship for higher studies. By this time he was married and had two little children. He travelled to Delhi for the interview with only a vague idea of what it entailed. At the end of the interview he was told that instead of the government scholarship the interview board had decided to offer him *the first Nuffield Foundation Scholarship* ever to be awarded to an Indian. Never having heard of it, he had to look up for details of this scholarship! But it took him to distant England (with a reluctant father, finally having been persuaded to allow his son to cross the seas), leaving his young family behind for a full two and a half years.

Gopalan made an instant impression on his mentor in England. Though he had initially been sent only for two years of research training, his guide offered to enrol him for a Ph D in Nutrition. 'My scholarship money is only for two years', pointed out Gopalan. We will cross that bridge when we come to it, was the mentor's response. Then followed two years of the most intense work, long hours of hands-on handling of experimental animals, conducting experiments and tabulating results. 'I had to do everything myself', he recalls, 'right down to cleaning the cages. No helpers and hand-holders at all'.

With a few months of extension of the scholarship period, Gopalan had his Ph D and a D Sc in two and a half years flat, and was soon sailing home to a far from clear future in his home country.

Within months thereafter, he found his future in nutrition research. Or rather, a nutrition research career found him. Many of his relatives were disappointed. Here was this brilliant young man in their

family, who had blazed new trails in academic excellence. He could put up his name plate, go into medical practice and become a millionaire very soon. Instead, he was going off into uncharted waters, agreeing to work for a pittance of a salary in distant Coonoor, way up in the Nilgiri hills, in the shabby environs of what had once been a small jam factory which had been taken over to house a laboratory. But it turned out to be the beginning of what Gopalan always described: a very challenging and fulfilling career.

Why nutrition research?

As a newly minted doctor in 1940, having qualified for his MBBS degree with flying colours, Gopalan had already begun to realize where his true interest lay. Those were the times when India was a veritable museum of florid clinical forms of nutritional deficiency diseases like, Kwashiorkor (protein-calorie malnutrition), keratomalacia (blindness due to vitamin A deficiency), rickets and osteomalacia (vitamin D deficiency), beri beri (vitamin B1 deficiency), pellagra (niacin deficiency), scurvy (vitamin C deficiency), severe iron deficiency anaemia aggravated by malaria and hook worm infection, pendulous goiters (iodine deficiency), etc. The nutrition ward in Madras Stanley hospital of which Gopalan was in charge as house surgeon, was full of these cases. He realized that thousands more existed in the countryside, for whom medical help was out of reach. And then in 1943 came the Great Bengal Famine that killed an estimated 2.5 to 3 million people – far more than all the lives lost in the World War II. The die was cast. This was the turning point when this young doctor decided to devote his medical career to ‘the investigation and mitigation of the nutrition-related problems of Indians, especially



Gopalan explaining the work done at NRL to Prime Minister Jawaharlal Nehru (1950).

those of the disadvantaged sections’ to put it in his own words.

From small beginnings

Gopalan’s professional career in nutrition research started at the Nutrition Research Laboratory (NRL), founded by Robert McCarrison under the British Empire. It was located in a disused jam factory, in the premises of the Pasteur Institute in Coonoor, Tamil Nadu. Gopalan was the Deputy Director, and the staff strength, as one can well imagine, was minimal. In 1950 Prime Minister Jawaharlal Nehru visited NRL. Impressed by the work being done there, Nehru wanted a government programme to be drawn up for providing mid-day meals (MDM) to children in government schools. Gopalan sent him a proposal, which was circulated to all the chief ministers, but it stopped at that. Many years later, the idea fructified, and today all government schools have an MDM programme, which has greatly improved school enrolment and reduced drop-out rates, even if it has not improved child nutrition status significantly.

To great heights

In the late 1950s, NRL moved to Hyderabad, and Gopalan took over as Director in 1962. Under his stewardship, the institution grew and flourished. It rapidly won recognition both nationally and internationally. In 1969 during its Golden Jubilee, NRL was designated as ‘National Institute of Nutrition’ (NIN) in recognition of its growth, development and contributions, at a glittering function graced by India’s Health Minister and by the Director General of the World Health Organization among many other dignitaries. NIN continues to flourish as the apical institution for nutrition research in India.

Nutrition being a multi-disciplinary subject, the institute set up divisions such as clinical division, biochemistry, biophysics, endocrinology, analytical chemistry and the field units. Later, a Food and Drug Toxicology unit was added. With nutrition wards set up in three large city hospitals and field units in several villages, NIN continually extended its range and reach. In addition, there was a state-of-the-art laboratory animal facility to improve research workers’ access to laboratory animals. This has now become

the National Centre for Laboratory Animals (NCLAS), a resource centre. NIN also has a very nice museum covering different aspects of human nutrition.

At NIN, Gopalan also initiated a training programme for scientists from India as well as other South East Asian countries. The course was much sought after, and hundreds of medical and science graduates benefited from it, over the years. Some of them went on to occupy important positions around the globe.

Experience sharing by authors

‘We who worked at NIN have experienced at first hand the unique scientific culture that Gopalan helped to nurture at NIN during those years. Apart from research activities, weekly group meetings, seminar and journal club meetings were held to discuss the most recent advances in nutrition and the work done at NIN. The library was very good and (till recently) used to stay open all the 24 hours. He had a unique way of guiding research by asking questions. This forced us to think and plan. Unlike many senior scientists, he never allowed his name to be put on a paper in which he felt his contribution was not sufficient to merit it. Thus, I regret not having him as a co-author on any of my publications, despite having benefited immensely by picking his brain.’

– Mahtab S. Bamji

‘Personally, I am greatly indebted to Dr Gopalan who shaped my career and guided me through my sojourn in the field of nutrition. I knew nothing about nutrition or research, but his intuition that I would be suitable for the organization, filled me with courage and confidence. The younger generation looked up to him and he in turn motivated, energized and enabled all of us to work hard and be productive. He was not interested in excuses for not doing the work and was interested only in the work being done. He is a strict disciplinarian and expected everyone to be punctual and perform their best.’

– Kamala Krishnaswamy

Indian Council of Medical Research

In 1973, Gopalan moved to New Delhi to take over as the Director-General of ICMR. During his tenure (1974–1979), he promoted research in communicable diseases and modernized several of the ICMR research institutions. He set up three new institutes: (i) Malaria Research Institute; (ii) Vector Control Research Institute and (iii) Leprosy Research Institute, to develop and implement innovative preventive and management strategies for these ‘orphaned’ tropical diseases. He gave a new orientation to medical research in the country, making it more relevant to the country and ensuring adequate emphasis on the problems of communicable diseases and those related to poverty and under nutrition. He also launched a unique Talent Search programme (which he considers to be one of his ‘flagship’ programmes) to attract young, aspiring medical graduates to a career in research. The programme was successful, and many of the early talent scholars are holding important positions today.



Gopalan, the then director, guiding Radhakrishnan through the NIN museum.



Presenting to the Prime Minister Atal Behari Vajpai the *Proceedings of the IX Asian Congress of Nutrition*, New Delhi, 2003.

After laying down office at ICMR, Gopalan developed an Action Programme in Nutrition for South East Asia, as consultant to the WHO.

Nutrition Foundation of India

Gopalan retired from government service in 1979, but not from service to the nation. In 1980 he set up the Nutrition Foundation of India (NFI) in New Delhi. This non-governmental organization works on nutrition-related problems in the country, particularly in the areas of public health nutrition and nutrition policy. As Founder President, he continues to guide and keep abreast of all its activities. He has been fortunate to have Prema Ramachandran as Director, to take the institution forward, according to his vision. NFI has been bringing out publications and bulletins on various aspects of nutrition policy and programmes. It has taken up studies, such as the effect of n3-fatty acid on birth weight, detection and management of anaemia in pregnancy and effect of calcium/vitamin D supplements during early childhood on growth. The institution has undertaken evaluation of national programmes such as nutrition programme for adolescent girls, MDM programmes in MCD schools in Delhi and is currently participating in the clinical anthropometric and biochemical component of the Annual Health Survey.

Major contributions in research

Gopalan’s approach as a researcher was to start with facts, rather than from an existing hypothesis. His scientific curiosity and acumen led him to turn towards seeking India-specific explanations and solutions for diseases arising from nutrition deficiency. His penchant for seeking long-term solutions, rather than quick-fix ones, made him a life-long advocate of the food-based approach for prevention of nutritional deficiencies. He always urges nutritionists to look to *the farms, not the pharmacies*.

Protein-calorie malnutrition

Kwashiorkor and Marasmus (protein-energy malnutrition) were two major nutritional problems affecting children not only in India but worldwide. The widely held view that prevailed till late seven-

ties was that Kwashiorkor was due to deficiency of protein in the diet. Based on this view, international agencies were advocating protein concentrates (such as fish protein concentrates) for developing countries as a solution to the problem.

Gopalan’s path-breaking contribution was the convincing demonstration that the basic deficiency underlying Kwashiorkor in India was primary calorie deficiency and not protein deficiency, as was being generally believed. He showed that if the habitual household diets with marginal improvements were fed to children in amounts which met their caloric needs, their protein needs would be largely met. This finding implied that developing countries like India could solve this problem through judicious use of indigenous, inexpensive, locally available foods. This view was put forward by him at a time when the ‘protein hypothesis’ was at its peak, as early as 1968, in a classical paper entitled ‘Kwashiorkor and marasmus: evolution and distinguishing features, in *Calorie Deficiencies and Protein Deficiencies* [Gopalan, C., *Proceedings of a Colloquium held in Cambridge, April 1967* (eds McCance, R. A. and Widowsen, E. M.), J&A Churchill Ltd, London, 1968, p. 498].

The above paper was reprinted as a ‘Medical classic’ by the *National Medical Journal of India*, 24 years later, in 1992 along with remarks by John Waterlow.

The paper published nearly a quarter of a century ago and still widely quoted, had a very important influence on all of us working on childhood malnutrition.

This paper of Gopalan’s had an impact in three ways: it showed the artificiality regarding malnutrition, as it evolves in a community, as a single-factor disease; it restored the balance when the pendulum had swung too far towards exaggerating the importance of protein; and it displayed the dangers of basing public health policy on inadequate scientific evidence.

– J. C. Waterlow
London School of Hygiene and Tropical Medicine, London, UK

Beri-beri

This is a disease of yesteryears, no longer seen in India, though sub-clinical

thiamine (vitamin B1) deficiency persists. Until 1950s, both the wet and the dry variants of the disease existed. Routine vitamin B1 supplementation was mooted as the remedy by R. R. Williams. In India, the disease seemed to be more entrenched in Andhra Pradesh where highly polished rice was the staple. Almost all the vitamin B1 content of rice is in the bran. Rice eaters further south, did not have the problem as they ate less-polished rice or parboiled rice. By advising the government to supply less polished rice, the disease died a natural death. This showed that a food-based approach rather than supplements of vitamin B1 worked.

Pellagra

Pellagra, a classical nutritional deficiency (nicotinic acid) disease, was always believed to be a disease of maize eaters. It was attributed to deficiency of the essential amino acid, tryptophan (precursor of niacin) and to the fact that nicotinic acid is in a bound form in maize. In India, Gopalan and colleagues noticed high prevalence of pellagra in populations for whom sorghum (jowar) was the staple with little else. Both maize and sorghum have high contents of leucine, which inhibits absorption of nicotinic acid. Leucine-isoleucine imbalance was found to be the biochemical basis of the disease. Later studies showed that the disease can be cured by correcting the imbalance or by administering nicotinic acid. Increased production of rice, and access to rice at subsidised price through the public distribution system resulted in rice becoming the staple cereal amongst the erstwhile jowar eaters, and pellagra



Gopalan receiving the lifetime achievement award from the president of the National Academy of Medical Sciences, November 2005.

disappeared without needing niacin supplements.

Nutrition and reproductive health

Gopalan defined the prevalence and adverse consequences of under-nutrition and anaemia in pregnancy on the mother-child dyad. Studies on beneficial impact of maternal food supplement and iron folic acid supplements to pregnant women on maternal nutrition and birth weight of the offspring, laid the foundation for food supplementation under the ICDS programme and iron and folic acid supplementation under the national anaemia prophylaxis programme to pregnant women.

While the importance of breast-feeding for infant survival, health and growth is now recognized, in the 1940s and 1950s breastfeeding was considered to be a primitive practice in underdeveloped countries. It was at this time that Gopalan showed, through classical studies, the importance of breast-feeding for infant growth and also the effect of maternal dietary intake and nutritional status on breast milk composition. His studies also showed that if the energy cost of lactation is not met with higher dietary intake in lactating women they tend to lose weight in the first few months of lactation. These studies led to inclusion of lactating women, among those receiving food supplementation under ICDS programmes.

Other major contributions of Gopalan in the aetio-pathology of deficiency disorders include the role of pantothenic acid in the burning feet syndrome and the role of fatty acids in phrynoderma.

Food toxicology

The Food and Drug Toxicology Research Centre (FDTRC) at NIN under Gopalan's guidance identified the problem of neurotoxicity due to *Lathyrus sativus* (kesari dal) consumption. This led to a ban on cultivation of lathyrus in certain states in India. The link between aflatoxicosis and hepatic carcinoma was demonstrated by him and his colleagues in experimental animals. His studies on fluorosis are yet another significant addition to food-related toxic disorders (environmental factors associated with excess intake of fluoride affecting skeletal health).

Dietary fat and CVD risk factors

The importance of dietary fat in the pathogenesis of atherosclerosis is now well recognized. However, in the 1950s, there was very little recognition of the link between the quality of fat, hypercholesterolemia and atherosclerosis. Gopalan's papers in *Lancet* in 1956 and the *Indian Journal of Medical Research* in 1959, showed striking differences in serum lipid profile with butter and hydrogenated fat on the one hand and gingili oil, mustard oil, groundnut oil and corn oil on the other. This is one of the earliest demonstrations of the importance of essential fatty acids and the deleterious effects of trans fatty acids.

Nutritive values of Indian foods and recommended dietary allowances

The publication *Nutritive Value of Indian Foods* was Gopalan's brainchild. Based on analyses of over 500 Indian foods, and having undergone periodic revisions, it is even today a bible for professionals in the field. This invaluable contribution is the basis for calculating the dietary intake of all nutrients. India was the first developing country to have its own 'recommended dietary allowances' under the leadership of Gopalan.

Promoting the meeting of minds

Nutrition Society of India

Gopalan always believed that communication, information-sharing and networking among nutritionists will serve to accelerate progress. Also, nutrition was being subsumed under the areas of health and agriculture, but needed to be flagged as an important subject for India's development. He, therefore, mooted the idea of forming a 'Nutrition Society of India'. Despite initial scepticism from some quarters about its viability, the Society was born in 1966 and today has a membership of over 1500. It offers a unique platform for nutrition scientists from all disciplines to meet, discuss and advise the government on policies.

Asian Congress of Nutrition

Gopalan was also responsible for major efforts towards forging a fraternity of Asian nutrition scientists who could talk

directly to each other. He initiated the series of Asian Congress of Nutrition. The first Congress was held under his leadership in Hyderabad in 1970 to be followed soon after by the formation of the Federation of Asian Nutrition societies. Since then, ten Asian Congresses of Nutrition have been held at regular intervals, and the ninth was held in Delhi in 2003 again under his Presidentship.

The way forward

As India transitions into the double nutrition burden era, confronting both under-nutrition and overnutrition; as it attempts to reduce poverty and meet the aspirations of its growing population; as it seeks to become an important economic power, what should be the priorities and guiding principles of nutrition scientists?

Gopalan believes there should be absolutely no compromise on the food-based approach as the bedrock of nutrition pol-

icy. He also says that heavily-subsidized free food grain distribution programmes, while excellent as a time-bound, targeted measure to combat hunger in poorer segments of population, cannot be sustainable in the long run. Only empowerment through education (awareness generation), skill development and employment generation for the skilled workforce with adequate emoluments can lead to sustainable long-term food security.

Gopalan feels that we have not sufficiently leveraged the latent power of the students of community medicine and home science in hundreds of colleges nationwide, who are uniquely equipped to reach the community and make a difference on the ground.

He is also an advocate of the multi-disciplinary approach to ensuring the nutritional well-being of Indians. Agricultural scientists, health workers, dieticians, doctors, educationists, community leaders, media...in fact all stake-holders

should be encouraged to play their roles in this important task of nation-building.

Gopalan himself has walked the talk. He has dedicated a lifetime to the task of nation-building through his chosen career of nutrition research. Truly a living legend!

Honours, Recognitions, Awards

From the scores of honours and awards received by Gopalan during his lifetime of achievement, we list just a few:

Fellowships: The Royal Society, London, the Indian National Science Academy, the Indian Academy of Sciences, the National Academy of Medical Sciences of India, the Third World Academy of Sciences.

Some important positions held: Director, National Institute of Nutrition, 1963–1973; Director-General ICMR, 1973–1979; President, International Union of

Excerpts from *A Festschrift for Dr C. Gopalan on his 90th birthday*

'For over 60 years, Dr C. Gopalan has been drawing attention to the basic nutritional malady in our country, namely chronic under-nutrition, mostly resulting from inadequate purchasing power. He has therefore been advocating a food based approach to overcoming endemic protein–energy under-nutrition. He has also been emphasizing the need to shift our public policies from just food security at the aggregate level, to nutritional security at the level of every individual child, woman and man.'

– M. S. Swaminathan
M.S. Swaminathan Research Foundation, Chennai, India

'His encyclopaedic knowledge of nutrition and wisdom has influenced, and continues to influence, the manner in which we understand nutrition and undertake design interventions to improve the status quo.'

– S. Plianbangchang
Former Regional Director WHO – SEARO, New Delhi

'He led the nutrition research to a high, which was recognized as the golden era of nutrition sciences in India. His contribution during that phase was seen to be most rewarding since he could put the nutrition agenda in the limelight.'

– K. Tontisirin
Institute of Nutrition Mahidol University, Thailand

'His vision for the future often looked revolutionary at the time he propounded it, but time and again his visionary foresight proved to be correct.'

–M. Gabr
Professor of Paediatrics, Cairo University, Egypt

'The NIN Hyderabad has achieved world status thanks to his efforts and is considered the Mecca of nutrition science in Asia and indeed throughout the world. His tenure as DG, ICMR, was a golden age for the ICMR. I have personally been witness to the events during this period, when research of a very meaningful kind relating to problems special to India were conducted all over the country.'

– S. Padmavati
President, National Heart Institute

Nutritional Sciences, 1975–79; Member, Global Advisory Committee on Medical Research, WHO, 1977–1980.

Significant awards and recognitions: Lifetime Achievement Award from NAMS2005; Padma Shri, 1971; Padma Bhushan, 2003; R.D. Birla Award for Outstanding Medical Research, 1990; International Union of Nutrition Sciences Award, 1989; Sir C.V. Raman Gold Medal of the Indian National Science Academy, 1988; Dhanvantari Award, 1978; Ambuj Nath Bose Prize of the

Royal College of Physicians, London, 1976; Dr B.C. Roy National Award, 1974; Basant Devi Amir Chand Prize (Senior) of the Indian Council of Medical Research in 1960 for research in nutrition and public health problems.

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