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STRATEGIES TO CONTROL MICRONUTRIENT MALNUTRITION

Hunger and malnutrition contribute to about 40-50 per cent of the child deaths in India. Apart from protein energy malnutrition (PEM), which has long been recognised to contribute to high mortality and growth retardation in children, micronutrient malnutrition poses a serious threat to the health of the vulnerable groups of population. Though required in small quantities, these nutrients govern many vital functions connected with metabolism, reproduction, immune mechanism, and intelligence. These 'micro' nutrients, thus have 'micro' health implications. The three important micronutrient deficiencies of public health significance in India are:

(i) vitamin A deficiency leading to blindness in children,

(ii) iron deficiency anaemia contributing to reduced work output and high maternal mortality

(iii) iodine deficiency disorders causing intellectual and neurological impairment.

Although short-term measures to control these deficiencies have been in operation in India for the past quarter of a century, the global movement set in motion by the World Summit for Children (1990)[1] and the International Conference in Nutrition (ICN, 1992)[2] have provided a new impetus to strengthen and expand control measures against micronutrient deficiencies at the national level. The National Nutrition Policy of the Government of India (1993)[3] aims to eliminate vitamin A deficiency and blindness, reduce iodine deficiency disorders (IDD) to below endemic levels (< 10% of population) and bring down anaemia in pregnant women to 25 per cent by 2000 AD. An attempt is made here to review the current policies and programmes, and suggest alternative strategies to overcome micronutrient malnutrition.

MICRONUTRIENT MALNUTRITION IN INDIA

Magnitude

Vitamin A Deficiency

Severe forms of vitamin A deficiency lead to irreversible blindness. Milder forms like Bitot spots in the eyes are observed in about 1-5 per cent of preschool children in the country[4,5]. Longitudinal community studies indicate that in some pockets of the country the incidence of corneal xerophthalmia is between 0.5 to 1 per thousand preschool children[6,7]. The repeat surveys of the National Nutrition Monitoring Bureau[8] in 10 states indicate a decline in the prevalence of Bitot spots from about 2 per cent in 1975-79 to about 0.7 per cent

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in 1988-90; still of public health significance by WHO criteria. Similarly, recent national surveys have indicated that vitamin A deficiency contributes to only 0.04 per cent of the total blindness as compared to about 2 per cent about two decades ago[9].

Iron Deficiency Anaemia

Anaemia, due to iron deficiency, is particularly common in women of the reproductive age group and young children. Surveys of haemoglobin levels of populations in different areas reveal that 88 per cent among pregnant women suffer from anaemia and about 26 per cent have severe anaemia (< 8 g/dl)[10].

Iodine Deficiency Disorders

Goiter has been endemic in the Himalayan and sub-Himalayan region. Recent surveys indicate presence of goitre even in areas outside the sub-Himalayan belt. An ICMR survey in 14 districts indicates that the prevalence of endemic cretinism is very alarming[11]. Among the 150 million people in the endemic regions of the country, more than 54 million suffer from goitre and about 9 million from different grades of mental and motor handicaps[12].

Consequences

Vitamin A, in addition to preventing nutritional blindness, has been considered to promote growth and prevent certain morbidity and mortality in young children. Vitamin A supplementation has been shown to restore cell mediated immune response in the deficient children, and enhance antibody response and macrophage function, suggesting immuno potentiating effect[13]. The role of vitamin A supplementation in reducing child mortality has been controversial. A large community based double blind trial conducted by the National Institute of Nutrition (NIN), Hyderabad, revealed that supplementation with six monthly massive dose of vitamin A to children between 1-5 years of age, did not, *per se,* have any impact either on child morbidity or mortality[14]. The number of deaths were, however, lower in children who had received two doses of either vitamin A or placebo, than in those who had not received the dose perhaps, due to Hawthorne effect or contact effect[15].

On the other hand, studies carried out in Madurai and Nepal[7,16] reveal substantial decline in child mortality after vitamin A supplementation. Interestingly mortality reduction either in Madurai or in Nepal was not associated with any reduction in morbidity. It is, therefore, not clear as to how vitamin A brought about reduction in mortality. Another randomized double blind and placebo controlled trial in Sudan did not reveal any impact of six monthly vitamin A supplementation on child mortality[17].

Severe anaemia in pregnancy is associated with increased risk of maternal mortality causing an estimated 80,000 maternal deaths every year, high incidence of premature delivery, low birth weight, perinatal mortality and foetal wastage. Anaemia in infancy and childhood is associated with poor cognitive abilities, impaired motor development and behavioural changes. Anaemia can also lower resistance to infection, and reduce work output and physical capacity. Iron supplements have been shown to improve the achievement-test scores of school children by 5-25 per cent[18], and children perform better on tests of mental and motor skills.

Iodine deficiency in the mother interferes with the development of the unborn child leading to abortions and still births. The most compelling aspect of IDD is neuromotor and intellectual retardation. The major effect of iodine deficiency is endemic cretinism, which is characterised by growth failure, mental deficiency and deaf mutism. Children born to iodine deficient mothers have reduced IQ scores as compared to those of non-deficient mothers[19].

Determinants

Dietary inadequacy is the main cause for the high prevalence of vitamin A deficiency and iron deficiency anaemia, while environmental iodine deficiency, characterised by poor iodine content in soil leading to deficiency of iodine in food and water is responsible for IDD. Maternal malnutrition, delayed and inadequate supplementation, frequent childhood infections, avoidance of micronutrient-rich foods due to ignorance as a result of high female illiteracy, poor bioavailability of dietary iron and low purchasing power of the families are the important causes for vitamin A and iron deficiencies. In the case of IDD, iodine in the soil is depleted due to frequent flooding, heavy rains or glaciers in mountainous regions.Consumption of unconventional foods containing goitrogens has also been implicated.

Methods of Prevention

There are two basic approaches to prevent micronutrient deficiencies:

(i) Short-term measures like supplementation of specific nutrients either as medicinal doses or through food fortification, and

(ii) Long-term sustainable programmes of promotion of production and consumption of micronutrient rich foods involving horticulture and nutrition education.

Specific Nutrient Supplementation

Vitamin A deficiency

Based on the successful field trials carried out by the NIN[20], a National Prophylaxis Programme against blindness due to vitamin A deficiency is in operation in the country since 1970, covering about 30 of the estimated 85 million preschool children. Six monthly administration of oral vitamin A concentrate (200,000 IU) to preschoolers, particularly to those aged between 9 months and 3 years, is carried out by paramedical personnel (auxillary nurse midwife/multipurpose health workers-ANM/MPHW under the supervision of the primary health care (PHC) Medical Officer. An evaluation of the national programme indicated significant reduction in the prevalence of xerophthalmia in areas where the vitamin A programme was implemented satisfactorily. There was no impact in the other areas due to poor coverage, the reasons for which included inadequate and/or irregular supplies, lack of supervision, poor coordination between the various health functionaries, non-involvement of village level workers, and complete absence of nutrition education[21].

The outreach of the target population is being improved in all the areas where Child Survival and Safe Motherhood (CSSM) projects are in operation and by linking vitamin A distribution with the Universal Immunization Programme (UIP), and the Integrated Child Development Services(ICDS) both of which have infrastructure and an in-built system of monitoring and supervision, and cover a higher proportion of children. There is as yet no scientific evidence which indicates that vitamin A supplementation be extended to infants below 6 months though this is now being suggested by certain institutions.

Iron deficiency anaemia

The National Anaemia Prophylaxis Programme, started by the Government of India in 1970 in all the states of the country, covers pregnant and lactating women, women who accept family planning and children of 1 to 12 years. While the adult beneficiaries receive 60 mg of elemental iron (ferrous sulphate) and 500 μg of folic acid daily, the child beneficiaries are provided daily 20 mg iron and 100 μg folic acid. The tablets are to be distributed to each beneficiary for a period of 100 days by the ANMs, MPHWs and the health visitors.

An evaluation by the ICMR[10] in 11 states during 1985-86, revealed very low coverage and poor performance of the programme. There was no impact of the programme on the haemoglobin levels in pregnant women who had completed 20 weeks of gestation. It is now proposed to concentrate on high risk groups of pregnant and lactating women, and preschool children and, to improve their compliance through a comprehensive strategy of information, education and communication.

Fortification

Iron fortified salt

Though the prevalence of anaemia is particularly high in women, it is observed in all the segments of the population. There is, therefore, a need to develop a strategy to increase consumption of iron in all the groups of population. The NIN has developed a method of fortification of salt with iron as an alternative approach to improve iron status of the general population. An additional 15 mg of iron will be available to the individual on the assumption that about 10-15 g of salt is consumed by an adult in a day. Multicentric field trials have found the salt to be acceptable and the incidence of anaemia was reduced. No untoward effects were observed even among non-anaemic subjects[22]. Currently, iron fortified salt is being distributed on a limited scale in Tamil Nadu, Orissa and Rajasthan.

Iodised salt

The oldest and the commonest control measure for IDD has been fortification of common salt with potassium iodate. Injection of iodised oil has been employed as a specific measure for women and children in hyper-endemic areas. The National Goitre Control

Programme in India has gained momentum only recently, though in operation for the last three decades. An independent assessment of the programme by the Nutrition Foundation of India indicated[23] inadequate production of iodised salt, non-availability of rail wagons for shifting the salt from production centres, entry and free availability of non-iodised salt in endemic areas, lack of quality control, poor supervision, lack of co-ordination between the various departments involved in the programme and, lack of awareness about the IDD in the population[23].

The Government of India is now committed to universal iodisation of the entire stock of edible salt to ensure availability of only iodised salt all over the country. The Government will provide subsidies to prevent cost escalation and start quality control laboratories to ensure presence of 30 ppm of iodine at the production level and a minimum of 15 ppm at the consumer level. Available evidence indicates that consumption of iodised salt, at the current levels of fortification, is quite safe even in non-endemic areas.

Double fortified salt

Since iron deficiency anaemia is also highly prevalent in the areas where iodine deficiency disorders are endemic, the most cost-effective approach to control both these problems of public health importance would be fortification of salt simultaneously with both iron and iodine. The technology for double fortification of salt has been successfully developed at the NIN[24]. Laboratory and clinical studies have shown satisfactory results with respect to stability and bioavailability of iron and iodine[25]. Large scale community trials are needed to confirm its efficiency in controlling the twin problems of iron and iodine deficiencies. Preliminary field trials in tribal areas of Andhra Pradesh indicated no deleterious clinical effects of consumption of the double fortified salt for about two years[26].

Iodised oil

Intramuscular injection of iodised oil has been used for tackling goitre and cretinism in hyper-endemic areas in many countries of the world. The advantage of the approach is that a single dose of 1 ml will provide protection for 3-5 years. The high cost and the difficulty in reaching all the victims of IDD make this effective approach less practicable.

It has been argued that excess iodine in the case of pregnant women can even induce neonatal chemical hypothyroidism (NCH) by suppressing thyroxine synthesis[27]. Iodised oil is usually suggested as an interim measure, till the salt iodisation programme picks up, and that too for areas which are hyper-endemic and inaccessible. Recently, studies[28] have been conducted to explore the possibility of using iodised oil orally, which may be more acceptable to people than iodised oil injection. However, oral iodised oil is even more costly than the injection, since the amount of iodised oil required is twice that needed by the intramuscular route[29].

Dietary Modification

Dietary modification to increase consumption of micronutrient rich foods is the safest and most sustainable long-term strategy. However, it needs an understanding of the food preferences and taboos of the community, and involves behavioural modifications, changing attitudes and practices. Food and Nutrition Board (Government of India), through its network of 67 centres, has been imparting education and training in nutrition and home-scale preservation of fruits and vegetables. These efforts are not adequate.

Attempts to increase production of micronutrient rich foods through horticulture are being made by the Department of Agriculture, Horticulture and Social Forestry. The Indian Council of Agricultural Research (ICAR) has established a number of *Krishi Vigyan Kendras* (KVKs) or Farm Science Centres in various parts of the country to impart training to farmers in the latest agriculture technologies to improve horticulture production. Women extension workers are being trained in agriculture technologies, home gardening and preparation of supplementary foods. Practical approaches attainable through increased production and consumption of nutritious foods, though time consuming and difficult to implement, can only be a permanent solution to all nutritional problems arising from dietary deficiencies.

Constraints and Needs

Many nutrition programmes in India, though in operation for over two decades have not had a significant impact on the prevalence of nutrient deficiencies because of the followings constraints: (i) use of a 'vertical'

approach to control each deficiency; (ii) lack of coordination between the various departments; (iii) resource and man power constraints; (iv) inadequate and irregular supplies; (v)) lack of proper orientation and training to the functionaries; (vi) poor monitoring and supervision; and (vii) a weak education component. These constraints can be overcome with determination and perseverance.

Integrated Assessment

An integrated assessment of the extent and distribution of all the three micronutrient problems should be adopted rather than the current approach of assessing individual deficiencies separately and independently. Assessment of vitamin A deficiency by using Bitot spots in preschool children, and IDD by the presence of goitre in various stages in 6-12 year old children is recommended. The extent of anaemia can also be assessed during these surveys by the estimation of haemoglobin. A well implemented micronutrient surveillance system can be developed to continuously monitor the situation.

Integrated Delivery

Since the health functionaries are involved in the micronutrient supplementary programmes, an integrated mechanism should be developed so as to enable the workers to perform the tasks during their routine visits. They can also monitor the entry of non iodised salt by spot checks of salt at the household level during their routine visits, using the available kits.

Information, Education and Communication

Field programmes can succeed only when the community is well informed and educated about the problems of nutrient deficiencies and the measures of their control, and motivated to utilise the available resources. This involves use of the multi-media approach, adoption of modern techniques of social marketing, on the job training of functionaries, development of messages by formative research, and provision of simple audiovisual tools to the functionaries. Information, education and communication (IEC) is an absolute necessity for control and prevention of any deficiency. Money and manpower should not be bottlenecks in this endeavour.

Home Gardens

In terms of achieving national food security, horticultural production has to be increased to provide adequate quantities of micronutrients. Green leafy vegetables, and yellow/orange fruits and vegetables are rich sources of beta carotene (provitamin A). In India, availability of per capita beta carotene is low and its distribution is unequal, favouring higher income groups. Green leafy vegetables contribute to only about 16 per cent of the total vegetable production. A 50 per cent increase in the productivity of vegetables and fruits can boost the total production of horticultural crops to 100 million tonnes. Productivity can be increased by raising awareness among the farmers about the importance of these foods, supplying good quality seeds and encouraging proper crop management procedures like application of chemical fertilizers and pesticides and reducing post harvest losses.

Home gardens can substantially increase horticultural production at the household level. Use of less familiar but hardy and nutritionally adequate foods like *Basella alba* (a leafy vegetable) and papaya should be encouraged to provide beta carotene. Similar foods can be identified in different regions.

The NIN's home gardening project in 20 villages in two drought prone and backward districts of Andhra Pradesh for three years, yielded encouraging results. About a half of the households were growing one or more beta carotene rich foods as against only 10 per cent at the beginning of the project. Trained manpower were raising village level nurseries. The district administration has now volunteered to operate similar programmes through the existing departments of Agriculture, Horticulture, Social Forestry, Women and Child Development and Health.

Single nutrient deficiencies are rare. Diets deficient in vitamin A and iron usually lack in other nutrients like vitamin B complex and C. Home gardening can, therefore, take care of multiple deficiencies. In the long run, dietary modification, at the household level, will be more cost effective, and perhaps, is the only strategy to completely eliminate nutrient deficiencies. The so called short-term nutrient supplementation programmes cannot go on for ever, and will be more like filling a bottomless pit.

National Plan of Action

Recognising the overwhelming importance of the problem, a comprehensive plan of action is being developed at the national level setting the goal of eliminating micronutrient deficiencies by 2000 AD. It is now realised that sporadic interventions in selected sectors would not suffice to annihilate the problem. Therefore, a multisectoral, concerted action at the district and intermediary levels will be implemented. Included in this armament of measures are nutrition education to create community awareness and motivation to ensure people's participation, nutrient supplementation, food fortification, horticulture production, training of the functionaries *etc.* With such a comprehensive, holistic approach, it can be hoped that the challenge posed by micronutrient malnutrition will be met with success.

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This write-up has been contributed by Dr. K. Vijayaraghavan, Deputy Director, National Institute of Nutrition,, Hyderabad.

ABSTRACTS

Some Research Projects Completed Recently

Pathophysiological implications of coarse cereals.

The study was carried out on healthy volunteers and non-insulin dependent diabetics of either sex to define the effects of a few cereals on serum lipoprotein profile and glucose tolerance. The effect of a mixture of wheat, barley and Bengal gram was also studied

In response to maize, none of the variables examined were significantly different as compared to white bread. The glycaemic response to bajra was significantly lower than that to white bread in healthy subjects, but the two responses were indistinguishable in patients of non-insulin dependent diabetes mellitus (NIDDM). The insulinaemic response to bajra and white bread were not significantly different in either group of subjects. These characteristics do not make maize and bajra very suitable for prevention or treatment of diabetes.

The glycaemic response to barley was significantly lower than that to white bread in both groups of subjects. However, the insulinaemic response to barley was significantly lower than that to white bread only in healthy subjects. In NIDDM patients, there was a tendency for the response to barley to be higher than that to white bread 0.5 h after ingestion. Barley, with a low glycaemic index (68.7 in healthy subjects 53.4 in NIDDM patientsand) and a high insulinaemic index (105.2) in NIDDM patients seems to mobilize insulin in NIDDM. The glycaemic index of the wheat-barley-Bengal gram mixture was 68.6 and 64.9 and the insulinaemic index 88.1 and 66.0 in healthy and NIDDM subjects respectively.

The long-term effects of both barley and the wheat-barley-Bengal gram mixture were an increase in HDL cholesterol, a fall in LDL cholesterol, an increase in HDL/total cholesterol ratio, and a marginal improvement in glucose toterance.

Although barley had favourable physiological effects, its acceptability is likely to be low because of its poor organoleptic properties. Whereas the mixture of wheat-barley-Bengal gram has much better organoleptic properties than barley alone, and may be more acceptable for the prevention and treatment of diabetes mellitus.

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Protection against ascending pyelonephritis by immunization with pili and K - antigen of *Escherichia coli.*

The study was carried out on female Wistar strain albino rats (Wt. 180±20g) to produce ascending pyelonephritis using uropathogenic strain of *Escherichia coli,* to isolate and purify pili and K-antigens and to find out whether immunization with pili and K-antigens provides protection against ascending pyelonephritis.

Ascending pyelonephritis was produced successfully in the rat model by inoculating uropathogenic *E. coli* 06 into the bladder with and without ligation of the left ureter. Histopathology of the kidneys showed significant increase in severity score on days 7 and 14 post-infection in both obstructed and unobstructed kidneys.

Purified capsular polysaccharide K-antigen from uropathogenic *E. coli* contained less than one per cent contamination of nucleic acid and protein. Coupling of K-antigen with bovine serum albumin (BSA) produced a high molecular weight complex eluted into void volume of sepharose 6B column. Immunization with two doses of K-antigen-BSA conjugate at four weeks interval protected 60 per cent rats from ascending pyelonephritis. However, either K-antigen or BSA alone failed to protect the animals against the disease.

SDS-PAGE analysis of purified pili antigen showed a single band at molecular weight of 17 kDa. When tested pili antigen was found to be immunogenic. Animals receiving either active or passive immunization with pili antigen had comparatively low severity score compared to non-immunized infected animals sacrificed on days 7 and 14 post-infection. Pyelonephritis produced damage in the kidney and the transport of glucose and amino acids through renal brush border membrane was also altered (reduced). The changes in the uptake of glucose, L-alanine, L-lysine and L-proline amino acids were partially restored after immunization with pili antigen.

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ICMR NEWS

The following meetings of various technical groups/committees of the Council were held at New Delhi:

Project Review Committee for Research in Non-Communicable Diseases.	July 21, 1994
Meeting on Legal Policies related to HIV/AIDS and Prisons.	July 25 and August 9, 1994
Task Force on Development of an Instrument of Psychological Stress	August 5, 1994

Participation of ICMR Scientists in Scientific Events:

Dr. S.K. Subba Rao, Deputy Director, Malaria Research Centre, Delhi, participated, as a Faculty Member, in the 5th Biology of Diseases Vectors Course at Crete, Greace (July 17-24, 1994).

Dr. G.V. Satyavati, Director-General, ICMR, participated in the Technical Advisory Board meeting of the Council of Scientific and Industrial Research, New Delhi held at Hyderabad (July 22-23, 1994).

Dr. J.J. Rodrigues, Director-in-Charge, Dr. Nita Mawar and Dr. R.R. Gangakhedkar, Sr. Research Officers; National AIDS Research Institute, Pune and Dr. Jayashree Nandi, Research Officer, National Institute of Virology, Pune, participated in the X International Conference on AIDS at Yakohama (August 7-12, 1994).

Dr. Leela Raman, Dy. Director (Senior Grade), National Institute of Nutrition, Hyderabad, participated in the symposium on Safe Motherhood at Stockholm (August 15-16, 1994).

ICMR AIDED SYMPOSIA/SEMINARS/WORKSHOPS/COURSES/CONFERENCES

Symposium/Seminar/Workshop/ Course/Conference	Date & Place	Contact Address
National Workshop on Laboratory Diagnosis of Fungal Infections	August 1-7, 1994; (at Madurai)	Dr. V.V. Pankajalakshmi, Organising Secretary of the Workshop, Institute of Microbiology, Maduari Medical College, Maduari.
X Indian Conference on Family Welfare and Voluntary Sterilization.	August 19-21, 1994; (at Pondicherry)	Dr. Asha Oumachigui, Organising Secretary of the Conference, Department of Obstetrics and Gynaecology, Jawaharlal Nehru Institute of Postgraduate Medical Education and Research, Pondicherry.

Symposium/Seminar/Workshop/ Course/Conference	Date & Place	Contact Address
National Workshop on Neuroepidemiology.	September 1-4, 1994; (at Bangalore)	Dr. M. Gourie-Devi, Organising Secretary of the Workshop, Department of Neurology, National Institute of Mental Health and Neurosciences, Bangalore.
Continuing Medical Education in Psychiatry.	September 10-11, 1994; (at Manipal)	Dr.P.S.V.N. Sharma, Organising Secretary 4th Annual Conference of the Indian Psychiatry Society, Department of Psychiatry, Kasturba Medical College, Manipal.
Symposium on Complex Carbohydrates.	September 15-16, 1994; (at Roorkee)	Dr. Ritu Barthwal, Organising Secretary of the Symposium, Department of Biosciences and Biotechnology, University of Roorkee, Roorkee.
VI National Symposium on Ultrasonics and One Day Workshop on Ultrasound in Medicine.	September 15-17, 1994; (At Tirupati)	Prof. L. Rama Murthy, Convenor, NSU-VI-94, Department of Physics, S.V. University, Tirupati.
National Update on Nutrition in Children.	September 24-25, 1994; (at New Delhi)	Dr. H.P.S. Sachdev, Secretary, Indian Academy of Pediatrics, Department of Pediatrics, Maulana Azad Medical College, New Delhi.
International Conference on Molecular and Metabolic Endocrinology and Contraceptive Technology.	September 26-27, 1994; (at Madras)	Dr. M. Michael Aruldhas, Organising Secretary, Silver Jubilee International Conference, Department of Endocrinology, Dr. A.L. Mudaliar Postgraduate Institute of Basic Medical Sciences, Madras.
MICON-Internationl'94.	November 9-12, 1994; (at Mysore)	Dr. R. Shankaran, Chairperson of the Organising Committee, MICON-International'94, Defence Food Research Laboratory, Siddhartha Nagar, Mysore.
III International Conference on DNA Fingerprinting.	December 13-16, 1994; (at Hyderabad)	Dr. Lalji Singh, Organising Secretary of the Conference, Centre for Cellular and Molecular Biology, Hyderabad
International Symposium on Atherosclerosis, Thrombosis and Transfusion Medicine.	December 15-20, 1994; (at Bombay)	Dr. D. Mohanty, Director, Institute of Immunohaematology, Parel, Bombay.

COUNCIL'S TRAINING PROGRAMMES

Reproductive Biology

At the Institute for Research in Reproduction, Bombay:

... Workshop on Gynaecologic Cytology and Immunocytochemistry (September 26-October 1, 1994).

Endocrinology

At the National Institute of Nutrition, Hyderabad:

... Annual Training Course on Endocrinological Techniques and their Applications (August 1-September 16, 1994).

Nutrition

At the National Institute of Nutrition, Hyderabad:

... Annual Training Course in Nutrition (December 1, 1994-February 28, 1995).

Occupational Health

At the National Institute of Occupational Health, Ahmedabad:

... Orientation Course on Occupational Health for Industrial Medical Officers (September 19-24, 1994).

... Training Course on Air Pollution Monitoring and Risk Assessment (October 19-25, 1994).

... Training Course in Pesticide Residue Analysis (December 5-9, 1994).

Medical Entomology

At the Vector Control Research Centre, Pondicherry:

... M.Sc in Medical Entomology (from August 1994: for 2 years).

Laboratory Animal Technology

At the Laboratory Animal Information Service Centre, National Institute of Nutrition, Hyderabad:

... Training Course for Laboratory Animal Supervisors (September 12- December10, 1994).

Haematology

At the Institute of Immunohaematology, Bombay:

... Training Course in Blood Group Serology and Blood Bank Methodology for Technicians (August 9-September 8, 1994).

... Training Course in Blood Group Serology and Blood Bank Methodology for Medical Officers (August 9-October 7, 1994).

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