ANNUAL REPORT

2005 - 2006

National Institute of Nutrition
(Indian Council of Medical Research)
Hyderabad - 500 007

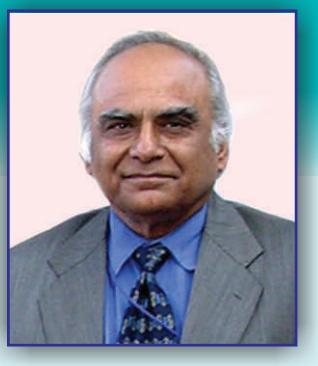
ANNUAL REPORT

2005-2006

National Institute of Nutrition
(Indian Council of Medical Research)
Hyderabad-500 007, INDIA
www.ninindia.org

आचार्य एन. के. गांगुली
महानिर्देशक
Prof. N.K. Ganguly
MD.FRC Path. (London), FAMS, FNA, FASc, FNASc
Director General

भारतीय आयुर्विज्ञान अनुसंधान परिषद
अंसारी नगर, पोस्ट बॉक्स 4911, नई दिल्ली -110 029
Indian Council of Medical Research
Ansari Nagar, Post Box 4911, New Delhi-110029



MESSAGE

The Eleventh Five Year Plan places firm emphasis on alleviation of major nutritional problems prevalent in the country today, especially those arising due to micronutrient deficiency. Dietary inadequacy of certain micronutrients like iron, iodine and vitamin A among our population groups has been a major issue. This silent hunger having deleterious effect on the physical as well as economic health of our people, especially women and children, has become a major cause for concern to the academicians as well as policy makers. The need for well-devised research programmes to provide cost-effective, pragmatic solutions to combat multifactorial nutritional problems is being largely met through the research endeavors of NIN.

The laboratory, clinical and community studies being carried out at this premier nutrition research institute are indeed need-based and aim at providing much awaited answers to several nutritional complexities affecting our society.

I am happy to state that the institute has readily responded to assist in disaster management programme by assessing health and nutritional status of Tsunami-affected population groups. Their studies on tribal population groups also speak of the priority accorded to the health of the underprivileged sections of our society. There is a lot to deduce from the studies carried out at NIN on the molecular basis of non-communicable degenerative diseases such as link of -Crystallin protein between diabetes and cataract and role of resistin in diabetes. This year's research has unearthed some interesting facts relating to the prevalence of hypertension, diabetes, obesity, cancers and other degenerative diseases in the rural communities. Some basic studies involving micronutrients, dietary fats and food fortification hold the potential of impacting on large-scale nutritional interventions in the country. NIN's studies in the areas of pre-clinical toxicology, laboratory animal science and nutrition extension also help to devise better research models for wider use.

I earnestly hope that the institute's research programmes turns out to be more need-based in the coming years and help solve different nutrition-related problems affecting our communities.

Prof. N.K. Ganguly

Tele: 26517204 (D); 26962794, 26962895 Extn: 264 Gram: SCIENTIFIC, Telex: 031-73067
Fax: 91-11-26868662, 26856713, 26514330, E mail: icmrhqds@sansad.nic.in

CONTENTS

RESEARCH STAFF

DIRECTOR

B.Sivakumar, MSc, PhD
(Upto 30th September 2005)

Officer-in-Charge

L. Singotamu, Msc, PhD
(From 1st October 2005)

CLINICAL DIVISION

MATERNAL AND CHILD HEALTH

Veena Shatrugna, MD
(Deputy Director)
B.A. Ramalakshmi, MBBS, DGO
K. V. Radhakrishna, MBBS, DCH
G. Jagjeevan Babu, MBBS
Bharati Kulkarn,i MBBS, DCH
M.S. Radhika, MSc, PhD
G. Amarendra Reddy, MA, MPhil
Prabhavati Paranjape, BSc

PATHOLOGY AND MICROBIOLOGY

L. Singotamu, MSc, PhD
(Deputy Director-Sr-Gr)
B. Sesikeran, MD
(Deputy Director)
P. Uday Kumar, MD
R. Hemalatha, MD
P. Yashodhara, MD
M. Shiva Prakash, MSc, PhD
SSYH. Qadri, MVSc
L.A.Ramaraju, MSc

BIOCHEMISTRY DIVISION

A. Vajreswari, MSc, PhD
(Deputy Director)
V.Vijayalakshmi, MSc, PhD
Ahmed Ibrahim, MSc, PhD
C. Suresh, MSc, PhD
Sanjay Basak, MSc, PhD
S. M.Jeyakumar, MSc, Mphil, PhD
S.Hemalatha, MSc, PhD

MOLECULAR BIOLOGY

Nasreen Zafar Ehtesham, MSc, PhD
M. Kaladhar, MSc, PhD
Sudip Ghosh, MSc, PhD
N. Vijaya Banu, MSc, PhD
Abdul Haseeb, MSc
B. Aruna, MSc

BIOPHYSICS DIVISION

K. Madhavan Nair, MSc, PhD
Y. Venkataramana, MSc, PhD
S. Ranganathan, MSc, PhD
P. Raghu, MSc, PhD
P. Ravinder, MSc, PhD
B. Satyanarayana, MSc
K. Sreenivasulu, MSc
Vasuprada Iyengar, MSc
Gitanjali, MSc

FOOD CHEMISTRY DIVISION

T. Longvah, MSc
(Deputy Director)
P. Amrutha Rao, MBBS, DPH
B. Sreedhar, MSc, PhD
K. Bhaskarachary, MSc, PhD, PGDN & DM
P. Sujata, MSc, PhD
P. Ramulu, MSc, PhD

ENDOCRINOLOGY & METABOLISM DIVISION

M. Raghunath, MSc, PhD
(Deputy Director)
G. Bhanuprakash Reddy, MSc, PhD
Rita Saxena, MSc
P. Suryanarayana, MSc, PhD
C. Vijayakumar Reddy, MSc, PhD
S. Chennaiah, MSc, PhD
D. Sreeramulu, MSc, PhD
L. Venu, MSc
M. Satish Kumar, MSc
P. Anil Kumar, MSc
Megha Saraswat, MSc
T. Mrudula, MSc
Y. Durgakishore, MSc

FIELD DIVISION

G.N.V. Brahmam, MBBS, DPH
(Deputy Director)
Shahnaz Vazir, MA, PhD
A. Laxmaiah, MBBS, MPH
R. Harikumar, MBBS, DPH
N. Arlappa, MBBS
Ch. Gal Reddy, MA, MPhil
K. Mallikharjuna Rao, MSc, PhD
Sharad Kumar, MA, MPhil
M. Ravindranath, MA

STATISTICS DIVISION

K. Venkaiah, Msc
T. Prasanna Krishna, MSc, PhD

M. Vishnuvardhan Rao, MSc,PhD
N. Balakrishna, MSc,PhD
Grace Maria Antony, MSc, PGDCA

EXTENSION & TRAINING DIVISION

K.V. Rameshwar Sarma, MD, MSc (AN)
(Deputy Director)
Krishnakumari Menon, MSc
D. Raghunatha Rao, MSc, PhD
T. Vijaya Pushpam, MA, MPhil
G. M. Subba Rao, MA, PGDJ, PGDT
K. Damayanthi, MSc, PhD
Anilkumar Dube, MA, MCJ, DPM
R. Nageswara Rao, MSc, BJ

LIBRARY

M. Devidas, MA, MLISc

INSTRUMENTATION

R. Subramanian, MSc, PhD
(Deputy Director)
Ramachander Chowgule, Dip. in Electronics

FOOD & DRUG TOXICOLOGY RESEARCH CENTRE (FDTRC)

Director
B.Sivakumar, MSc, PhD
(Upto 30th September 2005)

Officer-in-Charge
L. Singotamu, MSc, PhD
(From 1st October 2005)
Kalpagam Polasa, MSc, PhD, MBA
Deputy Director

FOOD TOXICOLOGY

Arjun L Khandare, MSc, PhD
J. Padmaja, MSc, PhD
V. Sudershan Rao, MSc, PhD
S. Vasanthi, MSc, PhD

DRUG TOXICOLOGY

M.P. Rajendra Prasad, MBBS, MSc (AN), PhD
B. Dinesh Kumar, MSc, PhD
T. Manjula, Mpharm

NATIONAL CENTRE FOR LABORATORY ANIMAL SCIENCES (NCLAS)

Director
B.Sivakumar, MSc, PhD
(Upto 30th September 2005)
Officer-in-Charge
L. Singotamu, MSc, PhD
(From 1st October 2005)
N.V. Giridharan, MSc, PhD
(Deputy Director)
S. Kalyanasundaram, Msc
P. Suresh Babu, MVSc
N. Hari Shanker, MSc, PhD
A.Uma Devi, MSc
Kiran Kumar, MSc

PRE-CLINICAL TOXICOLOGY

Director
B.Sivakumar, MSc, PhD
(Upto 30th September 2005)
Officer-in-Charge
L. Singotamu, MSc, PhD
(From 1st October 2005)
B. Sesikeran, MD
(Deputy Director)
Kalpagam Polasa, MSc, PhD, MBA
(Deputy Director)
N.V. Giridharan, MSc, PhD
(Deputy Director)
T. Prasanna Krishna, MSc, PhD
S. Kalyanasundaram, MSc
P. Uday Kumar, MD
P. Suresh Babu, MVSc
R. Hemalatha, MD
P. Yashodhara, MD
B. Dinesh Kumar, MSc, PhD
SSYH. Qadri, MVSc
N. Hari Shanker, MSc, PhD

ADMINISTRATION

G. Krishna Reddy, B.Com
Alexander Verghese
M.J. Radha Bai
A. Subba Reddy, BA

MAINTENANCE

P. Rajamohan Rao, LCE, PGDCPEMM

RESEARCH HIGHLIGHTS

In its relentless efforts, the National Institute of Nutrition (NIN) continued its research in different thrust areas pertaining to human nutrition and health. As the life expectancy is increasing the prevalence of degenerative diseases is also on the rise. Keeping this in view, National Nutrition Monitoring Bureau (NNMB) carried out surveys on the prevalence of degenerative diseases and the dietary intake of the population in different states of the country. During this year under the Country Investment Plan, technology transfer for the development of micronutrient-fortified foods to the State Government enterprise was given priority. In addition, technical assistance was also provided to the AP State Civil supplies department to fortify and supply wheat flour to the community through Public Distribution System. Emphasis was given to other priority areas like tribal nutrition, beneficial effects of antioxidants in human health and also as stablilizing agents in edible vegetable oils. In addition, there is a paradigm shift in the nutrition research related to degenerative diseases. Fostering this vision, NIN has taken up new approaches in identifying molecular basis of degenerative diseases such as link of a-Crystallin between diabetes and cataract and role of resistin in diabetes. A series of studies on dietary fats, micronutrients, women's health, food safety and health benefits of ginger were also carried out. The role of NSS volunteers as change agents in nutrition education in the community was studied. Here are the highlights of the research carried out during the year.

1. COMMUNITY STUDIES

1.1 Health and nutrition status of Tsunami affected population living in the relief camps in Andaman & Nicobar Islands

A rapid survey was carried out during the months of April/May 2005, to assess the health and nutritional status of Tsunami affected population living in the relief camps. In addition, a survey was carried out in the two hostels (one each for boys and girls) in students studying in 10th and 12th standards in the affected islands, to assess their nutritional status. A total of 2513 individuals from 28 relief camps established in nine Islands for Tsunami affected population in Andaman and Nicobar Islands were covered in the survey.

The levels of consumption of various food groups observed in the current survey were, however, better than those reported for their rural counterparts of mainland except other vegetables, milk & milk products, the intake of which was low. The median intake of various nutrients (per CU/day) by the households barring proteins was less than the RDA. The data revealed that the extent of undernutrition among preschool children in the relief camps of Andaman and Nicobar Islands was significantly lower than that reported for their rural counter parts of mainland. The girls were nutritionally at a disadvantage as compared to boys among both the Settlers and Nicobarese. The adult Nicobarese were better in their nutritional status as compared to the settlers.

1.2 Prevalence of Vitamin A deficiency (VAD) among preschool children of rural India

As a part of the survey on "Prevalence of micronutrient deficiencies" Vitamin A deficiency (VAD) was investigated among the vulnerable groups of rural population in the States of Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and West Bengal. Out of the total of 71,591 preschool children from 633 villages 3,934 samples were analyzed for blood Vitamin A levels using Dry Blood Spot (DBS) technique to assess the sub-clinical Vitamin A deficiency.

The result suggest that about 62% (CI: 60.3, 63.3) of children in general, had blood vitamin A levels of <20 g/dL, indicative of high prevalence of sub-clinical vitamin A deficiency. The proportion ranged from a high of about 88% in Madhya Pradesh, through 79% in Kerala to about 50-60% in the remaining States. The prevalence of sub-clinical VAD (<20 g/dL) was significantly ($p<0.05$) higher among 3-5 year children (63.1%, CI: 61.2, 65.0)

compared to 1-3 year children (59.6%, CI: 57.1, 62.1), with no significant gender differentials (Boys: 60.8%; Girls: 62.8%).

The prevalence was relatively higher (66.7%) among children who did not receive massive dose of vitamin A during the past 12 months, compared to those who received either one (61.6%) or two doses (56.3%). In the State of Kerala, where the prevalence of sub-clinical VAD was highest (79.4%), the proportion of children with dietary intake of vitamin A in amounts of <50% RDA was also high (91.8%) and that of coverage for massive dose of vitamin A was least (38.5%), compared to the remaining states surveyed.

The study revealed that the magnitude of prevalence of sub-clinical vitamin A deficiency was quite high in all the States including those states where the prevalence of clinical deficiency signs were either absent or very low. Therefore, there is a need to strengthen all the components of the National Programme for Prevention of Nutritional Blindness in the country.

1.3 Assessment of diet and nutritional status of individuals and prevalence of hypertension in adults & anaemia among adult men and NPNL women in rural communities

In view of increasing problems of diet related chronic diseases such as obesity, hypertension, etc a survey was carried out to assess the prevalence of obesity, hypertension among adult men and women (≥20 years). The prevalence of diabetes mellitus (DM)/ hyperglycemia was assessed in the State of Andhra Pradesh on a pilot basis. Estimation of haemoglobin was also carried out among adult men and NPNL women. A 24hr. dietary recall survey was also carried out to assess the food and nutrient intake of all the individuals, in every alternate HH (covered for socio-demographic information).

Obesity

The overall prevalence of abdominal obesity in terms of waist circumference (≥102 cms) was about 1% among men, while it was 7% among women (≥88 cms). The prevalence of abdominal obesity in terms of waist hip ratio (WHR) was 25% and ranged from as low as 10.1% in Madhya Pradesh to a high of 40.5% in the State of Kerala among men. It was 69% in women and ranged from a low of 36.7% in the State of Maharashtra to a high 91.8% in Kerala.

Hypertension

The overall prevalence of hypertension (SBP ≥140 and/or DBP ≥90mm of Hg) was about 25%. No gender differentials were observed in the prevalence of hypertension. The prevalence tended to increase with age, from 13.6% in 20-30 years group to 56.4% in ≥80 years age group. About 60-67% of the adults were aware of hypertension, while 2-3% were currently on treatment. The prevalence of hypertension was high among the adults, who were suffering from overweight/obesity (48%) compared to normals (26%).

Diabetes mellitus

Estimation of fasting blood glucose among adults was carried out only in the State of Andhra Pradesh. The prevalence of diabetes mellitus (FBS levels of ≥126 mg%) was about 4% among adult men, and about 3% among women. The proportion of impaired fasting glucose FBS levels of 110 to 126 mg% was about 2% each among men and women. About 48-56% were aware of diabetes mellitus, and about 2% were currently on treatment.

About one third of adult men were currently smoking, out of them three fourths were smoking since more than 10 years. The prevalence of diabetes mellitus was high among adult men and women who were overweight/obese (9%) compared to normals (2-4%).

1.4 Nutritional status of tribal population in ITDA project of Bhadrachalam in Khammam District, Andhra Pradesh

A special survey was carried out to assess the health and nutritional status of the tribal population in the project area. The district has a total tribal population of about 4.5 lakhs, mainly constituted by Koyas, Lambadas/Sugalis, and Kondareddis. The study revealed high rate of adult illiteracy, poor economic status, dependency on agriculture and allied occupations for livelihood, low intake of protective foods and gross inadequacy in the intake of micronutrients. The overall prevalence of undernutrition, though low compared to their tribal counterparts of the State, it was however, higher than

their rural counterparts. The prevalence of morbidities such as fever and diarrhoea was also relatively higher compared to that reported in rural areas, indicating the problem of poor environmental sanitation and personal hygiene. The coverage of beneficiaries for immunization and supplementation of massive dose vitamin A and IFA tablets was relatively good. Poverty and poor health seeking behaviour probably contributed to aggravate the situation.

1.5 Acceptability of micronutrient fortified millet based biscuits-A study among primary school children

Undernutrition continues to be a major public health problem in India, affecting a large section of the communities, the most vulnerable being young children and women of reproductive age groups. . In addition to the existing mid day meal (MDM) programme, the Commissioner of Civil Supplies, Government of Andhra Pradesh proposed to supplement micronutrient fortified millet based biscuits as snacks to the primary school children. The biscuits were fortified with ragi/maize/jowar in levels, so as to provide 50% of the recommended allowances per day/child, by consumption of three biscuits with a total weight of 24 g. Sensory evaluation of the fortified biscuits was evaluated. All the three varieties of biscuits viz. jowar, maize and ragi based ones were found to be equally good.

With regard to the acceptability of the micronutrient-fortified biscuits among primary school children, about 90% of the children gave a score of 'good' to 'very good' for all the characteristics studied viz. appearance, colour, texture, flavour and taste with respect to all the three types of micronutrient fortified biscuits.

2. CLINICAL STUDIES

2.1 Obstetric outcome and proinflammatory cytokine response in women with genital tract infections

There has been extensive research on maternal infection and pregnancy outcomes in developed countries, relatively, little is known in the under-privileged poor communities of India, where the problem of infections is much greater. Association of IUGR and PTD with histological chorioamnionitis and local cytokine (IL8, TNFa) response was determined.

The results revealed that height and weight of mothers were associated with birth outcome, histologic chorioamnionitis was significantly associated with linear growth of babies. In addition to nutritional factors, other factors such as inflammatory response due to genital tract infections might play an equally important role in adverse birth outcome.

2.2. Maternal nutrition in early pregnancy affects placental development

A study was carried out to assess and compare the placental morphology by measuring the villous structure and vascular endothelial growth factor (VEGF) and placental growth factor (PLGF) expression from conception at 7-10 weeks of gestation, of low socio-economic status (LSES) and high socio-economic status (HSES) groups, in relation to their nutritional status. The study indicated the significant disparity in placental structure between the undernourished and well nourished at a comparable gestational period and is suggestive of a predominant hypoxemic placental development in these LSES women under the stress of undernutrition.

3. BASIC STUDIES

A. Micronutrients

3.1 External validation of the National Facility for Dried Blood Spot Technology for Vitamin A Estimation

The National facility for Dried Blood Spot (DBS) Technology for vitamin A estimation established at the Institute is operational since March 2004.

There was a good agreement between the DBS and plasma retinol analyzed at the facility at various time points and that analyzed at the Croft Technologies after a period of one year. Thus the performance of NIN DBS facility has been externally validated.

3.2 Iron and zinc bioavailability of representative Indian and US diets : Regional distribution and availability of iron and zinc from representative Indian diets

One of the main causes of iron deficiency anaemia is low dietary bioavailability of iron. It is, generally, accepted that iron and zinc deficiencies

frequently occur together because the dietary factors that impair iron absorption also affect zinc absorption. There are no RDAs for zinc in India. Therefore, it is important to obtain regional data on dietary intake and food composition and to measure iron and zinc absorption from several days of dietary consumption as meals.

There are regional, rural and urban differences in iron and zinc density and their *in vitro* availability, which are mainly due to the composition of major staple and phytate content in the diet. Modification of diet to improve iron and zinc availability can be achieved by replacing major staple either by improving iron content and/or minimizing inhibitor phytate. Ironically good sources of minerals are also good in phytates and the intake of absorption promoters such as fish, meat and ascorbic acid is very low.

B. Food fortification

3.3 Fortification of whole wheat flour (atta) with micronutrients iron, folic acid and vitamin A - Public Private Partnership

As part of the Pubic Private Partnership and under Country Investment Plan, the technology of fortification of whole wheat flour (atta) with micronutrients developed by NIN has been translated to fortify and supply wheat flour through fair price shop in the state of Andhra Pradesh on a pilot scale by the AP State Civil Supplies Department, Government of Andhra Pradesh. The fortified atta branded 'VIJAYA ENRICHED ATTA' provides iron - 60 mg, folic acid - 1.5 mg and vitamin A 3300 IU per kg of atta and is priced Rs.12/kg.

C. Dietary fats

3.4 Effect of sesame lignans on the oxidative stability of edible vegetable oils

Sesame (Sesamum Indicum Unn) has long been used as a traditional health food in India for its nutritional and medicinal value. Sesame contains substantial amounts of unique components, namely sesamin and sesamolin. The higher stability of sesame oil has been attributed to its inherent lignans. The effect of sesamin and sesamolin in enhancing the stability of edible vegetable oils was evaluated. The increase in antioxidant potential and Radical Scavenging Activity (RSA) of Soyabean oil (SBO) or Sunflower oil (SFO) due to addition of lignans may possibly be due to synergism among sesame lignans and non-glyceride components of SBO (soya lignans, isoflavanoids) or SFO (phytosterols).

3.5 Role of n-3 PUFA in foetal programming of insulin resistance in offspring: Biochemical and molecular mechanisms

Long chain polyunsaturated fatty acids (LC-PUFA) of both n-6 and n-3 series are integral components of cell membrane and are important determinants of fetal growth and development. Studies on the effects of n-3 PUFA on fetal programming of biochemical and molecular parameters associated with insulin resistance suggests that maternal intake of Trans fatty acids (TFA) (from hydrogenated vegetable oils) may increase the susceptibility to biochemical/metabolic alterations known to be associated with increase in risk of chronic diseases.

ELOVL4 is a novel member of family of human fatty acid elongases involved in long chain fatty acids and whose function is essential for photoreceptor maintenance. These observations suggest that ELOVL4 expression may be related to n-3 PUFA nutritional status. Further, the decrease in retinal ELOVL4 expression associated with abnormality in retinal morphology in TFA fed groups suggests that TFA may affect retinal function and metabolism of long chain PUFA.

D. Antioxidants

3.6 Health beneficial effects of fruits and vegetables: Total phenolic content and antioxidant activity of dry fruits

Phenolic compounds present in fruits and vegetables are reported to have multiple biological effects including antioxidant activity (AOA). The phenolic content and antioxidant activity of some commonly consumed plant foods and some preliminary data on the antioxidant activity of a few fresh fruits as natural sources of antioxidants has been generated. Dry fruits are rich in antioxidant activity and phenolic compounds appear to be significant contributors to their antioxidant activity. Consumption of dry fruits may therefore augment the antioxidant status and protect against chronic diseases.

3.7 Development of antioxidant rich recipes utilizing legumes as the base

Phenolic compounds are the potent ubiquitous antioxidant substances present in plant foods. An attempt was made to generate the data base on the antioxidant activity (AOA) and phenolic content (PC) of plant foods commonly consumed by the Indian population and assess the effects of different types of domestic processing on these parameters. It also involves formulating AOA rich recipes based on the data generated and assessing the effect of the consumption of these recipes on AO status in human volunteers. The AOA of salad prepared with green gram sprouts with lemon, salt and pepper was the highest among the different salad recipes tested and the one prepared from Bengal gram sprouts was the next best.

E. Degenerative diseases

3.8 Diabetic cataract and chaperone function of -crystallin

Prolonged diabetes, without proper management, can lead to various short-term and long-term secondary complications, including diabetic cataract. Accumulation of modified proteins due to unfolding and aggregation is the major molecular event in cataractogeneis. Chaperone-like function of one of the lens proteins, -crystallin, is believed to be vital for not only to prevent protein aggregation in cataract formation but also to function as a stress mediator in many other stress conditions. Studies indicate that post translational modifications such as nonenzymatic glycation under diabetic conditionshas a negative impact on the chaperone function of -crystallin in terms of protecting enzymes against inactivation. Though, expression of -crystallin is increased due to hyperglycemia induced stress in many tissues including lens, there is enhanced degradation and modification. These studies provide a link between chaperone function of -crystallin and diabetic cataract. Further studies are under way to manipulate the expression and modification *viv-a-vis* chaperone function of -crystallin by dietary agents.

3.9. Transcriptional analysis of resistin and identification of *cis* - and *trans* acting factors regulating resistin expression

The adipocytokine resistin, a member of a family of cysteine-rich proteins known as resistin-like molecules (RELM) is also shown to be involved in inflammatory processes. Previous studies have however highlighted that resistin impairs glucose tolerance and insulin action in mice. In addition, resistin also inhibits adipogenesis in murine 3T3-L1 cells. In order to further evaluate the role of these transcription factors in the expression of human resistin, an electrophoretic mobility shift assay was performed wherein the binding of AP-1, C/EBP and c-Rel to their respective cognate oligonucleotides was characterized.

Resistin promoter sequences containing the binding sites for C/EBP, AP-1 and c-Rel shows binding with nuclear extracts prepared from corresponding cells. These experiments clearly demonstrate that AP-1, C/EBP and c-Rel present in the nucleus bind to the resistin promoter and could thereby modulate the expression of human resistin.

4. EXTENSION & TRAINING DIVISION

In addition to the extension and training activities, the division has carried out research activities pertaining to nutrition education.

4.1 Development of communication strategies to improve nutrition and health related knowledge of NSS volunteers

A study (Phase-I) using NSS volunteers as change agents to educate the community on various aspects of nutrition was conducted. The NSS volunteers were selected from the colleges of urban and rural areas around Hyderabad.

The initial knowledge levels were significantly different among the NSS volunteers of rural and urban areas (ANOVA, $p<0.001$). Intervention through nutrition education by using suitable communication materials improved the nutrition knowledge of NSS volunteers of degree colleges. Since the NSS volunteers are involved in community education programmes, such programmes help them to gain the nutrition knowledge which may in turn help them to educate the community on health and nutrition aspects.

5.FOOD AND DRUG TOXICOLOGY RESEARCH CENTRE

A. Food safety

5.1 Effect of magnesium compounds on mobilization of deposited fluoride in rabbits

A study was conducted to assess the possible benefits of magnesium compound administration in fluorosis and its capacity to mobilize already deposited fluoride from the bones as well as to prevent new fluoride deposition and, toxicological potential of Mg salts on various organs. Simultaneous feeding of magnesium compound (milk of magnesia) reduces fluoride absorption suggesting a beneficial effect of magnesium hydroxide ingestion on fluoride retention and toxicity. Histopathology and haematological study showed that there was no adverse effect of magnesium compound in experimental animals.

B. Cancer and xenobiotics

5.2. Antimutagenicity of heat processed ginger

Spices are important constituents in the preparation of various foods in Indian culinary practices. A study was undertaken on the antimutagenicity of fresh and dry forms of ginger under commonly practiced culinary conditions. The antimutagenic effect of ginger was not altered in the extracts of ginger subjected to normal cooking conditions.

5.3.Ethnopharmacological validation of bio-dynamic compounds in traditional medicine

The results of earlier studies indicate that extracts (coded 4308,4212,3107,3223 & 5322) of plants, which are traditionally used as anti-inflammatory drugs have potential antioxidant activity as evaluated by battery of *in vitro* tests and *ex vivo* test (AR. 2002-04). The present investigation was therefore undertaken to validate its anti-inflammatory potential using standard experimental animal models.

The study results suggest that aqueous and alcoholic aqueous extracts of traditional preparations Rasna panchaka has potential anti-inflammatory activity as evident from decreased exudate volume, reduced oxidative stress and modulate levels of TNF-a and IL-6. The biological plausibility as evident from the study suggest that water and water plus methanol extracts of Rasna panchaka can be considered as potential candidates in the treatment of rheumatoid arthritis.

5.4 Role of nutrients in environmental toxicity

The use of heavy metals like Lead (Pb), Mercury (Hg), Cadmium (Cd), Arsenic (As) etc. has resulted in the rise of their levels in environment resulting in exposure that is toxic to human health. Since one decade, reports mostly from developed countries suggest that the heavy metals (Pb, Cd, Hg, As etc.) used in industries, induce slow progressive and most of the times, irreversible damage to the nervous, haemopoietic and renal systems in population. In addition, few reports indicate their interaction with nutrients (Fe, Zn, Cu, Mg, Ca etc.) and alteration in biochemical functions specially at sub-cellular /cellular levels. The important physiological functions of essential metal ions like Iron (Fe), Zinc (Zn), Copper (Cu), Magnesium (Mg) etc. have been well established. Among the various heavy metal toxicities reported, lead toxicity is reported from all parts of the world. The study suggested that among those screened 70% had lead level above 10µg/dl. The haemoglobin was inversely correlated with blood lead levels of 15µg/dl. The serum iron levels were found to be high with blood lead levels. The correlation between zinc, Iron and lead levels indicates the interaction of nutrients and pollutants.

6. NATIONAL CENTRE FOR LABORATORY ANIMAL SCIENCES

6.1 PCR based DNA fingerprinting of WNIN strain and its obese mutants

Two mutant obese rat strains, WNIN/Ob and WNIN/GR-Ob were developed from the existing WNIN rat colony, which is being maintained at NCLAS in an inbred status for the past 84 years. Both the mutants are obese, but WNIN/GR-Ob has impaired glucose tolerance additionally. A study was undertaken to establish genetic identity for these two obese mutant rats. The cloned product from WNIN/GR-Ob were expressed both in mutant and parental strain and thus not unique to the mutant.

6.2. Establishment of baseline values of body composition and blood pressure in different species of laboratory animals maintained at NCLAS, NIN - A study in rat strains

National Centre for Laboratory Animal Sciences (NCLAS) is maintaining different species of laboratory animals for biomedical research both for in house use as well as supply to other institutions. As the center is catering to the needs of several institutions including for pre-clinical toxicology testing, it has become necessary to establish normal physiological and biochemical values in the most commonly used strains of laboratory animals. Since rat strains are the most frequently used animals, initial studies were taken up in different strains maintained at the centre viz., Wistar/NIN (WNIN), Sprague Dawely (SD), Fischer - 344N (F-344N), Wistar Kyoto (WKY), CFY and Holtzman.

The study showed that there were significant differences between strains of rats in terms of body composition, physical activity, serum clinical chemistry and blood pressure. By virtue of higher body weight for age in SD rats, their total body fat was also significantly higher than other strain of rats. However, it is WNIN male rats, which had higher percentage of body fat, higher resting time, higher plasma tryglycerides, higher heart rate when compared to other strain of rats. This was followed by Wistar Kyoto strain. The Fischer-344N rats showed the least growth rate, higher night time activity. These studies show that there were differences between strains and between genders in the same strain.

7. PRE-CLINICAL TOXICOLOGY

7.1. Safety/toxicity studies of ayurvedic formulations (**a,b,c,d,e**) (WHO Biennium Programme)

The traditional use of Ayurvedic formulations is one of the widely accepted therapy especially in the treatment of chronic diseases viz. arthritis, asthma, infertility, rejuvenation etc. The data on safety of the Ayurvedic formulations has become important for wider global acceptance of these products.

The coded Ayurvedic formulations developed by CCRAS, MoH & FW are reported to have potential therapeutic activity in chronic diseases and hence were taken up for pre-clinical toxicity screening as per WHO guidelines. Safety of five Ayurvedic formulations "**a,b,c,d**&**e**' by acute/sub-acute toxicity tests in mice/rats were evaluated as per the protocols suggested by sponsor.

7.1.1. Acute

No mortality, morbidity, weight loss and abnormal behaviour was recorded after a single exposure of a test compound with ten times of the recommended therapeutic dose after 14 days in Swiss albino mice which were exposed to the test formulations.

7.1.2. Sub-Acute

Pre-terminal deaths occurred in animals receiving (therapeutic dose) 1XTD (10%), 5XTD (30%) and 10XTD (60-70%) of formulation **a** between 14th day to 28th day, while the test compound **b, c , d** and **e** did not show any behavioral changes.

There were no pre-terminal deaths in animals receiving **b** test formulations at various dose levels. The physical and physiological activities, food intake and gain in body weights were not significantly different between groups exposed to **b** test compound and animals receiving vehicle. There were pre-terminal deaths with formulation c of males only (10%) in all the groups of animals receiving test formulations at various dose levels. There were no histopathological changes due to formulation **c, d** & **e** in all the major organs studied.

The Institute continued its endeavours to meet its mandate through various research projects that were initiated in IX Five Year Plan. Efforts are continued to identify newer emerging areas in different fields of nutrition research from time to time to develop need-based strategies to combat nutrient deficiency disorders in the country so as to meet the goals of the Country's National Nutrition Policy.

I. COMMUNITY STUDIES

1. Health and nutrition status of Tsunami affected population living in the relief camps in Andaman & Nicobar Islands

INTRODUCTION

Natural calamities like droughts, famines, cyclones, floods, earth quakes etc., in addition to causing devastating effects like loss of life and properties, also affects country's economy adversely, by decreasing agricultural and industrial output, increasing rural unemployment, migration of the poor to urban areas etc. thereby reducing purchasing power and increasing household food and nutrition insecurity. In addition, acute shortage of drinking water and inaccessibility to food contribute significantly to increased undernutrition, morbidities and mortalities in the communities.

On the morning of 26th December 2004, the country experienced a less known phenomena called 'Tsunami', meaning "harbor waves" in Japanese, which were generated due to earthquakes in the sea floor near Indonesia. These giant waves travelled across the sea and hit Andaman & Nicobar Islands and several villages in the coastal areas of Tamil Nadu, Pondicherry and Andhra Pradesh States. The most severely affected one was Union Territory of Andaman & Nicobar Islands, viz., Carnicobar, Katchal, Little Andaman, Kamorta, Teressa, Chowra and Great Nicobar.

The Administration of Andaman & Nicobar, Government of India and several national and international NGOs swung into action to provide immediate relief measures such as shelter, food, water, clothing and medical care to the affected populations by establishing relief camps at various sites. Subsequently, the Andaman & Nicobar administration, with the assistance of Government of India and several NGOs initiated various welfare programmes such as food for work, provision of rations including vegetables, construction of temporary shelters, establishment of dispensaries etc. In addition, 10th and 12th class boys and girls appearing for Board examinations in various Islands for the current academic year were brought to Port Blair and were accommodated in hostels. They were provided with free food, new set of books etc., as well as special coaching classes, so as to enable them to appear for final examinations.

At the request of Andaman & Nicobar Administration, the National Institute of Nutrition, Hyderabad, carried out a rapid survey during the months of April/May 2005, to assess the health and nutritional status of Tsunami affected population living in the relief camps.

GENERAL OBJECTIVE

To assess the health and nutritional status of Tsunami affected population living in selected relief camps and temporary shelters in Andaman and Nicobar districts.

SPECIFIC OBJECTIVES

1. To assess the nutritional status in terms of anthropometry and prevalence of clinical signs of nutritional deficiency of Tsunami affected population living in relief camps.
2. To assess the average food and nutrient consumption at the household level and relief camps by weighment method of diet survey, and
3. To assess the prevalence of morbidities in the community during the previous fortnight.

STUDY DESIGN

It was a cross sectional study, carried out among inmates of relief camps established by Andaman and Nicobar administration.

Sample size and sampling procedure

Keeping in view the rapid nature of survey and constraints in the inter island transportation, it was decided to cover a sub-set of 28 relief camps out of 149, spread over in different parts of the Andaman & Nicobar Islands. In addition, a survey was carried out in the two hostels (one each for boys and girls)

wherein students studying in 10th and 12th standards in the affected islands, to assess their nutritional status in terms of anthropometry and clinical examination, and history of morbidity during previous fortnight.

INVESTIGATIONS

The following investigations were carried out during the survey:

- Measurement of heights and weights of all the individuals using standard equipment and techniques
- Clinical examination of all those covered for anthropometry for the presence of nutritional deficiency signs
- History of morbidity during the previous fortnight
- Average intake of foods and nutrients at the household level by carrying one day weighment diet survey in a sub-sample of HHs and at the relief camps by carrying out institutional diet survey in the community kitchens.

The salient findings were as follows:

A total of 2513 individuals from 28 relief camps established in nine Islands for Tsunami affected population in Andaman and Nicobar Islands were covered in the survey. Of these, 1485 were Nicobarese while the remaining 1028 were settlers from mainland, belonging to Andhra Pradesh, Tamil Nadu or Orissa.

Profile of the community

Among Nicobarese, a third of adults (34.3%) were cultivators, while about 11% were engaged either in agricultural labour or other labour. The proportion of individuals engaged in service and business were 8.1 and 1.1% respectively. A majority of the adult females (82.4%) were housewives. About half of the adult male settlers (52.8%) were engaged either in agricultural labour or other labour. Only negligible proportion (3.3%) was engaged in cultivation, while about 15% were in service or business.

FOOD INTAKE

In general, the average consumption of various foods (g/CU/day) at the household level (n=43), barring cereals & millets, pulses & legumes and roots & tubers was less than the recommended levels. The intake of protective foods like green leafy vegetables, other vegetables and milk & milk products was grossly inadequate. The levels of intakes were essentially similar between Nicobarese and settlers, except for other vegetables, roots & tubers and fats & oils, the consumption of which was relatively higher among the Nicobarese. The levels of consumption of various food groups observed in the current survey were however, better than those reported for their rural counterparts of mainland by NNMB except other vegetables, milk and milk products, the intake of which was low.

NUTRIENT INTAKE

The median intake of various nutrients (per CU/day) by the households barring proteins was less than the RDA. The intake of micronutrients such as vitamin A, iron, free folic acid and riboflavin was grossly inadequate in both the groups. The levels of intake of various nutrients were comparable between the Nicobarese and the settlers, barring vitamin C, which was grossly inadequate among Nicobares. This could be attributed to low intake of protective foods such as vegetables and fresh fruits.

The proportion of households with consumption levels of nutrients in amounts of < 50% RDA was maximum for vitamin A (92%), free folic acid (76%) and iron (63%) compared to other nutrients. Only about 4% of the households, at the time of survey, were found to be consuming protein and energy in amounts of less than 50% of RDA.

NUTRITIONAL STATUS

Prevalence of Clinical signs of nutritional deficiency

None of the infants examined exhibited clinical signs of nutritional deficiency. About 0.5% of preschool children (1-5 years) were emaciated. The prevalence of vitamin A deficiency signs such as conjunctival xerosis was higher (2.7%) as

compared to that reported for their rural counterparts of mainland (1.3%). The prevalence of clinical signs of B complex deficiencies such as angular stomatitis and glossitis was about 0.5% each. About 2.3% had dental caries. Among school age children, about 8.6% had conjunctival xerosis, the prevalence of which was higher than that reported for mainland rural counter parts (5%). The prevalence of Bitot spots was about 0.4%.

The prevalence of conjunctival xerosis and dental caries among adolescent children was about 3-4%, while that of Bitot spots was 0.6%. The prevalence of total goitre rate (TGR) was 7.8%. About 6% of adults had pallor, 3.2% had goitre and 2.9% had dental caries.

Anthropometry

Preschool children

Weight for age

The overall prevalence of underweight (weight for age< Median- 2SD) was about 48%, while that of severe underweight (< Median- 3SD) was about 11%. The prevalence of underweight observed was significantly lower ($p<0.01$) than that reported for their rural counter parts in mainland (48% Vs 60%). The prevalence of underweight (< Median- 2SD) was significantly higher ($p<0.01$) among girls (53%) compared to boys (42%) and among children of Settlers (58%) compared to Nicobarese (41%).

Height for age

The overall prevalence of stunting (height for age< Median - 2SD), an indicator of long duration malnutrition, was about 37%, while the extent of severe stunting (<Median - 3SD) was about 13%. The prevalence of stunting was significantly lower ($p<0.01$) compared to that reported for their rural counter parts of mainland (37% vs 49%).

Weight for height

In general, the prevalence of overall wasting (Weight for height< Median-2SD), an indicator of short duration undernutrition, was about 16%, while that of severe grade was about 3%. The prevalence was significantly lower ($p<0.01$) than that reported by NNMB for rural children (16% vs 23%).

Thus, the data revealed that the extent of undernutrition among preschool children in the relief camps of Andaman and Nicobar Islands was significantly lower than their rural counter parts of mainland, the Nicobarese children were better off compared to those of settlers. The girls were nutritionally at a disadvantage compared to boys among both the Settlers and Nicobarese.

Adolescents

The overall prevalence of undernutrition (those below 5th percentile of BMI) among adolescents was about 22%. A higher proportion of boys were undernourished (27%) compared to girls (16%). A significantly higher ($p<0.01$) proportion of adolescents among Settlers (42%) were undernourished as compared to Nicobarese (5%). Similarly, the prevalence of overweight/ obesity was about 3%, which was higher among Nicobarese (4.8%) compared to Settlers (1.4%).

About 17% males and 19% females had varying degrees of chronic energy deficiency (BMI <18.5), the levels of which were significantly ($p<0.01$) lower than that reported by NNMB for their rural counterparts of main land (37% and 39% respectively). The prevalence of overweight and obesity ($\geq$25 BMI) was 13% and 21% among adult males and females respectively, which was significantly higher ($p<0.01$) as compared to their rural counter parts of mainland (6% and 8% respectively). The prevalence of CED was however; lower among adult males and females of Nicobarese (10 &11%) as compared to the Settlers (28 & 31%). Conversely, the prevalence of overweight and obesity was higher among adult males and females of Nicobarese compared to settlers (17 & 25% vs 7% & 15%).

Thus, the data reveals that among those living in Tsunami relief camps, the adults of Andaman & Nicobar Islands covered in the present survey were nutritionally better off compared to their rural counterparts of mainland, and the adult Nicobarese were better off than to the settlers.

Nutritional status of hostellers

Among the adolescents, the common nutritional deficiency signs observed were goitre (8.1%), conjunctival xerosis (3.6%), pallor (1.8%), and dental fluorosis (1.3%).

The most common morbidities reported were fever (4%), acute respiratory infection (2%) and diarrhoea (0.5%) among adolescents, 2.4%, 1.5% and 0.5% respectively for adults. About 88% were normal ($\geq 5^{th}$-$<85^{th}$ centile of age/sex specific BMI). The overall extent of overweight/obesity ($\geq 85^{th}$ centile of BMI) was about 8%. The overall prevalence of undernutrition ($<5^{th}$ centile of BMI) was about 5%, with the proportion being higher among boys (8.3%) compared to girls (2.3%).

In general, about 14% of adult men and 10% of women had chronic energy deficiency (<18.5 BMI), while 83% of men and 80% women were normal (18.5 - <25 BMI). The prevalence of overweight/obesity was relatively higher among women (10.1%) compared to men (3.4%).

Thus, the data revealed that the inmates of both boys and girls hostels were nutritionally better off compared to their mainland rural counter parts.

RECOMMENDATIONS

- There is an urgent need to improve the micronutrient status of the community. The programme of supplementation of micro-nutrient fortified biscuits to preschool children under ICDS, initiated by UNICEF in some areas may be strengthened and extended to all areas.
- IEC activities have to be strengthened to ensure better nutrition of girl child, especially in <5 year age group, through ICDS services.
- High prevalence of overweight and obesity among the adults of Nicobarese signifies the need for health and nutrition education to impart better dietary practices and lifestyle patterns among them to prevent chronic degenerative diseases at a later part of life.

2. Prevalence of Vitamin A Deficiency (VAD) among preschool children of rural India

INTRODUCTION

The NNMB undertook the survey on "Prevalence of Micronutrient deficiencies" viz., Vitamin A Deficiency (VAD), Iron Deficiency Anaemia (IDA) and Iodine Deficiency Disorders (IDD) among the vulnerable groups of rural population in the State of Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and West Bengal during 2002-2003. The objectives, study design, sampling procedures, survey methodology and the results of the survey were published earlier (NIN Annual Report 2004-05 & NNMB Technical Report No. 22). However, the data on sub-clinical vitamin A deficiency among preschool children could not be included in the above publication, due to the delay in establishing the Dried Blood Spot (DBS) facility at the Institute for vitamin A analysis, which became operational in March 2004 (Annual report: 2004-2005). The results on both clinical and sub-clinical vitamin A deficiency along with its association with socio-economic variables are presented in this report.

METHODOLOGY

Sample collection, transport, storage and analysis

A free falling drop of blood from finger-prick from the selected preschool child was collected on a pre-coded special chromatography paper. It was shade dried, wrapped in black paper, kept in an envelope and sent to NIN by courier from the field, every third day. The samples were protected from light and preserved in a deep freezer at -20^0 C till analysis at the DBS facility. The survey extended over a period of one and a half years and the duration between collection of sample and analysis ranged from about 6 months to 2 years, with an average period of about 21 months.

Salient findings of the survey were as follows:

COVERAGE

A total of 71,591 preschool children from 633 villages in the eight States were covered for VAD survey. The survey could not be conducted in the States of Gujarat and Uttar Pradesh due to logistic reasons. A total of 3,934 samples from 8 States were analyzed for blood vitamin A levels.

Sample Characteristics

A majority of the children covered belonged to Hindu (85.3%) households (HHs), followed by Muslims (10.6%) and Christians (3.6%). The proportion of Muslims was relatively higher in the States of Kerala (31.6%) and West Bengal (22.5%). About 42% of the HHs belonged to other backward communities (OBCs), while about 30% belonged to Scheduled caste/Scheduled tribe. The proportion of tribal households was relatively higher in the States of Madhya Pradesh (28.4%) and Orissa (19.5%), while the proportion of Scheduled caste HHs was relatively higher in the States of West Bengal (27.5%), Andhra Pradesh (25.1%) and Tamil Nadu (24.6%). The major occupation of the head of HHs was Labour (45%, agricultural labour: 15.9% and other labour: 29.5%), followed by agriculture (27%), business (10.2%) or service (9.7%).

About 52% of the adult females in the HHs surveyed were illiterate, the proportion of which was maximum in the State of Madhya Pradesh (76%), followed by Karnataka (71%), Andhra Pradesh and Orissa (60% each), West Bengal (57%) and 6% in Kerala. In general, only about a fourth of the HHs (24.2%) had sanitary latrine, the proportion of which was maximum in Kerala (94%) and least in Orissa and Madhya Pradesh (8-9%).

Prevalence of Clinical VAD

The overall prevalence of Bitot spots among 1-5 year children, an objective sign of vitamin A deficiency, was 0.8% (CI: 0.73, 0.87). The prevalence was more than 1% in the States of Madhya Pradesh (1.4%, CI: 1.15, 1.65), Maharashtra (1.3% CI: 1.06, 1.54) and Andhra Pradesh (1.2%, CI: 0.98, 1.42). While none of the preschool children examined in Kerala had Bitot spots, its prevalence in the State of Orissa was observed to be about 0.3%).

The overall prevalence of night blindness and conjunctival xerosis was 0.3% (CI: 0.26, 0.34) and 1.8% (CI: 1.70, 1.90) respectively.

The prevalence of Bitot spots was significantly ($p<0.05$) higher among children from households belonging to Hindus (0.8%), Scheduled Castes (1.4%), Scheduled Tribes (1.2%), agricultural labour (1.3%), non-agricultural labour (0.9%), HHs with an illiterate mother (1.1%) and those HHs not having sanitary latrine (0.9%).

Sub-clinical VAD

The overall median blood vitamin A level was 17 g/dL, which ranged from a low 9 g/dL in the State of Madhya Pradesh to a high of about 20 g/dL in the States of Tamil Nadu & Karnataka. No significant age (1-3 years: 17.2 g/dL and 3-5 year: 16.6 g/dL) and gender (boys: 17.2 g/dL and girls: 16.5 g/dL) differentials were observed in the median blood vitamin A levels.

About 62% (CI: 60.3, 63.3) of children in general, had blood vitamin A levels of <20 g/dL, indicating high prevalence of sub-clinical vitamin A deficiency. Their proportion was highest in Madhya Pradesh (88%), followed by 79% in Kerala and about 50-60% in the remaining States. The prevalence of sub-clinical VAD was significantly ($p<0.05$) higher among 3-5 year children (63.1%, CI: 61.2, 65.0) compared to 1-3 year children (59.6%, CI: 57.1, 62.1), with no significant gender differentials (Boys: 60.8%; Girls: 62.8%).

The prevalence was significantly ($p<0.05$) higher among children belonging to Christians (68.8%) and Muslims (69.3%), Scheduled Tribes (74.1%) and backward communities (62.9%), households with illiterate adult woman (62.8%) and those having no sanitary latrine (64.6%). The prevalence, though not statistically significant, was relatively higher (66.7%) among those children who did not receive massive dose of vitamin A during the past 12 months, compared to those who received either one (61.6%) or two doses (56.3%).

In the State of Kerala, where the prevalence of sub-clinical VAD was highest (79.4%), the proportion of children with dietary intake of vitamin A in amounts of <50% RDA was also highest (91.8%) and that of coverage for massive dose of vitamin A was lowest (38.5%) compared to other States.

Multiple logistic regression analysis revealed that the risk of having sub-clinical vitamin A deficiency was 2.0 (CI: 1.6, 2.6) times higher for Scheduled Tribe children compared to other

community, 1.5 (CI: 1.2, 1.8) times higher in Muslims compared to Hindus and 1.3 (CI: 1.0, 1.5)times higher for HHs having a family size of =8 compared to small family size (1-4) and 1.5 (CI: 1.0, 2.3) times higher among those children who did not receive massive dose of vitamin A compared to those who received the same during past one year.

The study revealed that the magnitude of prevalence of sub-clinical vitamin A deficiency was high (62%) in all the States irrespective of extent of prevalence of clinical deficiency signs. Similar high prevalence of sub-clinical VAD (64%) was reported in another large scale study carried out in Orissa, under the aegis of WHO during 2003.

In the present study, the prevalence of sub-clinical VAD was observed to be very high in the States of Kerala despite absence of clinical signs of VAD, which could be due to low dietary intakes of Vitamin A as well as low coverage for massive dose Vitamin A supplementation. Several other studies conducted during nineties have also revealed a very high prevalence of sub-clinical VAD despite absence of clinical signs in countries such as Lesotho (78%), Senegal (72%), Cote D'ivore (68%) and Congo (98%) (WHO MIDIS Working paper No.2, 1995, WHO/Nut/95.3).

Thus the study revealed that the prevalence of sub-clinical VAD is significantly higher among the preschool children in all the States surveyed, and therefore there is an urgent need to strengthen the national programme of supplementation of massive dose vitamin A to young children and to extend the same up to 5 years of age. The IEC activities need to be intensified to bring in dietary diversification by encouraging the community to grow kitchen gardens and to include locally available vitamin A rich foods in their daily diets, more frequently. The scope of fortifying foods with vitamin A, wherever possible, should also be explored.

3. Assessment of diet and nutritional status of individuals and prevalence of hypertension in adults & anaemia among adult men and NPNL women in rural communities

The National Nutrition Monitoring Bureau (NNMB), which was established in the year 1972 by the ICMR in the States of Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Madhya Pradesh, Orissa, West Bengal and Uttar Pradesh has been carrying out diet and nutrition surveys on a regular basis. During the year 2000-01, the NNMB undertook the diet and nutrition surveys in the rural areas of all the States, except Uttar Pradesh. In view of increasing problems of diet related chronic diseases such as obesity, hypertension, etc being reported in the developing countries, the components such as assessment of prevalence of obesity, hypertension among adult men and women ($\geq$20 years) were also included in the survey. In addition, estimation of haemoglobin was also carried out among adult men and Non-pregnant and Non-lactating (NPNL) women, the groups which were not covered in the micronutrient deficiency survey carried out earlier (2002-03). The prevalence of diabetes mellitus (DM)/ hyperglycaemia was assessed in the State of Andhra Pradesh on a pilot basis.

METHODOLOGY

Sampling design

The villages surveyed by the National Sample Survey Organization (NSSO) in its 54th Round of Consumer Expenditure Survey, during the year 1998 formed the sample frame and a sub sample of villages were covered in the present survey. A total of sixteen strata (1.8 million population/ per strata) were selected from each State and from each of these strata, five villages were selected randomly. Thus, a total of eighty villages were covered in each State. In each of the selected villages, twenty households (HHs) were covered for survey by adopting cluster-sampling method. For this purpose, the village was divided into five geographical areas (cluster of HHs), one of which consisted of households belonging to SC/ST community. From each geographical area, four consecutive HHs were surveyed, by selecting random start.

INVESTIGATIONS

In each village, socio-demographic particulars were collected from all the 20 HHs. Anthropometric measurements, such as, height, weight, mid upper arm circumference (MUAC) and fat fold thickness at

triceps (FFT) were taken on all the individuals from these HHs. They were also examined for the presence of clinical signs of nutritional deficiency. Information on morbidity such as fever, acute respiratory infections, measles, and diarrhoea during the preceding 15 days of visit was also collected from all the individuals. Twenty four hour dietary recall diet survey was carried out to assess the food and nutrient intake of all the individuals, in every alternate HH (covered for socio demographic information).

About 51,705 individuals of different age /sex groups from 14,256 HHs of 713 villages were covered for anthropometry, clinical examination, and prevalence of morbidity. Data on food and nutrient intake was collected on 30,244 individuals from 7078 HHs. Blood samples were collected on 3391 men and 3384 NPNL women for the estimation of haemoglobin levels. Measurement of blood pressure was carried out on 11,923 men and 13,702 women and fasting blood samples were also collected from 1803 men and 1883 women only in the State of Andhra Pradesh for estimation of blood glucose levels.

Socio-economic profile

About 37% of the HHs belonged to backward communities, 22% belonged to SC and 11% ST, while the rest (30%) were of other castes. About two thirds of HHs (62.4%) lived in semi pucca houses, while about 21% were in kutcha houses.

The average family size was 4.9. About 49% of the HHs did not possess any agricultural land. About 32% of adult men ranged from a low 7.7% in Kerala to a high 46% each in the State of Andhra Pradesh and West Bengal and 48% of adult women were illiterate ranged from a low 11.5% in Kerala to a high 65% in the State of Madhya Pradesh. About a third of the households each were fetching drinking water either from public taps (39%) or tube wells (35%). In general, about 27% of the HHs had sanitary latrine, about 76% of the HHs possessed separate kitchen and about two thirds of the houses (72.1%) had electricity.

Food intake

Cereals formed the bulk of the rural dietaries while millets constituted 13%. The average intake (g/CU/day) of all the foodstuffs, except roots & tubers formed males and other vegetables was below the RDI in all age/sex/physiological groups. The mean consumption of cereals & millets (418 g) among males was below the recommended level of 460 g in majority of the States, except in the States of Orissa (472 g) and West Bengal (509 g). Similarly, in case of females, the States of Orissa and West Bengal were meeting the RDI.

The average intake of green leafy vegetables is grossly deficit when compared to RDIs of both males and females in all the States barring among males in the States of Orissa and West Bengal. Consumption of other protective / income elastic foods such as milk & milk products (80 ml), sugar & jaggery (14 g) and fats & oils (13 g) was also grossly deficit when compared to the recommended levels among both sexes.

Nutrient Intake

The median intake (CU/day) of all the nutrients was lower than the recommended levels in both sexes in all the States, except for niacin among the females. The median intake of all the nutrients was lower than the recommended levels among all the age/sex/physiological and activity groups especially the consumption of micronutrients such as iron, vitamin A, riboflavin and folic acid was grossly deficit compared to RDAs.

Clinical examination

None of the preschool children exhibited signs of kwashiorkor and marasmus. The prevalence of Bitot spots, the objective sign of vitamin A deficiency, was 0.6% ranged from nil in the State of Kerala to 1.3% in Maharashtra, while 0.8% had angular stomatitis, indicative of B-complex deficiency. Among the school age children, the common deficiency signs observed were conjunctival xerosis (1.9%), Bitot spots (1.6%), angular stomatitis (1.9%), phrynoderma (0.9%) and goitre (1.4%). About 13% had dental caries.

Morbidity

The most common forms of morbidities among different age groups were fever, diarrhoea, dysentery, and acute respiratory infections, the prevalence of which ranged from 0.1- 5 %.

Anthropometry

The mean heights and weights of individuals of different age / sex groups were considerably lower

than the reference values (NCHS). Overall prevalence of underweight (weight for age <Median-2SD) was 55% ranged from a low 35.0% in Kerala to a high 64% in the State of Madhya Pradesh. The prevalence of stunting (height for age < Median- 2SD) was 52%, while wasting (weight for height <Median- 2SD) was 15%. No significant gender differences were observed.

The prevalence of undernutrition based on BMI (<5th centile of age and sex specific BMI) was 57% among 10-13 years and 30% among 14-17 years, while the prevalence of overweight/obesity was about 1%.

About 33% adult men (a low 27.7% in Kerala to a high 42.4% in Karnataka) and 36% (a low 21.1% in Kerala to a high 47.6% in Orissa) of the women had different grades of chronic energy deficiency (CED) as measured by BMI (<18.5). About 59% of men and 53% of the women had normal body mass index (18.5-25.0). The prevalence of overweight/obesity (BMI >25) was high among women (11%) compared to men (8%).

Abdominal obesity

The prevalence of abdominal obesity in terms of waist circumference (>102 cms) was about 1% among men, while it was 7% among women (≥88 cms). The prevalence of abdominal obesity in terms of waist hip ratio (WHR) was 25% ranged from a low 10.1% in Madhya Pradesh to a high 40.5% in the State of Kerala among men and 69% ranged from a low 36.7% in the State of Maharashtra to a high 91.8% in Kerala among women.

Undernutrition vs. socioeconomic status

The overall prevalence of undernutrition (weight for age <Median - 2SD) among preschool children was significantly higher among the children belonging to Scheduled Tribes and households living in kutcha houses. The prevalence of undernutrition among preschool children was relatively high, in those with average household income of <Rs.300/- p.m.

Anaemia

The overall prevalence of anaemia was about 55% in adult men and 75% among women (NPNL). The prevalence was very high in the States of West Bengal (84% in males vs 93% in females), Kerala (68% in males vs 89% in females) and Madhya Pradesh (68% in males vs. 87.4% in females).

DIET RELATED CHRONIC DISEASES

Hypertension

The overall prevalence of hypertension (SBP ≥140 or/and DBP ≥90mm of Hg) was about 25% among men and 24% in women. The prevalence tended to increase with age, from 13.6% in 20-30 years group to 56.4% in ≥80 year age group. About 60-67% of the adults was aware of hypertension, while 2-3% were currently on treatment. The prevalence of hypertension was high among the adults, who were suffering from overweight/obesity (48%) compared to normals (26%).

Diabetes mellitus

Estimation of fasting blood glucose among adults was carried out only in the State of Andhra Pradesh. The prevalence of diabetes mellitus (FBS levels of ≥126 mg%) was about 4% among adult men, and about 3% among women. The proportion of impaired fasting glucose FBS levels of 110 to 126 mg% was about 2% each among men and women. About 48-56% were aware of diabetes mellitus and about 2% were currently on treatment for diabetes mellitus.

The prevalence of diabetes mellitus was high among those who were suffering from overweight and obese (9%) among adult men as well as women compared to normal adults (2-4%).

4. Acceptability of micronutrient fortified millet based biscuits - A study among primary school children

Undernutrition continues to be major public health problem in India, affecting a large section of the communities, the most vulnerable being young children and women of reproductive age groups. Recently, the problem of micronutrient deficiency disorders such as iron deficiency anaemia (IDA), vitamin A deficiency (VAD) and iodine deficiency disorders (IDD) are attracting the attention of both policy makers as well as public health administrators. The studies carried out by the National Nutrition Monitoring Bureau (NNMB) in

several States including Andhra Pradesh have shown that the diets of population in general and those of young children in particular are grossly deficient in micronutrients such as iron, calcium, vitamin A, riboflavin, folic acid and vitamin C.

Since micronutrient deficiencies are identified as silent epidemics affecting the growth, development and well being of the populations, diverse intervention programmes are being explored for supplementation of micronutrients. The Commissioner of Civil Supplies, Government of Andhra Pradesh had proposed to supplement micronutrient fortified millet based biscuits as snacks to the primary school children, in addition to the existing mid-day meal (MDM) programme.

The A.P foods, a Government of Andhra Pradesh enterprise, Nacharam, Hyderabad, under the technical guidance of NIN produced micronutrient fortified millet based biscuits using jowar, maize or ragi. Based on the initial sensory evaluation carried out at the NIN, steps were taken to improve the organoleptic characteristics of these biscuits in terms of texture, taste and flavour.

The biscuits were fortified with ragi/maize/jowar in levels, so as to get 50% of the recommended allowances per day/child, by consumption of three biscuits with a total weight of 24 g. The A.P Foods prepared the fortified biscuits and sensory evaluation of the same was carried out successfully at NIN. All the three varieties of biscuits viz. jowar, maize and ragi based ones were found to be equally good.

However, before initiating the large-scale production of these biscuits and implementation of the programme, it was proposed to study the acceptability of the micronutrient-fortified biscuits among primary school children. Therefore the current study was carried out with the objective to assess the acceptability of the micronutrient fortified millet biscuits among preschool children.

METHODOLOGY

It was a cross sectional study carried out in a total of 14 primary schools @ 7 each from Ibrahim-patnam and Shameerpet Mandals of Ranga Reddy district. In each of the selected schools, about 70 children (35 boys and 35 girls) of 9 to 11 year age groups were included in the study. The acceptability was assessed among a total of 330 children for jowar biscuits, 350 children for maize biscuits and 314 children for ragi biscuits. To avoid cross over effect in reporting of acceptability levels, each group was included for evaluation of only one type of biscuit.

Informed written consent was obtained from the Directorate of School Education, Hyderabad and Heads of the Institutions.

The salient findings of the study are as follows:

In each of the selected schools, required number of children in the age group of 9-11 years was randomly selected. After explaining the purpose of the study to the group, each child was provided a copy of the pre-tested questionnaire in local language and contents of the same were explained to them. They were asked to record their opinion in the questionnaire in terms of 1-5 score after consuming the biscuits.

The analysis of data revealed that, about 90% of the children gave a score of 'good' to 'very good' for all the characteristics studied viz. appearance, colour, texture, flavour and taste with respect to all the three types of micronutrient fortified biscuits. The mean score (in a scale ranging from a low '1' to high '5') obtained for colour was maximum for maize (4.5), followed by ragi (4.3) and jowar (4.2). With respect to the 'appearance', the mean score was 4.2 for jowar biscuits, 4.1 for ragi, and 4 for maize biscuits. The score for 'texture' ranged from 4.1 for maize, 4.2 for jowar and 4.3 to ragi biscuits. A maximum score of 4.4 was observed with respect to 'flavour' for ragi, followed by 4.3 for maize and 4.2 for jowar. Ragi biscuits scored highest of 4.5 followed by maize (4.4) and jowar (4.2) with respect to the 'taste'. The mean overall score was maximum for maize (4.6), followed by ragi (4.5) and jowar (4.3) biscuits.

Some of the suggestions given by the students for improving the overall quality were;
(i) to increase the sweetness,
(ii) softness of the biscuits and,
(iii) addition of cream to the biscuits.

5. Nutritional status of tribal population in ITDA project of Bhadrachalam in Khammam District, Andhra Pradesh

The tribes live in isolation from the general population and are socially and economically disadvantaged. The health and nutritional status of tribal population depend on the ecosystem they live in. Geographical isolation, unique cultural and social practices, lack of formal education, poor infrastructural facilities, lack of better health seeking behaviour, poverty etc. expose them to higher risk of undernutrition, morbidities and mortality. National as well as State governments have been implementing several programmes under Tribal Sub Plan approach (TSP) for the overall development of tribes.

Andhra Pradesh is homeland of nearly 33 tribal groups accounting for 6.6% of the total population of the State and they are inhabiting the north and northeastern parts of the State as well as border States of Orissa, Maharashtra and Chattisgarh.

Earlier surveys carried out by National Nutrition Monitoring Bureau (NNMB) among the tribal population in the State revealed higher prevalence of underweight among preschool children compared to their rural counterparts. At the request of the Project Officer (PO), Integrated Tribal Development Agency (ITDA), Bhadrachalam, the National Institute of Nutrition (NIN) carried out a special survey to assess the health and nutritional status of the tribal population in the project area. The district has a total tribal population of about 4.5 lakhs, mainly constituted by Koyas, Lambadas/ Sugalis and Kondareddis.

GENERAL OBJECTIVE

To assess the health and nutritional status of tribals living in Bhadrachalam ITDA area of Khammam district.

SPECIFIC OBJECTIVES

To assess :

- Food and nutrient intake at household level among the tribal population.
- Nutritional status of the individuals in terms of anthropometry and prevalence of clinical signs of nutritional deficiency.
- Prevalence of morbidities during the preceding 15 days of the survey.
- Knowledge and practices of mothers on infant and child feeding, and
- Extent of coverage of target population under various nutrition intervention programmes, being implemented in the area.

METHODOLOGY

It was a cross-sectional study, adopting multistage random sampling procedure. Assuming an overall prevalence of 69% of undernutrition among 1-5 year children, with 95% confidence interval and 5% relative precision, a sample of 335 children was arrived at. It was proposed to carry out survey in about 1000 HHs to cover the required number of preschool children.

For the purpose of the study, five out of total 29 mandals inhabited by tribes were randomly selected. From each mandal, four villages were selected randomly. In each of the selected villages, starting from the northeast corner of the village, 40 contiguous HHs were covered for the survey.

INVESTIGATIONS

The following investigations were carried out :
Collection of household demographic and socio-economic particulars,

- Measurement of height and weight of all the individuals in the selected households, and examination for presence of clinical signs of nutritional deficiency.
- History of morbidity during the previous fortnight.
- 24-hour recall diet survey in a sub sample of every fourth household covered for nutritional anthropometry to assess the food and nutrient intake at the household level.
- Extent of coverage of 1-2 year children, for various Immunizations during the first year of life
- Coverage of target beneficiaries under National Nutritional Programmes such as supplemen-

tation of massive dose of vitamin A and distribution of iron and folic acid tablets, and

- Assessment of breast-feeding and child rearing practices among women.

RESULTS

Following were the salient observations in the study:

COVERAGE

A total of 2751 individuals from 802 HHs in 20 villages were covered for nutrition assessment. Food and nutrient intakes were assessed in 203 Hhs.

A majority (85%) of the houses were kutcha in nature. About three fourths (72%) of the families were nuclear. The average family size was 4.6. The major occupation of the head of the household was agriculture (44%), followed by agricultural labour (28%) and other labour (20%). The average size of land holding was 2.3 acres, while one fourth of HHs did not possess any agricultural land. Illiteracy among the male head of the household and their spouses was 72% and 88% respectively. The average per capita annual income of the HHs was Rs.4,590/-.

In general, the mean consumption of all the foods (g/CU/day), barring cereals and millets was lower than the RDI. The extent of deficit was higher with respect to protective / income elastic foods such as green leafy vegetables (90%), milk & milk products (80%), sugar & jaggery (83%) and fats & oils (70%).

The median intake of all the nutrients (CU/day) was lower than the RDA. The extent of deficit ranged from 45% for fats to 88% for vitamin A. The proportion of households consuming various nutrients in amounts of less than 50% of the RDA was maximum with respect to vitamin A (96%), followed by Iron (77%), riboflavin (74%), free folic acid (71%), thiamine (40%) vitamin C (38%) and calcium (36%). In about three fourths of the households, the consumption of energy and protein was less than the recommended levels.

The prevalence of conjunctival xerosis and Bitot spots, the signs of vitamin A deficiency was 0.5% each among preschool children, while among school age children, it was very high (6.7% and 12.4% respectively). The most commonly reported morbidities among various age groups were fever, diarrhoea and acute respiratory tract infections (ARI).

The mean heights and weights in different age and sex groups were much below the NCHS Median values but were comparable to their rural counterparts of the State (NNMB, 2000). About 65% of the preschool children were underweight (weight for age <Median- 2SD), while 18% had severe underweight (weight for age <Median -3SD). The prevalence of underweight was marginally low (65%) compared to their other tribal counterparts (69%) (NNMB Tribal Survey 2000).

The overall prevalence of stunting, an indicator of chronic undernutrition (height for age <Median- 2SD) was 46%, while that of wasting, an indicator of acute undernutrition was about 21%, which was lower than their tribal counterparts of Andhra Pradesh (57% of stunting, 27% of wasting). Significantly higher proportion of adolescent boys (45%) were undernourished compared to girls (21%) (age and sex specific BMI centiles of NHANES).

The overall prevalence of chronic energy deficiency (BMI <18.5) among adults was 51%, the prevalence being higher among females (58%) compared to males (41%). The extent of undernutrition among children and adults, however, was relatively low compared to their State counterparts.

About 90% of the mothers reportedly initiated breast-feeding within 24 hours after delivery. Only about 14% of the mothers discarded colostrum, mostly on elder's advice. The proportion of the same was lower compared to that of 30% generally encountered in the rural areas. Nearly three fourth's of the mothers initiated complementary feeding to their children during 4-6 months of age, which mostly included rice/roti, bread and biscuits and milk. None of the mothers gave commercial baby foods to their children.

Majority (93%) of the children were completely immunized by 12 months of age, while the rest did not receive the third dose of DPT/Polio. About 93% of the women received TT vaccination during

previous pregnancy. Though nearly 90% of the children received massive dose of vitamin A during the previous year, only 52% reportedly received the recommended two doses against 25% in their rural counterparts (NNMB, 2003). Similarly, about 90% of the currently lactating women received iron and folic acid tablets during the last pregnancy, the corresponding figure in the rural counterparts is 62%. Only 69% received minimum of 90 tablets against 30% in rural areas. The coverage of lactating women for IFA Tablets distribution was much lower (33%).

The study revealed high rate of adult illiteracy, poor economic status, dependency on agriculture and allied occupations for livelihood, low intake of protective foods and gross inadequacy in the intake of micronutrients. The overall prevalence of under nutrition, though low to their tribal counterparts of the State, but was higher compared to their rural counterparts. The prevalence of morbidities such as fever and diarrhoea was also relatively higher compared to that reported in rural areas, indicating the problem of poor environmental sanitation and personal hygiene. The coverage of beneficiaries for immunization and supplementation of massive dose vitamin A and IFA tablets was relatively good.

Poverty and poor health-seeking behaviour probably contributed to aggravate the situation. The study highlights the need for strengthening of the existing health facilities, health and nutrition education programmes & poverty alleviation programmes being implemented by the Government.