

# Nutrition

In the field of nutrition, major thrust of the Council was on providing technical support and guidance to strengthen the ongoing national nutrition programmes. Community surveys were undertaken besides studies on women's nutritional status, diet related cancers, micronutrient deficiencies, non-communicable diseases due to nutritional deficiencies such as diabetes, cataract *etc.* Surveys were also conducted for finding out nutritional status of tribals in various states of the country. The Council's National Institute of Nutrition (NIN), Hyderabad undertakes most of the studies in nutrition.

## COMMUNITY STUDIES

### Community Survey to Study Prevalence of Micronutrient Deficiency Disorders

A large scale, eight-state community based survey was carried out to study the prevalence of micronutrient deficiency disorders involving both clinical and biochemical forms of vitamin A deficiency (Bitot spots), iodine deficiency disorders (IDD) and iron deficiency anaemia during the year. The overall prevalence of Bitot spots was 0.8% and that of goiter was 4%. About 42% of the households were using non-iodized salt. Mostly lactating and pregnant women, adolescent girls and pre-school children were found to be affected by anaemia. While IDD registered a decline well below the epidemic level, vitamin A deficiency continued to be a matter of public health concern in many states. The results underscore the need to strengthen the existing national nutrition programmes as well as nutrition education component embedded in them.

A country-wide survey carried out to assess the changes in the prevalence of IDD particularly in the districts with higher levels of endemicity revealed that the overall prevalence of total goiter registered a significant decline from 14-69% in 1984 to 3-40% in 1994 especially in the north-eastern region of the country.

Another community-based study to assess diet and nutritional status in drought-affected areas in the country during May-June 2003 has shown that the mean intakes of all foodstuffs were below the suggested levels in almost all the states surveyed. Also, the recommended levels of cereal and millet intake were not met. Though drought relief programmes like 'Food for Work' could ensure steady supply of certain cereals and millets, there was insufficiency of other foodstuffs among the affected people. Prevalence of underweight and stunting in preschool-aged children and chronic energy deficiency in adults was found to be significantly high.

### Nutritional Studies in Tribals of Madhya Pradesh

Evaluation of effect of intervention (safe drinking water) on endemic fluorosis in Mandla by RMRC, Jabalpur revealed that supply of water with less than 1-ppm fluoride reduced genu valgum in children from 51.2% in 1996 to 2.6% in 2003. Urinary fluoride reduced to 9.8% (2003) from 40.8% (1996), though dietary intake pattern did not change much. Other biochemical parameters like serum alkaline phosphatase, calcium and inorganic phosphorus remained similar to pre-intervention period *i.e.* within normal range. Thus safe drinking water and nutrition supplementation resulted in reversal of bone deformities due to fluorosis (Fig. 1).

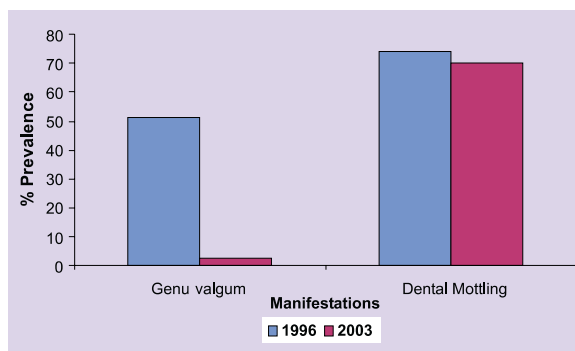


Fig. 1. Clinical manifestations before and after intervention.

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### **Nutritional Status of Raika Community in Jodhpur**

*Raika* community (OBC) in Jodhpur district commonly consumes camel milk which reduces diabetes and may be helpful in reducing nutritional deficiencies and morbidities in adult community. A nutritional survey revealed that *Raika* adults suffered from chronic energy deficiency (44.1%), vitamin A and B complex deficiencies (3.4 % & 2.4%) and anaemia (87.7%). Main morbidities reported at the time of survey were aches (56.6 %), gastric complaints such as abdominal pain (26.1%) and respiratory problems (8.8%). Morbidity showed negative association with personal cleanliness, housing conditions, education and haemoglobin estimation. Diet analysis also revealed that *Raika* adults suffered from calorie deficit (50.5%), but intake of proteins met the allowances recommended by ICMR.

### **Nutritional Habits and Cancer in Mizoram Community**

Confirmed cases of stomach cancer (274) belonging to Christian community of Mizoram were enrolled in a study conducted by RMRC, Dibrugarh for finding risk factors for stomach cancer in relation to their practices and food habits. Consumption of smoked salted fish and meat was found to be the risk factor. However, consumption of fresh fish and chicken was a protective factor. Among the peculiar food habits of Mizoram, consumption of fermented pork fat, fermented soybean and Soda were found to be the risk factors. A local cigarette (*meiziol*) was high risk factor for stomach cancer.

## **CLINICAL STUDIES**

### **Osteoporosis in Indian Women**

Indian data show early onset of osteoporosis among Indian women compared to women from West. Most of these women belonging to the underprivileged sections of the society subsist on a diet low in calories, proteins as well as calcium. These women breastfeed their infants for prolonged period of time (> 1 year). Studies are being carried out to establish peak bone

mineral density (BMD) reference values for both men and women and also to assess the prevalence of osteopenia and osteoporosis in Indian population groups in a multicentric task force study. Results have indicated that conservation of calcium occurs either through increased absorption or reduced excretion, or both. These compensatory mechanisms were observed to offset the breast milk calcium loss only in women who enjoyed better nutritional status (body weights and BMI). The link between body weight and BMI with peak bone mass is being explored in further studies.

### **Effect of Egg Intake on Serum Lipid Profile**

In a study conducted by AIIMS, New Delhi, 34 healthy young (22 men, 12 women; age 25.7±5.8 yr) vegetarian normolipidaemic volunteers were given one boiled egg per day for eight weeks. Out of them only 45% had greater than 15% rise in LDL cholesterol level and significant rise in total cholesterol, LDL cholesterol and total HDL cholesterol ratio after egg consumption. This indicates that knowing the cholesterolaemic response of an individual to eggs may be important before including the eggs regularly in the daily diet.

### **Effect of Ghee (Clarified Butter) on Serum Lipid Profile**

The study on 63 healthy physically active adult volunteers (52 men and 11 women) was conducted at AIIMS, New Delhi following a randomized controlled parallel design. The experimental group was provided *ghee* and mustard oil in diet for 8 weeks. Their serum total cholesterol and HDL cholesterol level increased while LDL cholesterol level did not show any change. The study did not indicate any adverse effect of *ghee* on lipoprotein profile.

### **Lipid Profile, Blood Glucose and Insulin Levels in Adolescents belonging to Affluent Families**

In a study conducted by Institute of Home Economics, New Delhi, 773 adolescents (boys-351; girls-422; age, 13-19 yr.) from affluent families were enrolled from five South Delhi



public schools. The data revealed that snacking in between meals and bingeing, eating out at restaurants and fast food joints was quite popular among the subjects. Most of the adolescents were engaged in sedentary activities in their leisure time like reading/listening to music/watching TV, talking to friends on the telephone, playing video games and working on computers/surfing the net. As per Garrow's classification, 11.4% of the adolescents were in grade I, 3.2% in grade II and 0.3% in grade III obesity (Fig. 2). Nearly 30% subjects had systolic blood pressure (SBP)>120 mm Hg and 16.7% had diastolic blood pressure (DBP)>80 mm Hg. A total of 27.8% of the subjects could be at risk of developing hypercholesterolemia and coronary artery disease (CAD) later in life. Of these, 5.8% subjects had cholesterol levels >200mg/dl and 22% between 170-200mg/dl. The data also revealed that 8.1% of the subjects were at risk of diabetes having fasting blood sugar levels > 100 mg/dl.

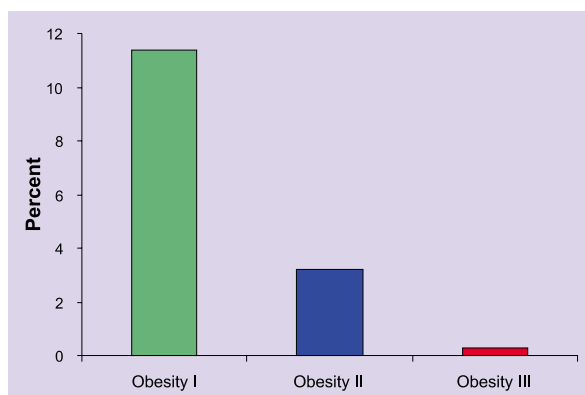


Fig. 2. Type of obesity in adolescents.

## STUDIES ON MICRONUTRIENT DEFICIENCY

### Vitamin A Deficiency

Assessment of vitamin A status in the population groups is a prerequisite for successful prevention and control of vitamin A deficiency disorders. A technology for collecting dried blood spot (DBS) on filter paper and later analyzing it for vitamin A using HPLC has been developed with the support from Micronutrient Initiative and MOST, New Delhi.

### Prevalence of Multiple Micronutrient Deficiencies amongst Pregnant and Non-pregnant Women

In a study conducted by AIIMS, New Delhi, 225 pregnant mothers and 225 newly married non-pregnant women in a rural block of Haryana State were enrolled to determine the prevalence of various micronutrient deficiencies.

Around 88% pregnant women were found deficient in zinc concentration, while 62% pregnant women and 68% newly married women had folic acid deficiency. Around 8.3 and 10% pregnant and newly married non-pregnant women respectively had iodine deficiency (Fig. 3&4)

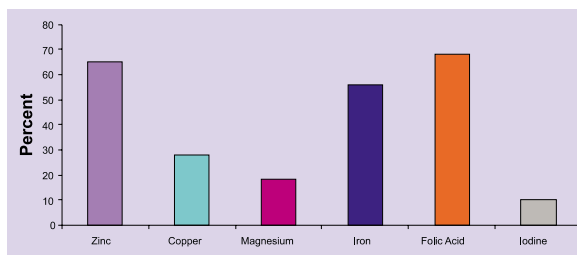


Fig. 3. Micronutrient deficiencies in newly-married non-pregnant women.

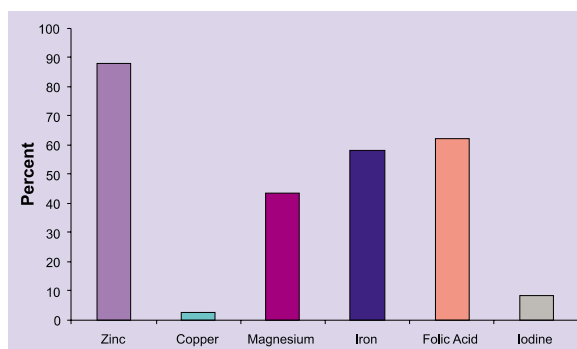


Fig. 4. Micronutrient deficiencies in pregnant women.

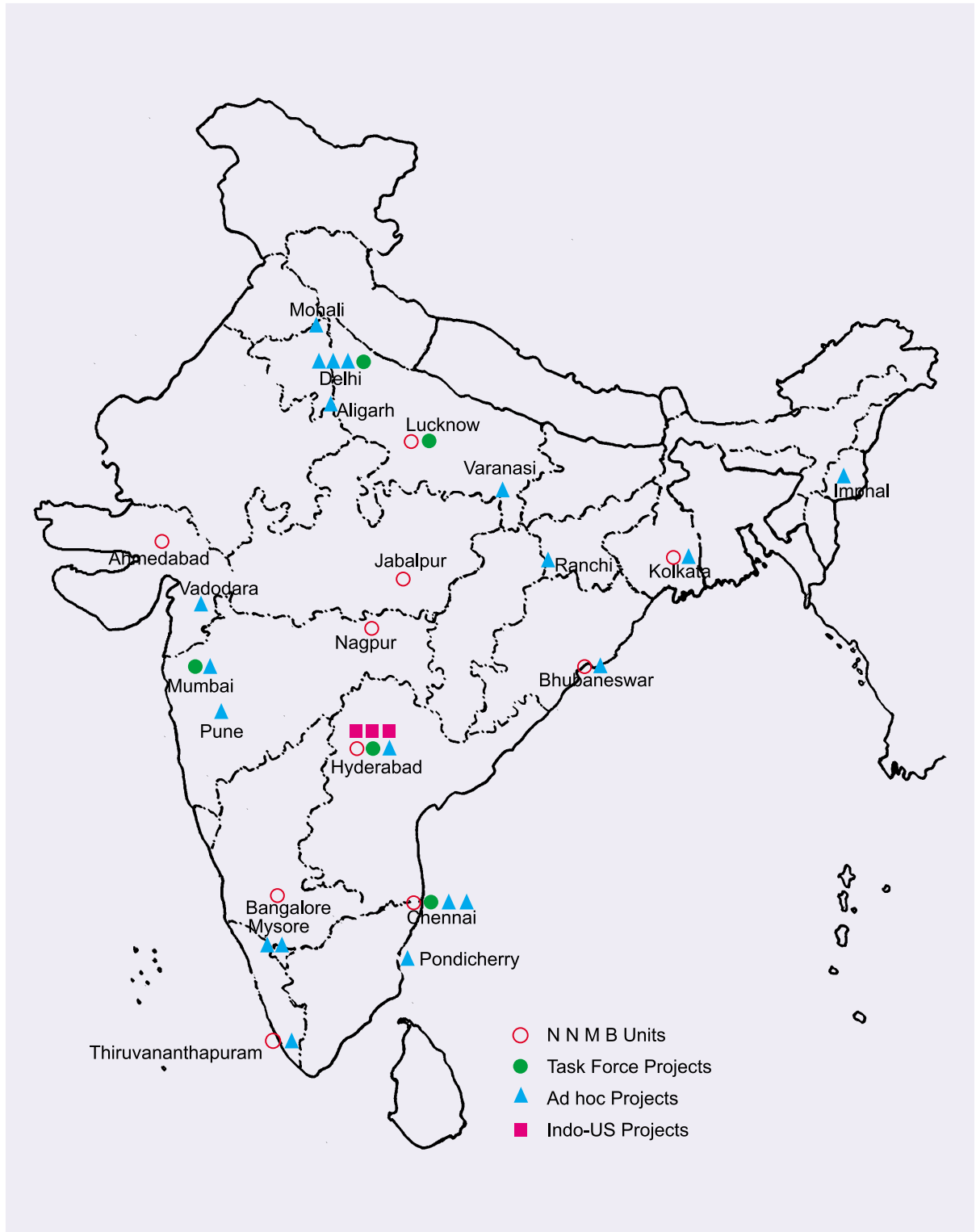
## DIET AND NON-COMMUNICABLE DISEASES

### AR Inhibitory Activity in Foods and Cataract

The enzyme, aldose reductase (AR) in lens has been a drug target because of its involvement in the development of secondary complications

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of diabetes including cataract. A study carried out to assess the inhibition of AR by *Embllica officinalis in vitro* and in lens organ culture revealed that its aqueous extract inhibited rat lens AR and recombinant human AR. The hydrolysable tannoids of *E. officinalis* were found to be responsible for AR inhibition. In an alternative approach, antiglycating agents (MAB1) have been worked out for delaying the onset of opacification of lens.

### **Resistin as a Molecular Link between Diabetes and Obesity**

Resistin, a cysteine rich secretory protein, which is downregulated by anti-diabetic drugs like thiazolidinediones (TZDs), has been implicated as the link between type 2 diabetes and obesity in mouse.

In an attempt to understand its role, the human resistin was cloned, expressed and purified to homogeneity from *E. coli*. The biophysical characterization of this recombinant protein revealed its unusually stable nature, which was possible due to intermolecular disulfide linkages. Resistin showed a tendency to aggregate at higher concentration where it undergoes dynamic structural changes as a function of concentration and time. While a link between insulin resistance and inflammation has been established, the exact mechanism has still not been worked out. However, it is seen that the recombinant resistin protein activates monocytic/macrophage cells (both murine and human) leading to enhanced secretion of pro-inflammatory cytokines, tumour necrosis factor (TNF- $\alpha$ ) and interleukin (IL-12).

### **Dietary Fatty Acids and Insulin Resistance**

Studies were carried out to investigate the effect of increasing dietary long chain n-3 polyunsaturated fatty acids (PUFA) from fish oil on membrane lipid composition and insulin sensitivity in skeletal muscle and adipose tissue of sucrose induced insulin-resistant rats. The results showed that replacement of 0.5en% long chain n-3 PUFA (n-6/n-3 ratio = 10) prevented sucrose induced insulin resistance by increasing peripheral insulin sensitivity.

### **Effect of Calorie Restriction on Aging**

A study was carried out to assess the effect of calorie restriction with/without micronutrient deficiency on oxidative stress and aging. The findings of the study established the beneficial effect of calorie restriction *per se* in protecting animals against oxidative stress and hyperinsulinemia.

## **FOOD TOXICITY**

An immuno-diagnostic kit has been developed based on latex agglutination test for rapid detection of *Staphylococcus aureus* in food samples. The sensitivity of this kit was found to be over 90%, while specificity was 88% with an efficiency of 90%. This kit can be used in the quality control of foods and as a substitute to imported kits.

## **NUTRITION AND CANCER**

### **Antimutagenicity of Ginger**

Antimutagenic and antigenotoxic potential of ginger was clearly established in a study. Another study was conducted on patients suffering from upper gastrointestinal tract cancers. Estimation of *in vivo* nitrosation potential after administering proline was carried out. The metabolites of nitroproline were found to be significantly higher.

### **Effect of Vitamin Restriction and Supplementation on Rat Intestinal Mucosal Cell Apoptosis**

A study was carried out to determine the effect of vitamin A restriction and supplementation on drug induced apoptosis of rat intestinal mucosal cells. It was observed that riboflavin and folic acid supplementation helps in preventing DNA damage, mutations and the occurrence of cancer as well as chemotherapy restricted adverse effects.

### **Antioxidant Properties and Hypcholesterolemic Effects of Sesame Oil**

Sesame oil (SO) is known to be stable against oxidative deterioration and its keeping quality

is mainly attributed to the presence of endogenous unsaponifiable components such as sesamol, sesamol and sesamin (absent in other vegetable oils). A study conducted by Central Food Technological Research Institute (CFTRI), Mysore showed that sesame oil is very stable against oxidative deterioration compared to sunflower (SFO) and groundnut oils (GNO) at room temperature over a period of time. When SO was heated at 60 and 180°C, various oxidative parameters were lower than in SFO and GNO. Blending of SO with GNO and SFO increased the shelf life of blended oils at room temperature and heated oils and the oxidative stability of blended oils increased as the content of SO in blended oils increased. Nutritional studies showed that SO reduced the cholesterol and triglyceride levels in both normal and cholesterol fed rats. SO was effective in reducing increased peroxidation induced by iron and in preventing triglyceride accumulation in liver induced by administration of carbon tetrachloride and ethanol. SO also helped in maintaining erythrocyte membrane integrity in cholesterol fed rats.

## OTHER STUDIES

### *Molecular Analysis of WNIN/Ob Rats*

Research carried out on obese rat model included identification of some obesity-related

genes like steroyl COA desaturase, uncoupling protein, leptin and lipoprotein lipase.

### *PCR based DNA Fingerprinting in Obese Rats*

DNA fingerprinting of the obese mutant rats using random primers yielded a fairly constant DNA fingerprint for the GR-Ob strain. Similar pattern was not found in WNIN/Ob strain and hence alternative techniques to obtain results are being explored. Also, genetic typing of obese mutant rats using microsatellite markers was carried out. Out of 100 markers, 60 primers spanning majority of the chromosomes have been screened.

### *Toxicity of Khesari Dal*

A rapid community survey carried out in the villages of Bhandara district of Maharashtra revealed that several people were affected with toxicity-related illness on consuming *Khesari dal* (*Lathyrus sativus*).

### *Fluoride Toxicity in Drinking Water*

In another study carried out in some villages of Nawada district of Bihar, high fluoride concentration in drinking water lead to vitamin D deficiency causing bone deformities in young children. Appropriate strategies to combat the problem were suggested.

