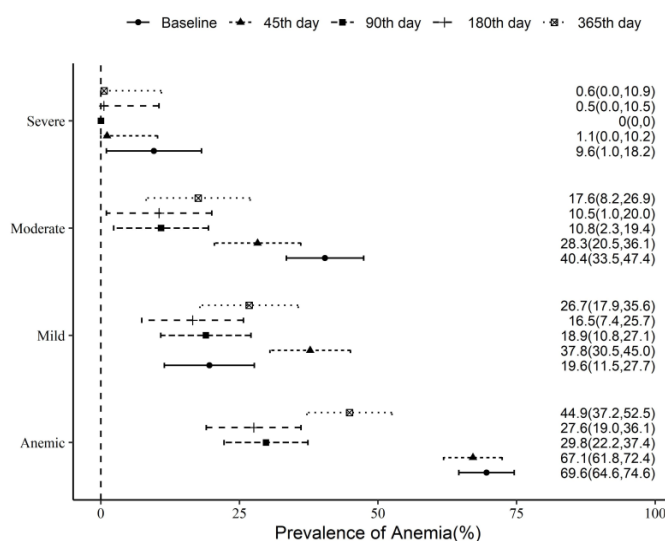


**ICMR-NATIONAL INSTITUTE OF NUTRITION
Hyderabad – 7**

**MAJOR PROJECTS UNDERTAKEN DURING THE YEAR 2021-22
AND THEIR ACHIEVEMENTS (April 2021 to March 2022)**

- Assessment of nutritional status of below 12 years children of Muzaffarpur District, Bihar - A rapid nutritional assessment:** A rapid study was carried out to assess the nutritional status of the children in litchi growing areas of Muzaffarpur district of Bihar, where an outbreak of Acute Encephalitis Syndrome (AES) was reported. It was found that the children were subsisting on inadequate diets, both quantitatively and qualitatively. The same reflected in their nutritional status - the prevalence of underweight (AES: 31.6% & non-AES: 25.1%) and stunting (AES: 47.7% & non-AES: 38.7%) among children under 5 was high. Anaemia was high among 3-5 years children (47.7%) and children below 3 years (76.4%). The prevalence of B12 deficiency was 45.4% in children 3-5 years and 58.6% in children below 3 years. All the deceased children were from underprivileged or marginalized communities. Most children reportedly consumed Litchi fruits and were exposed to hot sun during summer. Litchi fruits contain hypoglycin A or Methylene cyclopropylglycine (MCPG) known to cause hypoglycemia and metabolic derangement. Therefore, parents were sensitized not to allow their children to skip the night meal and play outdoors in hot sun.
- Efficacy of screen and treat approach for anemia reduction among women of reproductive age:** The efficacy of screening followed by treatment with iron-folic acid tablets as per the Anemia Mukht Bharath (AMB) guidelines was studied among women of reproductive age (WRA), along with changes in iron status biomarkers. Young WRA (n=470), aged 17-21 y, were screened for their venous blood hemoglobin (Hb) and treated with IFA for 90 days according to their grade of anemia, or if non-anemic, administered prophylactic IFA, and then followed-up additionally for 9 months. At baseline, anemia, iron deficiency (< 15 mg/L plasma ferritin) and iron deficiency anemia (< 12.0 g/dL Hb and < 15 mg/L Plasma ferritin) prevalence were 69.6%, 68.7% and 62.4% respectively. At the end of 90 days of IFA treatment, anemia, ID and IDA prevalence reduced by 40%, 47.3%, and 4%, respectively. Moreover, significant treatment effects persisted at 365 days of follow-up with 0.5g/dL decline in mean Hb compared to 90 days. These observations suggest that screening and administering tailored doses of IFA treatment in addition to the regular IFA prophylaxis in non-anemic WRA is efficacious in reducing the prevalence of anemia and improving their iron status, and that the combined effects largely persist for 9 months after cessation of treatment.



- **Development of prebiotic noodles containing galactooligosaccharides:** The study aimed to develop prebiotic (such as galactooligosaccharides) formulated noodles. Twelve different formulations of noodles were prepared and subjected to nutrient and sensory evaluation. The nutritional analysis showed increase in the protein content in the formulation containing Maida (74%) + Defatted Bengal Gram (DFBG) (20%) + galactooligosaccharides (5%) +1g Micronutrients (MN). The percent of carbohydrates were high in the formulation [Maida (95g) + galactooligosaccharides (5g)]. The results showed 75% acceptability for Maida noodles compared to 22% for Maida (74%) +DFBG (20%) + galactooligosaccharides (5%) +1g Micronutrients (MN)], 26% for wheat (95%) galactooligosaccharides (5%), 52% for Maida (95%) galactooligosaccharides (5%).
- **Consumption pattern of artificial sweeteners used in food products and as table top sweeteners among normal, overweight, obese and type II diabetes individuals located in major metropolitan cities of India:** This study examined the consumers' knowledge of artificial sweeteners and quantifying levels of high intensive sugars present in various food products available. The survey on the consumption pattern of artificial sweeteners among type II diabetic subjects indicated that 86% of individuals consumed table top sweeteners. The preference for these artificial sweeteners were 27% saccharine, 25% sucralose, 23% aspartame, 10% stevia, and 4% acesulfame K. About 74% of dieticians did not recommend using artificial sweeteners, while 26% recommended AS for weight management and glycemic control. Among the Artificial sweeteners, stevia (28%) and sucralose (15%) were most recommended by the dieticians. The content of sweeteners in various food products quantified using HPLC and TLC indicated that they were in accordance with Acceptable daily intake (ADI).
- **Resistant starch of plant foods and its hypoglycemic effect in human:** This study aimed to determine the resistant starch (RS) content in commonly consumed foods and to develop certain low GI/GL food products which may be useful for people with Diabetes. Twenty one different samples were analysed including, cereals, pulses, roots and tubers and vegetables. In cereals, high resistant starch content was present in jowar (5.717 g/100g), in pulses - red gram dal (29.4 g/100g), in roots and tubers - Colocasia (45.7 g/100g) and in vegetables - plantain (39.88 g/100g). Effect of different processing methods increased the resistant starch in cereals due to retro gradation and reduced RS content in pulses as well as in roots and tubers due to starch gelatinisation and solubilisation and starch lipid complexes respectively. Dry heat- reduced RS content due to dextrinization. Moist heat increased RS content due to gelatinisation. The food product developed using different ratios of wheat and plantain had different levels of sensory acceptability scores. These low glycemic index food products can be considered as a potential food alternative for control of Type 2 diabetes.
- **Effect of maternal protein restriction on body composition and protein quality control processes in the skeletal muscle of the offspring:** Several studies suggest that maternal protein content and source can affect offspring health. However, chronic impact of maternal quality and quantity protein restriction, and reversible changes upon rehabilitation on body composition, and protein quality control (PQC) processes in skeletal muscle in offspring is not known. This study examined the effects of maternal low-quality protein (LQP) and low-protein (LP) intake from preconception to post-weaning, followed by rehabilitation from weaning on body composition, glucose-homeostasis, metabolic factors, skeletal muscle (SM) proteolysis, ER stress, autophagy and ubiquitin -proteasome system (UPS) in rat offspring. Wistar rats were exposed to LQP

or LP isocaloric diets for 7 weeks before pregnancy to lactation. After weaning, offspring were either continued on these diets or rehabilitated with normal protein (NP) for 16 weeks. LQP and LP offspring had lower body weight, fat and lean mass, insulin and HOMA-IR than NP. LQP-offspring had higher cholesterol, T3, T4, lower triacylglycerides, glucose, while the same were unaltered in LP than NP. Interestingly, LP-offspring showed augmented PQC processes and increased SM protein degradation than NP-offspring. Majority of above outcomes were reversed upon rehabilitation. These results suggest that chronic exposure of rats to a maternal LQP and LP diets induced differential adverse effects by lowering body weight, fat, lean mass and skeletal muscle proteolysis which were reversed upon rehabilitation.

- **Development of α -crystallin mini chaperone peptides as therapeutic molecules for diabetic ocular diseases:** The protective and therapeutic effects of individual α -crystallin peptides and their combination in a 3:1 ratio in diabetic cataract and retinopathy were investigated in a rat model and cell lines. Even though systemically administered, α -crystallin peptides did not prevent hyperglycemia, however, they delayed cataract progression and preserved retinal function in the diabetic rats. Furthermore, α -crystallin peptide administration reduced the aggregation and insolubilization of protein. Additionally, hyperglycemia-induced oxidative and ER stress were also attenuated upon α -crystallin peptides administration. α -Crystallin peptides alleviated the hyperglycemia-induced apoptosis by reducing the caspase-3 activity and Bax levels. Additionally, α -crystallin peptides attenuated ER stress and oxidative stress in HeLa cells. α -Crystallin peptides preserved the retinal function, delayed the progression of diabetic cataract by attenuating the protein aggregation, oxidative stress, ER stress, and apoptosis. These studies will likely help in developing the α -crystallin peptides as therapeutic agents to delay cataract progression.
- **Effect of dietary zinc deficiency on skeletal muscle proteostasis and mitochondrial biology in growing rats:** Zinc deficiency leads to reduced growth, mass, and work capacity of skeletal muscle. However, the underlying mechanisms in connection with skeletal muscle proteostasis and mitochondrial biology are not clear, and hence, these aspects were investigated using a rat model. Results indicate a decreased mean muscle fiber cross-sectional area and increased apoptosis in the muscle of zinc-deficient rats. Activation of the ubiquitin-proteasome system as indicated by increased levels of the E1 enzyme, MuRF1 (muscle-specific E3 ligase; muscle atrophy marker), and proteasomal activity was observed in the zinc-deficient rats. Declined autophagy (Beclin1, ATG5, and LC3), and increased ER stress markers were observed. Zinc deficiency also affected mitochondrial biology. Thus, zinc deficiency appears to affect skeletal muscle proteostasis, and mitochondrial biology, causing muscle atrophy.
- **Anticancer effect of cinnamon extract and its active component procyanidin B2 in a rat model of prostate cancer:** This project studied the chemopreventive efficacy of cinnamon and its bioactive compounds in a rat model of prostate cancer. Histopathological changes such as hyperplasia and Prostate Intraepithelial Neoplasia [PIN] induced by the combination of chemical carcinogen and testosterone in the prostate were reversed by cinnamon and its bioactive compounds. Similar to chemo-preventive drugs, cinnamon (concentration) and its bioactive compounds led to inhibition of cell proliferation, induction of apoptosis, inhibition of oxidative stress and angiogenesis, proteasome inhibition and inhibition of metastasis in prostate tissue. The data demonstrates that

cinnamon and its bioactive compounds have a beneficial effect against carcinogen-induced prostate carcinogenesis.

- **Effect of traditional cooking on phytonutrient content and radical scavenging activity in cereals and millets:** Traditionally processed sorghum, pearl millet and finger millet (viz. cooking, fermentation with curd, fermentation without curd, addition of curd to fermented millets) were analysed for their nutritional and anti-nutritional properties. Protein content was significantly higher in the cooked and fermented with curd sorghum (20.57 ± 0.37 g/100g) and pearl millet (20.27 ± 0.27 g/100g). Phytic acid content in millet flours ranged from 4.77 ± 0.07 (pearl millet) to 8.6 ± 0.15 mg/g (sorghum) and a sharp reduction (3.28 ± 0.09 mg/g) was observed in sorghum after it was cooked and fermented overnight and mixed with curd. Nutrient retention of water soluble vitamins increased in all the traditionally processed millets. The millets when traditionally cooked, overnight fermented and then added with had decreased phytic acid (62.9%) and increased Fe and Zn content which may enhance the bioavailability of both the micronutrients.
- **Exploring the protective effect of gamma oryzanol on diet-induced model of non-alcoholic steatohepatitis:** The present study investigated the protective effect of gamma oryzanol in western diet-induced animal model with Non alcoholic fatty liver disease (NAFLD). The results demonstrated that gamma oryzanol at a dose of 300mg/kg body wt could ameliorate western diet- induced NAFLD. In addition, gamma oryzanol supplementation also reduced visceral adiposity. Given the high prevalence of NAFLD and non-availability of pharmacological interventions for their management, gamma oryzanol appears as a promising dietary intervention with potential benefits in managing NAFLD.
- **Association between pesticide residue concentration in tissues and with the lymphoma, leukaemia and breast cancers:** It is a cross-sectional study conducted among farmers and non-farmers visiting a tertiary cancer care hospital in Hyderabad, Telangana, diagnosed with leukaemia, lymphoma and breast cancers. In addition to these groups, family members of the farmers who were not engaged in farming and not diagnosed with any type of cancer were also included as study participants under the healthy control group. Face-to-face interview conducted among them revealed that farmers when engaged actively in farming activities did not adopt any GAPs. The results of the study revealed 17 and 14 pesticide residues in their blood and tissue samples respectively while there were no residues in the non-farmers. Further, higher frequency of polymorphisms in GSTT1, GSTM1 and CYP2E1 genes and elevated levels of 8-OHdG were found among farmers as compared to the non-farmers and healthy controls.
- **Understanding the possible dysregulation of molecular events associated with the exposure of Lead (Pb) and A β peptides on Neuronal/Glial cells:** Brain cells were exposed to 80 μ M of Lead(Pb) and the possible dysregulation of molecular events associated with neurodegeneration were investigated. Alterations in expression levels of various proteins like CDK5, p35, Calpain, Munc18, Neuregulin, E2F1 and H2AX were evaluated. Human microglial cells on exposure to lead had alterations in the phagocytosis and antioxidant markers indicating the fact that they have crucial role on progression of neurodegeneration.
- **Evaluation of maternal micronutrient status, inflammation and effect of COVID -19 on placentas of anaemic pregnant mothers, including fetal outcome:** 212 term

pregnant mothers were recruited, 58% of whom were positive for COVID-19 IgG antibodies and 42% were negative, although all were asymptomatic during their entire course of pregnancy and also were RT-PCR negative for SARS-CoV-2 antigen at the time of their admission for delivery, placental histology showed that irrespective of hemoglobin status of the mothers, placental hypoxia was evident.

- **Oral toxicity study of a new *Salmonella* killing bio-control agent NINMB 13076 bacteriophage:** Sub-chronic oral toxicity study of *Salmonella* phage conducted on mice revealed no side effects. The study revealed no difference in the probiotic microbiota population of BALB/c mice. *Salmonella* phage NINP13076 did not affect the growth of probiotic microbiota. Phages are proven to be safe, and they can be used for bio food preservation.
- **Microbiological safety and quality of commonly consumed herbal drugs:** Ashwagandha, Shatavari, aloe vera, and amla are the commonly consumed herbal drugs. Over 112 herbal drugs were collected. These included solid, semisolid, and liquid samples for microbiological analysis. Microbiological contamination in solid herbal drug samples was found to be more compared to semisolid and liquid herbal drug samples.
- **Studies on the efficacy of P995 technology to control microbiological contamination in foods:** Samples collected from the top layer after processing in the Ozonator showed a good reduction in microorganisms which could be due to better exposure to UV light. The Ozonator is not significantly effective in foods having a high microbial load. The findings of the study suggest that the treatment of different food samples with ozone and UV reduces the microbiological load, but the extent of reduction appears varied depending on the food sample.
- **Dermal penetration of pesticide residues in farmwomen workers: Assessment of cost-effective protective gears a preventive measure:** Analysis of pesticide residues/residual metabolites/haematological parameters was carried out in dermal washings (hand/wipe/patch), blood and urine samples among 360 farm-workers (men and women) who were not using PPE (n=180); using commercially available PPE (n=60) and PPE prepared using available resources (n=120) and provided free-of-cost. The mean concentration of ten pesticide residues detected ranged from 0.002 - 246 µg/mL in hand washings, 0.002 - 198.3 ng/cm² in patch and 0.0001 - 1740 ng/cm² in wipe samples among the subjects not using PPE. The same were lower in hand washings (0.01 - 16 and 0.0001 - 11.44 µg/mL); patch (0.001 - 6.57 and 0.0001 - 1.82 ng/cm²); and wipe samples (0.003 - 72.9 and 0.0008 - 39.7 ng/cm²) after using commercially available and PPE prepared and provided to them respectively. Further, Dimethyl phosphate, Diethyl thiophosphate and Diethyl dithio-phosphate were detected in plasma (1.9 – 936.1 ng/mL) and urine (0.45 – 535.03 ng/mL) samples among the subjects not using PPE; while their reduction in plasma (0.25 – 15.7) and urine (0–68.99) was observed after using commercially available/PPE prepared and provided to them. Further, increased inflammation (CRP, IL-6, IL-1β, Cortisol, TNF-α) was observed when compared to their respective normal ranges among those not using PPE.
- **Impact of long-term use of double fortified salt when used prenatally, on maternal iron and iodine status and cognitive development of infants in rural Meghalaya - A Pilot study:** The study was conducted in two blocks of the East Garo district of Meghalaya. A qualitative research study was conducted to understand the food habits and

health-seeking behaviours of Garo women during pregnancy. It was found that no special care or diet was taken during pregnancy, as it was considered a natural phase not requiring special attention. However, antenatal check-ups were considered important. Pregnant women were unaware of the need for iron-folic acid tablets during pregnancy. Consumption was not regular either due to non-compliance or non-availability. For the pilot study, a total of n=151 pregnant women (in the second or third trimester) were enrolled in the Double Fortified Salt group (n=57) or Iodised salt group (n=68). Supplementation was carried out for 8±1 months. There were no differences between the groups at baseline. At endline Haemoglobin, C-reactive protein, Ferritin, and vitamin B12 were similar in both groups. Serum Transferrin (43.33±27.47 (DFS) 44.29±33.16 (Iodised) (nmol/mL)) was higher (p=0.045) in the iodized salt group.

- Infodemic in Pandemic - An online survey on food and nutrition related web search behavior, food scares and changes in Knowledge, Attitudes and Practices (KAP) among Indians:** This study evaluated the trend of COVID-19 associated food and nutrition news search behaviours of Indian internet users between January 2020 and June 2021 and its impact on their perceptions and practices. The Relative Search Volume (RSV) on Google Trends (GT) of 34 popularly searched keywords showed a steep rise in search for immunity boosters, vitamin supplement brands and "ayush kadha" during the first wave (April- August 2020). With a brief period of decline, the search trend again hiked correspondingly with increase in number of COVID-19 positive cases during the second wave. The online survey conducted on adult Indian internet users (n = 572) reported high (71.9%) consumption of Vitamin C rich fruits as well as Vitamin C (68.2%) and Zinc (61.4%) supplements 'to boost immunity'. Traditional Indian spices like ginger and garlic were used by 62.9% and 50.9% respondents respectively. Most respondents reported to rely on social media for COVID-19 associated health tips, however those with history of infection relied more on doctors and health professionals. This study highlighted the need of media and health literacy to advocate for the use of health information cautiously.

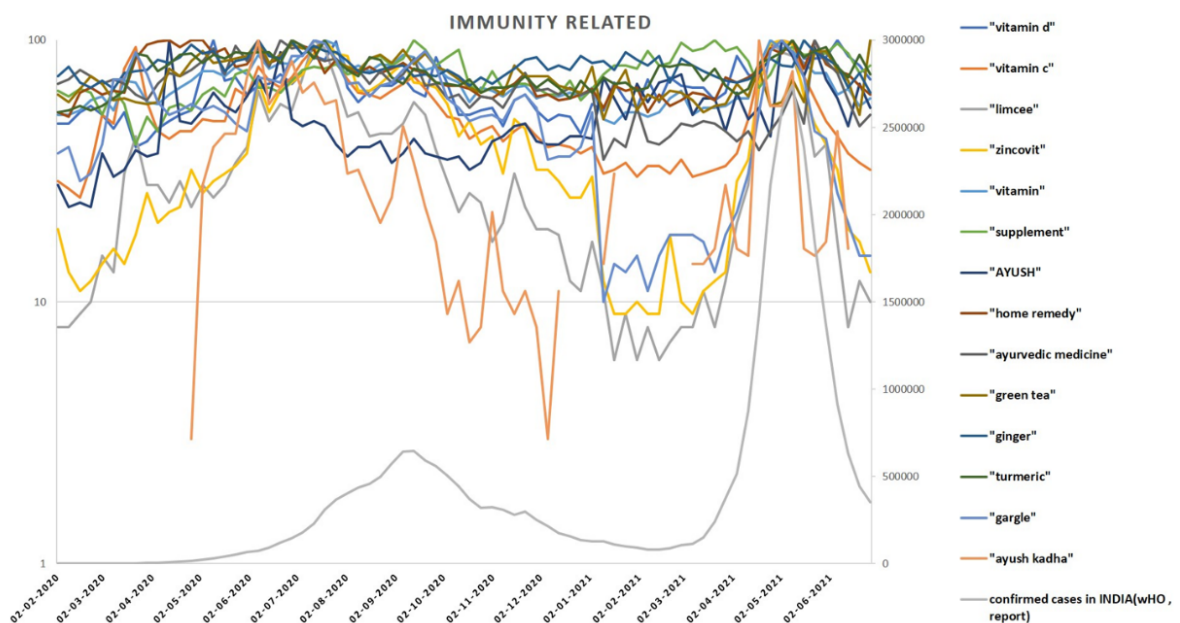



Fig. A positive correlation was observed between the number of COVID cases and search terms like “vitamin D”, “Limcee”, “grocery delivery”, “vegetable sanitizers”, “alcohol” etc. whereas, search terms like “street food”, “junk food”, “food delivery” etc. were negatively correlated to the number of cases.

- **Impact of integrated cognitive behaviour therapy (CBT) and pranayama on sleep quality of women living in welfare hostels:** The study was conducted among women living in welfare hostels. More than 50% reported sleep disturbances. The intervention with CBT was for three months. Significant mean differences between pre-and post-intervention were found. Statistically significant differences indicated that the intervention resulted in improved sleep quality. Although psychological well-being improved in all three groups, the mean difference was significantly higher for the integrated intervention group. The same trend was seen for psychological distress as well but not for perceived stress which showed all the groups benefitted similarly from the intervention.
- **Adaptation of the Food and Agricultural Organization’s, Education for Effective Nutrition in Action (ENACT) and Food Systems’ Courses for Nutrition Education in India:** The ENACT (developed by the FAO for Africa) is a comprehensive hands-on Nutrition Education course that has immense applicability in community nutrition. This project aimed to adopt the ENACT course material to the Indian context. The 11 units of the resource book and student’s book were adapted to the Indian scenario by contextualizing the case studies and also the pictures and graphics. Under output-2, six e-learning modules on “Nutrition and Food Systems” on the following topics were developed. Six universities have agreed to adopt the study material and e-learning modules as add-on courses in their PG curriculum of nutrition & dietetics.

Buying lobia (black-eyed beans)

- Mother has taken advice about the household diet and has decided that the family should eat more beans.
- She sends Kabir on his bicycle to buy lobia at the market. He is fast and willing. However, Kabir is not a good shopper. He buys lobia which are mouldy and expensive and on the way back he falls off, loses half the beans, and hurts his knee.



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Activity 1 Buying lobia (1)

To evaluate this “project”, here are some questions we could ask. Answer them orally first. Then check in the ‘Student’s Key’!

- Mother’s plan
 - More lobia for the family is the aim – is this what is needed?
 - What is Mother’s initial strategy for getting the lobia? Is it a good one?
- The shopping
 - How does the shopping go? What goes wrong and why?
 - How is it put right? What happens in the end?
- After the shopping
 - Do they achieve what they aimed for?
- In the longer run
 - Will this change in practice last?
 - What else has changed and for whom? Is it important?

Next time Mother sends Kabir’s little sister Monal. She is slow but capable. She brings back 10 kg of good beans.



- The family eats better for several weeks.
- Monal learns to ride Kabir’s bicycle and becomes the family’s main food shopper.



An extract from Unit 9: **Monitoring and evaluation** (Student’s book)

