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Malnutrition Approach to Diagnose, Neurological and Cognitive Sequel, Methods to Eradicate Nutrition Deprivation

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Abstract

Malnutrition in India has been rampant; in women and children this affects growth, development and skilled work. In 1973-74, decided to study on:

- Development of diagnostic tools to assess degree of malnutrition, using anthropometric indices on the nationwide data of affluent children < 5 yr and 5 to 18 yr of age (physical growth & sexual development). In addition, methods, were developed on blood and saliva. The fall in salivary ferritin was found sensitive in diagnosing early protein energy malnutrition (PEM). The fall of leucocyte Fαan and increase of glutamic acid in erythrocytes were also sensitive tests in PEM (Protein energy malnutrition).
- Studies were undertaken in rural areas to determine sequel due to malnutrition-physical, neurological or cognitive lesions, possible pathology in intrauterine and early life malnutrition.
- Developed treatment for acute protein energy malnutrition by dietary supplementation. Studies showed that Indian Dahi has immunonutrient properties i.e. Interleukin levels during treatment were much higher on WHO-Dahi as compared to WHO- milk diet after 15 d and 6 wk. The absolute lymphocyte counts, CD3, CD4, CD8, CD19 and CD56 increased in children receiving Dahi in WHO diet for 6 wk. Firstly, Dahi may replace the milk in WHO diet for treatment of malnutrition. Secondly, on feeding Berseem (Trifolium Alexandrium) leaves to PEM II & III, children also showed Immunonutrient properties, thus may be added in commercial cereals and legumes to eradicate malnutrition.

Keywords: Malnutrition; Sequel; Anthropometric indices; Leucocyte FαAN; Erythrocyte glutamic acid; Salivary ferritin; Dahi; Berseem leaves

Childhood Malnutrition

Develop diagnostic tools

Anthropometric indices: Growth Standards To diagnose malnutrition, growth data from affluent Indian children were collected during 1989-1991 from birth to 5 yr (7 states), only full term with birth weight ≥2500 g (boys 433 and girls 346) were followed during first yr of life at 3, 6, 9 and 12 mo of age with minimum of 3 reading for every infant (cohort-I). In cohort-II, from 12 mo to 5 yr + children of cohort-I also continued, 1011 boys and 874 girls were followed on their birthday and 6 monthly with minimum of 3 measurements for each child up to 72 mo of age. Children had received exclusive breast milk for 3-4 mo of life in cohort I. In a cross-sectional multicentric data for physical growth and sexual development for 5- 17.5 yr in girls and 5 to 18 yr in boys (cohort II- from 9 states- 23 schools; 12893 boys and 10,941 girls) on affluent Indian children were collected during 1989-1991 [1-4].

Development of biochemical tests to diagnose malnutrition

Blood -Leucocytes (life span 13- 20 days) FαAN decreased in hypoproteinemia [5]. Erythrocytes (life span 100 days) showed significant increase in glutamic acid [6]. The serum and salivary arginase activity and levels of salivary protein and ferritin

decreased with severity of PEM. The salivary ferritin showed very significant fall even in PEM grade I, in grade III the mean ferritin was 3.28 +/- 0.75ug/L as compared to 169.3 +/- 21.9ug/L for normal children. The changes in salivary protein, arginase activity, and ferritin in PEM may be used in recognizing severity as well as early stage of the disease [7-10].

Long term physical and neuromotor sequalae, possible pathology in intrauterine and early life malnutrition

Summarized from the research article [11]. A prospective epidemiological study was conducted in rural Varanasi, India to study effects of maternal nutrition/anemia on 3700 pregnant women and their offspring's- 34.6% <2500g (lbw) and only 8.2% > 3000 g. Polygraphic sleep cycle studies-EEG, ECG, ECOG, phasic body activity and respiration performed on term newborn babies of severely undernourished mothers showed disorganization during active rapid eye movement (REM) sleep and quiet nonrapid eye movement (NREM) sleep, babies clinically had hypotonia 72% and hypo excitability 56%, with incomplete Moro's [12,13]. National Family Health Survey of India- data (2021-2022 showed stunting in 35.5%, wasting 19.3% and underweight 32.1% in <5 yr children (14). Studies in Varanasi had shown that Stunted- wasted develop: soft neurological signs (SNS), their EEG had slow & sharp waves, in frontal, parietal and temporal lobes, with motor deficit [15]. There was - persistence of impaired repetitive speed movements with overflow & dysrhythmia. Wasted and underweight had deficit in higher mental abilities WISC IQ was low, poor social competence [16,17]. Examined at age 17 yr for biochemical and 31-phosphorus magnetic resonance spectroscopy (31-P MRS) showed that for vital functions, body mobilized amino acids from muscles: i) serum enzyme activities increased i.e. LDH, ALP, AST, ALT, CK, CK-MB and CK-mm and ii) b-ATP and Pi in muscles was increased at the cost of Pcr (Phosphocreatinine) [18]. In brain MRI and cognitive evoked potential studies- Frontal lobes- size was reduced and asymmetry of anterior as well as posterior lobes was lost [19]. These children with I Q > 90 had impaired perceptual maturity and conceptual grasp- Learning disability [20]. Reaction time was affected for perceptual abilities, information processing and analytical capabilities, irreversibly [21].

Identifying vegetarian immunonutrient foods to eradicate malnutrition

Children with PEM (severe) were treated as per WHO protocol (milk in diet). Studied 2 protein and micronutrients rich foods in WHO regime to develop better alternative to milk. i) Dahi (with lactobacillus bulgaricus and streptococcus thermophilus) and ii) Berseem leaf protein (LPC) was fed and compared for their efficacy; milk diet taken as control. All patients of PEM had infections. On WHO dahi diet improved in wt, Hb and CD2/CD4 cell ratio, high serum ferritin decreased and CRP got activated. The cytokine levels (TNFα, IFNγ, IL-10 and IL-4) were raised in PEM, on feeding dahi in WHO diet or LPC serum proinflammatory (TNFα, IFNγ), and anti-inflammatory (IL-10) cytokine levels increased. The increase in IL-10 was higher on dahi diet. IL-1, IL-6 levels increase on day 15th and at 6 wk, on both the diets. The mean initial absolute lymphocyte counts were 3707±1551 and 4553±1776/µl on dahi and milk diets, after 6wk of treatment to 6312±1937 and 3493±1418 µl, respectively (p=0.004). Similar, trend was observed for CD3+, CD4+, CD8+, CD19+ and CD56+ cells in both the groups. These observations demonstrate that dahi has immunonutrient properties i.e. lymphocyte counts increased and there was higher rise of IL10 and IL6 than on WHO milk diet. Dahi is an immunonutrient vegetarian food to treat & eradicate malnutrition and WHO diet should use dahi, instead of milk. While LPC may be mixed in cereals to raise protein and micronutrient content [22-28].

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