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

*Agarwal KN and Agarwal DK**

Department of Pediatrics, Institute Medical Sciences, Banaras Hindu University, India

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: 1. Development of diagnostic tools to assess degree of malnutrition, using anthropometric indices on the nationwide data of affluent children <5 year and 5 to 18 year 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 leukocyte FαAN and increase of glutamic acid in erythrocytes were also sensitive tests in PEM (Protein Energy Malnutrition).

2. 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.

3. 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 days and 6 weeks. The absolute lymphocyte counts, CD3, CD4, CD8, CD19 and CD56 increased in children receiving Dahi in WHO diet for 6 weeks. 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; Leukocyte FαAN; Erythrocyte glutamic acid; Salivary ferritin; Dahi; Berseem leaves

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Correspondence:
Agarwal DK, Department of Pediatrics, Institute Medical Sciences, Banaras Hindu University and Adolcare-Adolescent Health & Research Association, D-115, Sector 36, 201301, Noida, India

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Childhood Malnutrition

Develop diagnostic tools

i) Anthropometric indices, growth standards to diagnose malnutrition, growth data from affluent Indian children were collected during 1989-1991 from birth to 5 year (7 states), only full term with birth weight ≥ 2,500 g (boys 433 and girls 346) were followed during first year of life at 3, 6, 9 and 12 months of age with minimum of 3 reading for every infant (cohort-I). In cohort-II, from 12 months to 5 years+ children of cohort-I also continued, 1,011 boys and 874 girls were followed on their birthday and 6 monthly with minimum of 3 measurements for each child up to 72 months of age. Children had received exclusive breast milk for 3 to 4 months of life in cohort I. In a cross-sectional multicentric data for physical growth and sexual development for 5 to 17.5 years in girls and 5 to 18 years in boys (cohort II- from 9 states- 23 schools; 12,893 boys and 10,941 girls) on affluent Indian children were collected during 1989-1991 [1-4].

ii) Development of biochemical tests to diagnose malnutrition- Blood -Leucocytes (life span 13 to 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 ± 0.75 ug/L as compared to 169.3 ± 21.9 ug/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 sequela, 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 3,700 pregnant women and their offspring's- 34.6% <2,500 g (LBW) and only 8.2% >3,000 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 Non-Rapid 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-year 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 age17 years 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 (Phosphocreatine) [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 IQ >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 [22,23]. 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 [24-26]. All patients of PEM had infections. On WHO dahi diet improved in weight, 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 weeks, on both the diets. The mean initial absolute lymphocyte counts were 3707 ± 1551 and 4553 ± 1776/µl on dahi and milk diets, after 6 weeks 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 [27,28].

References

1. Manwani AH, Agarwal KN. The growth pattern of Indian infants during the first year of life. Hum Biol. 1973;45(3):341-9.
2. Agarwal DK, Agarwal KN, Upadhyay SK, Mittal R, Prakash R, Rai S. Physical and sexual growth pattern of affluent Indian children from 5-18 years of age. Indian Pediatr. 1992;29(10):1203-82.
3. Agarwal DK, Agarwal KN. Physical growth in Indian affluent children (Birth-6 years). Indian Pediatr. 1994;31(4):377-413.
4. Agarwal KN. The growth- infancy to adolescence 3rd Ed. 2015; CBS Publications, New Delhi.
5. Gupta M, Agarwal KN. Free amino acid patterns of plasma, erythrocytes and leucocytes in hypoproteinemia. Brit J Nutr. 1973;29(2):151-7.
6. Agarwal KN, Bhatia BD, Butta RK, Singla PN, Shankar R. Erythrocytic enzymes and amino acids related to glutamic acid metabolism in childhood hypoproteinemia. Amer J Clin Nutr. 1981;34(5);924-7.
7. Tripathi AM, Agarwal KK, Agarwal KN. Composition of oedema fluid in hypoproteinemic disorders. Acta Paeditr. 1983;74:741-4.
8. Agarwal PK, Agarwal KN, Agarwal DK. Biochemical changes in saliva of malnourished children. Amer J Clin Nutr. 1984;39(2):181-4.
9. Mishra OP, Agarwal KN, Agarwal RMD. Salivary iron status in iron deficiency. J Trop Pediatr. 1992;38(2):64-7.
10. Agarwal KN, Agarwal DK, Mishra OP. Alterations in body fluids (Plasma, Erythrocytes, Leucocytes), edema fluid and saliva as indicators of nutritional status. Ann Clin Med Res. 2021;2(3)1031.
11. Agarwal KN, Agarwal DK, Upadhyay SK, Agarwal S. Early life nutrition deprivation and mental functions. Sun Text Rev Pediatr Care. 2020;1(2):108.
12. Bhatia VP, Katiyar GP, Agarwal KN. Effect of intrauterine nutritional deprivation on neuromotor behavior of the newborn. Acta Paediatr Scand. 1979;68(4):561-6.
13. Bhatia VP, Katiyar GP, Agarwal KN, Das TK, Dey PK. Sleep cycle studies in babies of undernourished mothers. Arch Dis Child. 1980;55(2):134-8.
14. National Family Health Survey of India- data (2021-2022).
15. Agarwal KN, Das D, Agarwal DK, Upadhay SK, Mishra S. Soft neurological signs and EEG pattern in rural malnourished children. Acta Paediatr. 1989;78(6):873-8.
16. Upadhayay SK, Agarwal DK, Shastri J, Agarwal KN. Persistence of soft neurological signs in chronic undernourished children. Nutr Res. 1995;15(2):193-9.
17. Agarwal KN, Agarwal DK, Upadhay SK. Impact of undernutrition on higher mental functions in Indian boys aged 10-12 years. Acta Paediatr. 1995;84(12):1357-61.
18. Gupta RK, Mittal RD, Agarwal KN, Agarwal DK. Muscular sufficiency, serum protein, enzymes and bioenergetic studies (31-phosphorus magnetic resonance spectroscopy) in chronic malnutrition. IBID. 1994;83(3):327-31.
19. Mishra UK, Kalital J, Kumar S, Poptani H, Agarwal DK, Agarwal KN. Brain MRI and cognitive evoked potentials in rural chronically undernourished children. Nutr Res. 1996;16(7):1147-51.
20. Agarwal KN, Agarwal DK, Upadhay SK, Singh M. Learning disability in rural primary school children. Indian J Med Res. 1991;94:89-95.
21. Agarwal KN, Agarwal DK, Kumar A, Upadhay SK. Sequelae of early undernutrition on reaction time of rural children at 11-14 years. Indian J Med Res. 1998;107:98-102.
22. Agarwal KN, Bhasin SK, Faridi MMA, Mathur M, Gupta S. *Lactobacillus casei* in the control of acute diarrhea- A pilot study. Indian Pediatr.

2001;38(8):905-10.

23. Agarwal KN, Bhasin SK. Feasibility studies to control acute diarrhea in children by feeding fermented milk preparations Actimel and Indian Dahi. Eur J Clin Nutr. 2002:56(suppl 4):556-9.

24. Dewan P, Kaur I, Chattopadhya D, Faridi MMA, Agarwal KN. A pilot study on the effects of curd (dahi) & leaf protein concentrate in children with Protein Energy Malnutrition (PEM). Indian J Med Res. 2007;126(3):199-203.

25. Dewan P, Kaur I, Faridi, MMA, Agarwal KN. Cytokine response to dietary rehabilitation with curd (Indian dahi) & leaf protein concentrate in malnourished children (Randomized Controlled Trial). Indian J Med Res. 2009;130(1):31-6.

26. Dewan P, Agarwal KN. Berseem (Trifolium Alexandrium) leaves in diet as immuno-nutrient; cytokine and T-cell subpopulation responses in malnutrition. Ann Pediatr Res. 2020;4(4):1046.

27. Agarwal KN. Indian Dahi as immunonutrient pilot study. Acta Sci Paediatr. 2018;1(1):2-4.

28. Agarwal KN, Kashyap A, Dewan P, Agarwal DK, Gomber S. Dahi in India culture. Intl J Med Sci Clin Res Studies. 2022;02(06):505-11.