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Review Article

Nutritional Intervention to Combat Malnutrition among Children under the Age of Five: A Review

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ABSTRACT

Malnutrition is the major health burden in developing countries. Protein energy malnutrition is the underlying cause for child morbidity and mortality. Apart from marasmus and kwashiorkor, the two forms of protein energy malnutrition, deficiencies of iron, iodine, vitamin A and zinc are also manifestations of malnutrition. Malnutrition is a silent killer. Early and timely detection of malnutrition is the key for its management. An intervention to prevent malnutrition includes promotion of breast-feeding exclusively for six months and further complemented with weaning or supplementary foods. Micronutrient deficiencies should be addressed through food based strategies such as dietary diversification through home gardens and small livestock and fortification of weaning or supplementary foods with micronutrient mixes. Promoting nutrition programmes targeting women and children can also help to combat menace of malnutrition. Control and prevention of malnutrition among children requires nutrition and health intervention and education and partnership between physician and dietitian.

Key Words: Children, Developing countries, Micronutrient deficiency, Protein energy malnutrition

INTODUCTION

A wise investment in child's health, nutrition and education is the foundation stone for development of country as whole. Child population is most important section of society [1] and their growth and development is strong reflection on the future of a country. [2] The infants and pre-school children are most vulnerable to vicious cycle of malnutrition particularly under-nutrition. [3] Malnutrition, a silent emergency [4] prevents children from reaching their full physical and mental potential consequently [5] leading to delay in physical growth and motor development, lower intellectual quotient, behavioral problems and deficient social skills. [6] Globally more than one third of under-five deaths of children are attributable to under-nutrition. The global community has set a target of halving the prevalence of underweight children by 2015 as a key indicator of progress towards the Millennium Development Goal of eradicating extreme poverty and hunger. [7] In developing countries and India child malnutrition particularly protein energy malnutrition (PEM) is a major health burden and underlying cause of child morbidity and mortality. [8] PEM is measured in terms of

underweight (low weight for age), stunting (low height for age) and wasting (low weight for height). Globally, more than 26 per cent of children below five years are stunted. Sub-Saharan African and South Asia contribute 40 and 39 per cent of stunted children under five globally. Fourteen countries house 80 per cent of world's stunted children and India contribute to 38 per cent of stunted children under five globally. 52 million children below five years are moderately or severely wasted. The burden of wasting is highest in South Asia and India has highest prevalence of moderate or severe wasting in children under five. [9] In India, 20, 43 and 48 per cent of children below five years are wasted underweight and stunted respectively. [10] More prevalence of under nutrition in children below five years is witnessed by rural India in terms of stunting, underweight and wasting. [11]

Children are most prone to nutritional deficiencies during antenatal period that continues until age five. Therefore nutritional intervention to children from 6 months to five years of age offer them best chance to survive and reach optimal growth. [12] Vitamin A deficiency is the leading cause of preventable childhood blindness and reduced immunity towards infections. Deficiency of vitamin A adds more to burden of malnutrition in India. The prevalence of biochemical vitamin A deficiency is 62 per cent in children under in India. [13] Vitamin A supplementation results in 24 per cent reduction in childhood mortality. [14] Children under the age of five years are adversely affected by iron deficiency. It is the most common nutritional problem prevalent in growing children. Poor consumption of green leafy vegetables compromises the intake of micronutrients like iron and zinc in children below 5 years in India. [15]

Diagnosis of Malnutrition

The current WHO recommendation is to use the Z-score or standard deviation (SD) classification to grade three levels of malnutrition. The prevalence of malnutrition is expressed in terms of Z score or SD units from the median of the international reference population, developed from anthropometric data collected in the United States by the National Center for Health Statistics (NCHS). In India the Z scores are not widely in use in community based studies. [16]

Epidemiology of Malnutrition

The prevalence of malnutrition was reported higher in children in the age groups of 12-35 months. [17,18] Highest prevalence of wasting was reported in children under the age of 2 to five years in slum areas of Coimbatore. [19] Stunting was highly prevalent at 36 per cent in children of 3 to 5 years age group in Orissa. [20] In another study the mean MUAC among boys was higher than girls. Significant sex difference in MUAC was observed at ages 3 ($p < 0.005$) and 4 ($p < 0.05$). [21] Singh et al. assessed the prevalence of protein energy malnutrition and bio social characteristics associated with malnutrition in 516 children below 5 years. The prevalence was more in males than females. Sixty, 53.86 and 43.22 per cent children were reported wasted, stunted and underweight respectively. The study concluded that protein energy malnutrition increases with under five rural children. [22] Avachat et al., reported prevalence of malnutrition as 50.46 per cent in rural areas of India. Birth weight and age group had significant impact on prevalence of protein energy malnutrition in children. Multi pronged approach assimilating maternal and child health care practice, nutrition education and growth monitoring was found imperative to combat malnutrition among children. [23] Nutritional status of 1661 children aged 6 months to 2

years was assessed by Kokhar et al. Sixty per cent of children were found malnourished. Undesirable practices of discarding colostrum, not exclusively breast feeding the child till six months of age, delayed weaning, diluting top milk were prevalent among the mothers. [24]

Nutritional Management of Malnutrition among Children

The treatment of malnutrition and its prevention among children under five requires exclusive breastfeeding for the first 6 months of life followed by breastfeeding in combination with supplementary foods until at least 24 months of age. [25,26] By the age of 12 months infant can consume a variety of foods from mixed diet. Breast milk is adequate to meet the energy and nutrient requirements of an infant up to four to six months of age thereafter it is insufficient to sustain normal growth and needs to be complemented with other foods such as weaning or supplementary foods. An ideal supplementary food must be nutrient dense, easily digestible, of suitable consistency and affordable to the consumers. Therefore development of homemade supplementary food based on locally available germinated cereals and legumes has been suggested by the Integrated Child Development Scheme (ICDS) and Food and Agriculture Organization to combat malnutrition among children. [27] The nutritional quality of cereals and pulses are improved when both are used together by complementing their limiting amino acids, lysine, methionine and tryptophan. [28] Moreover, a household technology like germination and roasting increases protein and mineral bioavailability and protein and starch digestibility and decrease phytic acid and tannin content. Roasting is the first household processing technology adopted by human civilization. Supplementary foods with higher energy density and nutritive value could be developed from germinated cereals and pulses. [29] Owing to good nutritional value, low price and year round availability roots and tubers offer good alternate or improvement to cereal based supplementary foods to reduce the incidence of malnutrition among children. [30] The usefulness of weaning or supplementary foods to meet the nutrient needs of children is well recognized. Ghasemzadeh and Ghavidel formulated composite weaning foods using cereals, malted legumes and vegetable powders. Selected legumes (green gram and lentil) were germinated, dried and dehulled. Roasted wheat, rice, carrot powder and skim milk powder were also used. The formulated products were nutritionally superior, functionally appropriate and organoleptically acceptable. [31] The sensory characteristics of the sweet potato based infant weaning food were comparable to the commercial baby food. [30] Further addition of cowpea and peanut flour in the sweet potato based weaning food increased the protein content but decreased the sensory qualities of the product. [30] Five weaning formulations based on germinated wheat and mungbean were developed by Imtiaz *et al*. Total energy provided by the blends ranged from 377.825 to 376.600 kcal/100 g dry matter. The overall acceptability score was highest (7.45) in weaning food formulated from 44 % wheat flour, 36 % mungbean flour, 10 % skim milk powder and 10 % sugar. [27] Weaning foods using sweet potato, soybean and wheat flour and whole milk powder and sugar at different ratios were developed. The sensory attributes and nutritional quality of the developed products was reported equivalent to commercial weaning foods. [32] Low cost weaning foods namely panjiri, kheer, halwa and dalia were developed using germination, malting, roasting and pressure cooking. The experimental formulations with germinated wheat, pulses (Bengal gram, green gram and lentil) and roasted groundnut in the ratio of

75:25:25 was organoleptically acceptable. [33] In a study conducted by Dubey and Saxena four supplementary foods namely *panjiri*, sweet porridge, *ladoo*, sweet and salty biscuits were prepared by different combinations of germinated wheat, mung and bajra flour. The results revealed an increase in vitamin C and B complex vitamins in the developed weaning foods when compared with control samples. [34] Good sensory acceptability of supplementary food prepared using germinated sorghum and green gram flour, rice flour and different concentration of pumpkin powder was reported. Significant increase in protein, carbohydrate and vitamin A content was observed with the increase in concentration of pumpkin powder. [28] Chinhanga *et al* developed ready-to-eat sweet potato breakfast cereal from sweet potatoes and maize grits using extrusion technology. [35] Good sensory acceptability of supplementary foods developed using wheat, soybean and chickpea flour [36] and sorghum peanut blend and corn soy blend was reported. [37,38]

The supplementation of *soyladoo* to preschool children reported significant increase in intake of cereals, legumes and oils and fats before and after supplementation trial. [39] Supplementary feeding of ready-to-eat therapeutic foods by malnourished children aged 10-60 months reported greater rates of recovery and weigh gain. [40] Antenatal micronutrient supplementation had significant impact on head circumference in children under five years. There was no reported benefit on weight, height, weight-for-age z scores, height-for-age z scores and weight-for-height z scores. [41] Significant increase in absolute weight gains was observed in malnourished children aged between 6 to 24 months who received ready-to-eat therapeutic food for 5 months as compared to control subjects. The ready-to-eat therapeutic food controlled further weight loss in the malnourished children. The therapeutic food was developed from peanut paste, vegetable fat, sugar, skimmed milk powder, vitamins and minerals. [42] Lazzerini et al concluded that lipid based nutrient supplements and blended foods effectively treat mild to moderate malnutrition in children. [43] Similar results were reported from the supplementation of ready-to-eat therapeutic foods in mild to moderate malnourished children. [44]

CONCLUSION

Child malnutrition is a common nutritional problem that widely occurs in developing countries including India. Multipronged and multisectorial initiatives can be effective to tackle malnutrition. Actions like agricultural and dietary interventions, provision of safe drinking water and sanitation, nutrition education, special attention to gender issues and vulnerable groups such as pregnant women and young children and quality health services are need of the hour to combat malnutrition at national level. [45,46] Nutrition education and diet based strategies are most effective approach to contain malnutrition. [47,48] Moreover health care sector should address the problems related to early diagnosis, quick treatment and management and follow up prevent malnutrition among children in India.

Declaration of Interest

The submitted manuscript is not currently under consideration nor has it been published in the same form elsewhere. All the authors have read the manuscript and have approved this submission. The authors report no conflicts of interest.

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