Original Article

Stunting and micronutrient deficiencies in malnourished children

Muzamil Shabana Ejaz,[1] Nazia Latif[2]

Department of Paediatrics, Dow University of Health Sciences,[1] Civil Hospital,[1,2] Karachi.

Abstract

Objective: To determine the frequency of stunting and micronutrient deficiencies in malnourished children admitted in a tertiary care hospital.

Methods: It was a cross-sectional study conducted at Paediatric department of Civil Hospital Karachi from January 2007 to December 2008. Patients aged 6 to 60 months, admitted in the ward were assessed for nutritional status and stunting according to the WHO classification of malnutrition, mild (weight for height ratio between -1SD to -2SD) moderate (-2SD TO-3SD) and severe (less than -3SD of NCHS/WHO reference values) malnourished children were included in the study. All the patients were subjected to clinical examination, which included height/length, weight and clinical signs of micronutrient deficiencies. Laboratory investigations were done to confirm the clinical diagnosis of iron deficiency anaemia and rickets. The collected data was analyzed by Statistical Program SPSS version 15. Frequencies and percentages were computed to present all categorical variables. Quantitative variables such as age was presented by mean ± SD.

Results: A total of 150 patients were enrolled in this study. Their mean age was 24.4 ± 13.8 months (range 6 to 60 months). Of all, 63 (44%) patients were severely stunted, 44 (29%) had moderate stunting, 27 (18%) had mild stunting while only 16 (10.7%) had normal stature. Severely malnourished (<-3SD) were 119 (79%) patients, 30 (20%) patients had moderate malnutrition (-2SD to -3SD). Forty two percent severely malnourished children also had severe stunting. Anaemia was the most common micronutrient deficiency seen in 117 (78%) patients, out of these 88% had iron deficiency anaemia, Rickets was found in 54(36%) patients. Vitamin A deficiency was present in 21(14%) cases. Other miscellaneous micronutrient deficiencies were zinc and B-complex deficiency in 42 (28%).

Conclusion: Malnutrition and associated micronutrient deficiencies were frequently found in children between 13 to 24 months of age. Stunting was commonly present between 25 to 36 months of age, it was associated with severe malnutrition in 42% cases. Anaemia is the most common micronutrient deficiency in malnourished patients, it was observed in 78% of cases whereas 44% of severely stunted patients had coexisting rickets (JPMA 60:543; 2010).

Introduction

Growth assessment is a sensitive indicator of health and nutritional status of children under five years. Malnutrition is one of the major causes of mortality and accounts for fifty percent deaths in children less than five years of age.[1] In Pakistan it is associated with poverty and main causative factors include low consumption of food and foods with low nutritional value.

Malnutrition affects the physical growth, cognitive development, physical work capacity and risk for several chronic diseases in children. A survey done earlier by WHO, showed an average of 39% stunting in children under five in the developing world. In South-East Asia it was estimated at 43% whereas in Pakistan 50% of children under five were stunted, 40% were under weight and 9% were wasted.[2] This situation has not changed much in the region, recent reports showed that stunting is 37%, under weight 38%, while wasting is progressively increased to 13%, indicating lack of proper nutritional and health interventions at national level.[3]

Micronutrient deficiencies, like vitamin A and Zinc are responsible for 0.6 million and 0.4 million deaths respectively in children less than five years of age whereas iron deficiency anaemia is found in 40-50-% of infant and children.[4] An estimated 250,000 to 50,0000 vitamin A deficient children become blind every year and nearly half of them die within 12 months of losing their sight.[5] Nearly 50% of vitamin A deficiency cases are found in South-Asia, including India (35.5 million), Indonesia (12.6 million) and China (11.4 million).[6] Vitamin A is recognized as one of the major factors in reducing excess mortality from infectious diseases in developing countries. World Bank suggested that the cost of micro nutrient deficiencies might be up to 5% gross national product (GNP) whereas intervention might only cost 0.3% of the GNP.[7] Zinc and Calcium deficiencies are also related to growth failure and increasing number of patients with osteoporosis. Co-existing nutritional interventions can prevent stunting by 36% and DALYS (disability-adjusted life years) associated with stunting, severe wasting, IUGR and micro nutrient deficiencies by about 25%.[8]

Stunting in children is usually taken as mild chronic malnutrition, however it can rapidly worsen due to intercurrent infections like diarrohea, measles and respiratory tract infections. Stunted children do not require hospital admissions, unless they have serious illnesses. A severely wasted child can also have severe stunting and may require in patient management.[9] Micronutrient deficiencies can be diagnosed clinically as well as by laboratory investigations which are however not done at most of the local health facilities due to financial problems and diagnosis is based on clinical findings alone and few supportive investigations.

Local data regarding stunting and associated micronutrient deficiencies is scarce. The present study addresses these important aspects of malnutrition which were not considered previously together. It was done to determine the frequency of stunting and micronutrient deficiencies in admitted malnourished children. Further, this study will provide relevant information and contribute in determining the priorities for implementation of appropriate nutritional strategies in national health programme for prevention of severe malnutrition at community level.

Methods

It was a cross-sectional study conducted at Paediatric department of Civil Hospital Karachi from January 2007 to December 2008. Patients aged 6 to 60 months admitted in the ward were assessed for nutritional status according to WHO classification of malnutrition.[9,10] These patients were classified as mild (weight for height ratio between -1 SD to -2 SD), moderate (- 2 SD to -3 SD) and severe malnourished (less than -3SD or less than 70% of NCHS/WHO reference values), severe malnourished further sub grouped as severely wasted and edematous malnutrition (depending on presence of symmetrical pedal, hands or generalized edema) were included in this study. For stunting they patients were categorized into normal stature (95- 100%, +2 SD to -1 SD), mild (90 -94%, -1 SD to -2 SD), moderate (85 - 89%, -2 SD to -3 SD) and severe stunted (less than 85%, less than -3 SD). All the patients were subjected to clinical examination, which included assessment of height/length, weight and clinical signs of micronutrient deficiencies. In patients above two years standing height was taken by stadiometer while in patients below two years length was taken by infantometer. Height/length was plotted on National Centre for Health Statistics (NCHS) chart against the patient's age, 50th centile of their age and gender was taken as normal expected height. Parental height was also taken in patients where both parents were available. Standard deviation of weight for height ratio was calculated by plotting weight of patients on NCHS/WHO growth chart against their height/length on their corresponding gender site.

Patients who had edema due to renal, chronic liver diseases and cardiac failure were excluded from the study. Children having anaemia due to haemolytic diseases, bleeding disorders, chronic blood loss were also excluded from the study. Children having short stature due to endocrinological causes and skeletal dysplasia were also excluded from the study.

Micronutrient deficiencies were clinically detected, such as pallor (conjunctiva, palm and oral mucosa) for anterior anaemia, Sign of rickets such as frontal and parietal bossing, wide fontanel and wide wrist joint, bowing of legs for Vitamin D deficiency, eye signs such as photophobia, dry hazy conjunctiva and cornea, bitot spot or corneal ulceration

for vitamin A deficiency and sign of other miscellaneous micronutrients like, B complex and zinc such as chelosis, dermatitis and change in hair color were recorded on Performa. Investigations were done to confirm clinical diagnosis in cases with Vitamin D deficiency and iron deficiency anaemia. According to WHO, haemoglobin level less than 11 gm/dl was considered anaemia.[11] Microcytic hypochromic anaemia with low serum ferritin, low serum iron and increased total iron binding capacity (TIBC) was categorized as iron deficiency anaemia. Rickets was confirmed by radiological evidence of decreased mineralization, cupping, fraying on, X-ray of wrist joint and normal/low serum calcium, low serum phosphorus and increase serum alkaline phosphatase. Vitamin D, zinc and vitamin A levels were not done due to financial constraints and only clinical findings were taken into consideration for diagnosis. All the patients were managed and discharged according to the WHO protocol for management of malnutrition.[9] These children were called for follow up in the nutritional rehabilitation clinic in the OPD.

The collected data was analyzed by Statistical Program SPSS version 15. Frequencies and percentages were computed to present all categorical variables including gender, stunting, wasting, edematous malnutrition and presence of micronutrient deficiencies like anaemia, rickets and vitamin A deficiency while quantitative variables such as age was presented by mean ± SD.

Results

During the study period, 150 patients were enrolled. Their mean age was 24.4 ± 13.8 months (range 6 to 60 months). Most of the patients were between 13 to 24 months, however stunting was frequently observed in 25 to 36 months of age. Out of 150 patients, 79(53%) were males and 71(47%) were females. Male to female ratio was 1:0.8.

Regarding stunting in malnourished children, 63(44%) patients were severely stunted, 44 (29%) had moderate stunting, 27(18%) had mild stunting while only 16 (10.7%) had normal stature (Table-1). Male (41%) and female (42%) had severe stunting. 62% of patients between 25 to 36 months and 47% of patients between 13 to 24 months of age had severe stunting as compared to 12.5% of patients below 1 year of age who had severe stunting. 42% of severely malnourished patients were also severely stunted (Table-1).

Regarding malnutrition, 119(79%) patients were severely malnourished (<-3SD), 30(20%) had moderate malnutrition (-2SD to -3SD) and only one had mild malnutrition (-1SD) (Table-1) Among severely malnourished 29 (24%) had edematous malnutrition and 90 (76%) were severely wasted. Males (54.6%) were more affected with severe malnutrition whereas 75 to 80% of all age group were severe malnourished.

Anaemia was the most common micronutrient deficiency seen in 117(78%) patients (Table-2). Females (80%) were found more anaemic as compared to males (75%), with 70 to 80% of all age groups having anaemia. Majority of anaemic patients (88%) had iron deficiency with microcytic hypochromic blood picture, increase total iron binding capacity low serum iron and ferritin levels whereas 12% patients had normocytic normochromic anaemia with normal total iron binding capacity, serum iron and ferritin levels. In all 82% of severely stunted and 75% of severely malnourished patients were anaemic (Table-2,3), with 43% of anemic patients having coexisting rickets and 25% of anaemic patients showing clinical signs of other miscellaneous micronutrient deficiencies viz vitamin B and Zinc deficiency.

Rickets was the second common micronutrient deficiency, found in 54(36%) patients (Table-2). Males (37%)

Table-1: (n-150) Stature V/S Grade of Malnutrition.

Height	Grade of Malnutrition			Total
	Mild (-1SD)	Moderate (-2 to -3 SD)	Severe (< -3 SD)	
Normal stature >95%	0	5 (16.6%)	11 (9%)	16 (10.7%)
Mild stunting 90-94%	1	5 (16.6%)	21 (17%)	27 (18%)
Moderate stunting 85-89%	0	7 (23.3%)	37 (31%)	44 (29%)
Severe stunting <85%	0	13 (43.3%)	50 (42%)	63 (44%)
Total	1 (100%)	30 (100%)	119 (100%)	150 (100%)

Table-2: (n=150) Micronutrient Deficiencies V/S Grade of Stunting.

Micronutrient deficiency	Grade of Stunting				Total (150)
	Normal stature n=16	Mild stunting n=27	Moderate stunting n=44	Severe stunting n=63	
Anaemia	12 (75%)	22 (81%)	31 (70%)	52 (82.5%)	117 (78%)
Rickets	3 (18%)	8 (29%)	15 (34%)	28 (44%)	54 (36%)
Vitamin A deficiency	2 (12.5%)	3 (11%)	5 (11.3%)	11 (17%)	21 (14%)
Miscellaneous Micronutrient	5 (31%)	7 (26%)	12 (27%)	18 (28.5%)	42 (28%)

Table-3: (n=150) Micronutrient Deficiencies V/S Grade of Malnutrition.

Micronutrient deficiency	Grade of malnutrition			Total (150)
	Mild n=(1)	Moderate n=(30)	Severe n=(119)	
Anaemia	1 (100%)	27 (90%)	89 (75%)	117 (78%)
Rickets	0	14 (46.6%)	40 (33.6%)	54 (36%)
Vitamin A deficiency	0	6 (20%)	15 (12.6%)	21 (14%)
Miscellaneous	0	7 (23.3%)	35(29%)	42 (28%)

and females (33%) were equally affected. Rickets was more frequent between 13 to 24 months of age, constituting 49% cases. 44% severely stunted patients presented with rickets as compared to 34% and 29% of mild and moderate stunted patients while only 18% of normal stature had rickets (Table-2). Nearly 33.6% severely malnourished patients had rickets (Table-3). All the investigation done for its confirmation were also in favour of clinical diagnosis.

Clinical signs of vitamin A deficiency were observed in 21 (41%) patients whereas it was present in nearly 13% of severe malnourished patients (Table-2). It was commonly seen in 13 to 24 months of age, constituting 68% of cases.

Other miscellaneous micronutrient deficiencies were clinically found in 42 (28%) patients (Table-2), nearly 50% of cases were between 13 to 24 months of age.

Discussion

Malnutrition has a significant impact on health and survival of children under five years of age. It is the leading cause of global burden of disease. It has been estimated that nearly 50.6 million children under five are malnourished and almost 90% of these children are from developing countries.[12] According to UNICEF, over 220 million children less than 5 years of age in developing countries have significantly impaired growth.[13]

Malnutrition is frequently observed between 3 to 24 months of age. A study done in Kenya showed that most of the malnourished children were between 18-23 months of age, 44% were stunted and 34% were under weight.[14] Local data also showed similar findings with increasing percentage of malnutrition occurring between 6 to 24 months of age.[15] In the current study most of the patients were between 12 months to 23 months of age and stunting was more common between 25 to 36 months of age constituting 62% of cases. Under nutrition is reported more frequently among girls than boys[16] but the current study revealed that males(53%) were slightly more affected than females (47%). There is a high prevalence of stunting, wasting and under weight in South-Asia. It is estimated that one in every two pre-school children is stunted in this region.[6] On the other hand, reports from Latin and Central America showed moderate to high prevalence of stunting and wasting. A study done in Mexico revealed 54% stunting 2.9% wasting and 20% under weight respectively.[17] Studies from South-Asian countries like Nepal showed high prevalence of under weight (53%) and stunting (36.6%).[18] Another study from Bangladesh revealed that 45% children under five were stunted.[19] A recent study done in slums of Karachi indicate 78% under weight, 44% severe stunting and 6% severe wasting.[20]

Similar trends were also observed in the current study, 79% children were severely malnourished, out of them 76% were severely wasted and 24% were having edematous malnutrition, severe stunting was observed in 44% cases and nearly 42% of severely malnourished children were also severely stunted indicating a significant association between severe malnutrition and severe stunting.

Nearly 11% of all children under five years of age die due to four micronutrient deficiencies, vitamin A, iron, zinc and iodine. In most malnourished children deficiencies of more than one micronutrient are observed simultaneously.[21]

Iron deficiency anaemia is one of the most prevalent micronutrient deficiency and has an impact on cognitive development of children. A study done in Vietnam showed that 55.6% patients were anaemic, 11.3% had vitamin A deficiency and 79% of children had deficiency of two or more micronutrient simultaneously.[22] In another study co-existence of anaemia, stunting and under weight were observed in 5.9% and 2.9% respectively whereas vitamin A deficiency was associated with stunting and under weight in 2.97% and 1.48% respectively.[23] In the present study anaemia was the commonest micronutrient deficiency found in 80% of all age group patients predominately affecting females. Nearly 82% severely stunted and 75% of severely malnourished patients were having anaemia whereas 43% of anaemic patients had co-existing rickets.

Rickets was the second common micronutrient deficiency found in our study affecting 36% of patients. The age group most commonly involved was between 13 to 25 months of age and affecting both males and females equally. A significant association between rickets and stunting was also observed. It was present in 44% of severely stunted patients, 34% of moderately stunted and 29% mildly stunted patients respectively, whereas 18% had normal stature. Rickets and severe malnutrition were clustered in 33% of patients. Another study also showed increase frequency of rickets (61%) in malnourished children.[24]

Vitamin A deficiency is more frequently reported between 6-36 months of age. A study showed that 28.4% of patients had vitamin A deficiency, 10% of patients had co-existing iron and zinc deficiencies.[25] In the present study it was found in 14% patients and involved mostly children between 13-25 months of age.

Other miscellaneous micronutrients deficiencies clinically observed were zinc and vitamin B-complex deficiencies, found in 28% of patients.

Stunting and associated micronutrient deficiencies cause permanent loss of growth in children and most of them never regain the appropriate weight, leading to long term deficits in mental capacity, low birth weight babies are prone to become stunted especially if the mother herself is stunted and has poor nutritional status. Therefore, there is a need for policy making and adequate nutritional interventional strategies for management of stunting and supplementation of vitamin A, zinc and iron. Limitations of this study, it is a hospital based study and sample size was small, micronutrient deficiencies were assessed clinically and blood levels for the micronutrient were not done to confirm the diagnosis due to lack of finances, only iron and vitamin D deficiency was confirmed by laboratory investigations. Parental height was not taken for stunting in most of the cases due to non-availability of the parents.

Conclusion

Stunting and associated micronutrient deficiencies are significant health problems in children Patients between 13 to 24 months of age are more malnourished and more affected from micronutrient deficiencies. Stunting is commonly found between 25 to 36 months of age. It is associated with severe malnutrition, 42% of severely malnourished patients were also severely stunted.

Anaemia is the most common micronutrient deficiency found in malnourished children, it was observed in 78% of patients out of these 88% had iron deficiency anaemia. Coexisting rickets were found in 44% of severely stunted patients.

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