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Original Research Article

Study on impact of protein energy malnutrition on development in children

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ABSTRACT

Background: Majority of the children in India who live below the poverty line in an environment of deprivation and starvation have physical and developmental retardation. The Objective of this study to study the impact and comparison of protein energy malnutrition on the development with normal children.
Methods: This was a hospital based cross sectional study in which total 128 cases of protein energy malnutrition and 30 normal children were enrolled from nutritional rehabilitation center and in patients wards. The study population comprised of children less than 5 years of age, having weight for height/length ≤3 SD, with visible wasting, or bipedal oedema, with mid arm circumference <11.5 cm were assessed for their development in all four domains using Denver II developmental Screening Test (DDST-II).
Results: The gross motor milestones are affected in 62.5% with grade4 PEM & 42.85% with grade 3, the fine motor component is affected more in grade 4 with other domains less affected, no significant relation of language delay with PEM was observed in this study, 40% of children with grade 4 PEM shows delay in social domain while 18.18% of the patients with grade 3 PEM show delay in social domain. No patients with grade 1 or grade 2 PEM showed delay in social domain. All four domains are affected in PEM with a maximum effect in gross motor, but the difference does not seem to be significant as the p value is 0.3 i.e. >0.05 which is insignificant.
Conclusions: My study on the effect of protein energy malnutrition on development proves that there in increasing delay in all the domains of development with increasing grade of malnutrition. Early detection of malnutrition in community can cause early intervention and increase the productivity of nation.

Keywords: Development delay, DDST-II, Malnutrition, MUAC, Protein energy, Weight

INTRODUCTION

The health status of the people is the wealth of a nation and nutrition is one of the most important pre-requisites for good health. Child malnutrition is a wide spread public health problem having international consequences because good nutrition is an essential determinant for their well-being. The nutrition of infants and young children are causing great concern among social scientists and planners these days, since child is the chief victim of interplay of nutritional, socio-economic and health factors that cause malnutrition. Health and nutrient investments may be particularly important forms of human capital investments for low-income populations, including those in developing countries.[1] The quality of future human resource is determined largely by the investment made for the development of child population. In most developing countries, child health from a medical

point of view, both in absolute terms as well as in relation to the total population, is primarily more resource allocation to meet improved child health status. To the health economist, the areas of child health and nutrition are equally challenging. The three of the eight Millennium Development Goals (MDGs) emphasize on health which include reduction in child mortality, improved maternal health and combating HIV/AIDS, malaria and other diseases.[2]

A healthy and nutritionally well-fed population is indispensable for economic growth and development. Health and nutritional status affect the capacity to learn, which in turn determines productivity and economic growth. Nutrition has major effects on health which enables one to lead a socially and economically active life. On the other hand, malnutrition adversely affects health, which is reflected in the incidence of sickness among children and their life expectancy. Malnutrition during childhood affect growth potential and risk morbidity and mortality in later years of life. Malnourished children are likely to grow into malnourished adults who face heightened risks of disease and death.[3,4]

An individual's nutritional level is determined by a number of factors facing directly or indirectly such as, levels of employment, food availability, food consumption pattern, purchasing power of the people, distribution of income, intra-household food distribution, level of nutritional knowledge, literacy, availability of government schemes and awareness, etc. There is much evidence that nutrition and economic development have a two-way relationship. Improved economic development contributes to improved nutrition, but more importantly, improved nutrition drives stronger economic growth.[5]

Malnutrition is associated with both structural and functional pathology of the brain. A wide range of cognitive deficits has been reported in malnourished children. Effect of chronic protein energy malnutrition (PEM) causing stunting and wasting in children could also affect the ongoing development of higher cognitive processes during childhood.

The present study examined the effect of malnutrition on the rate of development of milestones using developmental assessment. Many studies have been done on the long term effects of malnutrition on mental health of children. Our study aims at the effect on the developmental milestones. The early interventions in the child will help to improve the long term outcome and can increase the economy ; productivity of nation.[6]

METHODS

This was a hospital based cross sectional study in which total 128 cases of protein energy malnutrition and 30 normal children were enrolled from nutritional rehabilitation center and in patients wards. Study was conducted during November 2011 to October 2013 after ethical permission of institutional ethical committee. Inclusion criteria for study participants were children aged between 6 months to 5 years, MUAC <115 mm with or without any grade of oedema, Weight for height <-3SD with or without any grade ofedema, Bilateral pitting oedema +/++ (children with edema +++always need inpatient care, all patients with visible severe wasting with or without edema from NRC and wards are included. Exclusion criteria were children with severe congenital deformity, severe prenatal insult, neurological disorder and children with known metabolic disease or any systemic illness. The study population comprised of children less than 5 years of age, having weight for height/length≤3 SD, with visible wasting, or bipedal oedema, with mid arm circumference <11.5 cm will be conducted in a nutritional supplementation center. The study design included 128 children from the NRC, Rajkot (Gujarat) and 30 normal children from inwards patients department were assessed for their development in all four domains using Denver II developmental Screening Test (DDST-II). The data were recorded in an Excel sheet. Proportion and Chi square statistical tests were used. Calculations were done with epidemiological informative software 07.

Measurement Tool

Weight

Weight is measured using electronic weighing machine. The beam should be properly balanced and should move freely when at rest and the pointer should be on zero. The scale should be set on a flat horizontal surface. The shoes should remove and children should be weighed with as little clothing as custom permits. The result is read directly but only after the beam reaches its balance point.

Height

For height measurement, Below the age of two years, a horizontal measuring infantometer is used which is called Length. Beyond the age of two years, a vertical measuring anthropometry is used. The wall itself is graded, with the zero is located exactly at the angel formed by the ground and the wall.

Mid upper arm circumference

Measurement for MUAC is performed on the left arm, midway between the acromion and the olecranon. The measuring tape is flexible and non stretchable and unaffected by temperature.

Head circumference

The maximum occipitofrontal circumference is measured by placing the flexible, onstretchable tape firmly over the most prominent region of occiput and frontal crests.

Development assessment

It is done by Denver II Developmental Screening Test (DDST-II). 125 Performance based and parent report items are used to screen children's development in four areas of functioning: fine motor-adaptive, gross motor, personal-social, and language skills. In gross motor sitting, walking, jumping and overall muscle movements are assessed. In fine motor adaptive, eye hand coordination, manipulation of small objects; problem solving are assessed. In language hearing, understanding and using language is tested. In social, getting along with people and caring for personal needs are assessed. Child's exact age was calculated and marked on the score sheet; for premature infants, number of months of prematurity was subtracted from the infant's chronological age. A vertical line was drawn or pencil was kept at child's corrected age. Any child who failed to achieve any item falling short on the left side of the vertical line was considered to having developmental delay. Any development below 75% was considered as a developmental delay.

RESULTS

In the present study 128 cases of protein energy malnutrition, 30 normal children were studied. The observation made during the study is presented below with an analysis of the same.

Table 1: Impact of PEM on gross motor mile stone (N=158).

IAP grade	With developmental delay	No developmental delay	Total	Percentage (%)
Normal	2	28	30	6.6
Grade 1	1	29	30	3.3
Grade 2	5	25	30	16.6
Grade 3	15	18	33	42.85
Grade 4	20	13	35	62.5

Chi square – 12.77, df – 4, p value – 0.00042

Table 1 shows that the gross motor milestones are affected in 62.5% with grade 4 PEM 42.85% with grade 3, 16.6% with grade 2, 3.3% with grade 1 & 6.6% with normal IAP grade respectively. The difference between 'with developmental delay' & 'no developmental delay' according to IAP grade was statistically significant ($p<0.05$).

Table 2: Impact of PEM on fine motor development (N=158).

IAP grade	With developmental delay	Without developmental delay	Total	Percentage (%)
Normal	1	29	30	3.33
Grade 1	0	30	30	0
Grade 2	1	29	30	3.33
Grade 3	7	26	33	21.2
Grade 4	16	19	35	45.71

Chi square - 22.4, df-4, p value - 0.0023

Table 2 shows that the fine motor milestones are affected in 45.71% with grade 4 PEM, 21.2% with grade 3, 3.3% with grade 2, 0.0% with grade 1 & 3.3% with normal IAP grade respectively. The difference between 'with developmental delay' & 'no developmental delay' according to IAP grade was statistically significant ($p<0.05$).

Table 3: Impact of PEM on language development (N=158).

IAP grade	With developmental delay	Without developmental delay	Total	Percentage (%)
Normal	3	27	30	10
Grade 1	2	28	30	6.6
Grade 2	3	27	30	10
Grade 3	7	26	33	20
Grade 4	13	22	35	40.6

Chi square - 6.77, df- 4, p value - 0.072

Table 3 shows that the language development are affected in 40.6% with grade 4 PEM, 20.0% with grade 3, 10.0% with grade 2, 6.6% with grade 1 & 10.0% with normal IAP grade respectively. The difference between 'with developmental delay' and 'no developmental delay' according to IAP grade was statistically not significant (p>0.05).

Table 4: Impact of PEM on social development (N=158).

IAP grade	With developmental delay	Without developmental delay	Total	Percentage (%)
Normal	0	30	30	0
Grade 1	0	30	30	0
Grade 2	2	28	30	6.67
Grade 3	6	27	33	18.18
Grade 4	14	21	35	40

Chi square – 10.8, df-4, p value – 0.044

Table 4 shows that the social development are affected in 40.0% with grade 4 PEM, 18.2% with grade 3, 6.67% with grade 2, 0.0% with grade 1 and 0.0% with normal IAP grade respectively. The difference between 'with developmental delay' & 'no developmental delay' according to IAP grade was statistically significant (p<0.05).

Table 5: Impact of all developmental domains in grade 4 PEM (N=33).

Milestone	Developmental delay		Percentage (%)
	Yes	No	
Gross motor	20	13	60.6
Fine motor	16	17	48.5
Language	13	20	39.4
Social	14	19	42.4

Chi square – 3.49, df-3, p value – 0.32

Table 5 shows that all four domains are affected in PEM with a maximum effect in gross motor, but the difference does not seem to be significant as the p value is 0.3 i.e. >0.05 which is insignificant.

DISCUSSION

In the present study 128 cases of protein energy malnutrition & 30 normal children were studied. The observation made during the study is presented below with an analysis of the same.

As per observation table number 1, 2 and 4 the gross motor and fine motor& social milestones were affected in 62.5% with grade 4 PEM. The gross motor delay shows a significant correlation with malnutrition.

Cravioto and Robles reported retardation in motor development, as measured by the Gesell scale, among children malnourished before the age of six years.[7]

Normal and malnourished children have also been reported to differ in performance on the visual-motor items of the Stanford-Binet test, when they were between 3 and 5 years of age.[8]

The Yale Development Scale that was used in the study by Chase and Martin assesses (apart from adaptive, language, and personal-social development) gross and fine motor abilities. The malnourished children admitted between 5 and 12 months of age showed themselves, at the ages of 3'/2-5 years, as much behind in these two aspects of motor development as in cognitive development.

Most of these studies were not interested so much in motor development itself as in motor ability as an indicator of development at this early age. Studies of older children have usually concentrated on cognitive abilities and no longer paid attention to motor ability. The assessment of motor function, however, provides an important supplement to the evidence obtained from other tests.

As per observation table number 3 the PEM does not significantly affect language delay. This insignificance may be due to the sample size and language delay is more common in normal children.

Some South American studies have emphasized that inter- sensory integration and language abilities are affected but these studies do not present findings regarding other abilities. Cham- pakam et al, have, on the contrary, reported that malnourished children showed less impairment on verbal and memory tests than on perceptual tests and tests for abstract reasoning.[9]

In a study by Fernando Monckeberg, M.D et al, on DQ in well nourished & malnourished children using gesell test were 76 malnourished children was compared with 14 well nourished group ,there was delay in all 4 domains

with a maximum delay in motor domain with all domains of development being affected as seen in the table below.[10]

As per observation table number 5 the difference in all the 4 domains and grade 4 PEM is not significant but grade 3 shows a significant difference ,this shows that all domains are affected in severe malnutrition. But in less severe forms motor milestones are more affected.

CONCLUSION

My study on the effect of protein energy malnutrition on development proves that there in increasing delay in all the domains of development with increasing grade of malnutrition. Early detection of malnutrition in community can cause early intervention and increase the productivity of nation.

Many studies have proven the effect on malnutrition on brain development. In this study the developmental milestones were compared in children with PEM. This study shows the need for early intervention in community to detect malnutrition & to increase the nutritional Rehabilitation Centres, to improve outcome, which contributes to the economic growth of nation. There is substantial evidence that early child malnutrition is detrimental to productivity in adulthood.

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