Original Article

ASSESSMENT OF GROSS MOTOR DEVELOPMENT IN INFANTS OF AGE 6 TO 18 MONTHS WITH PROTEIN ENERGY MALNUTRITION USING ALBERTA INFANT MOTOR SCALE: A CROSS SECTIONAL STUDY

Amruta Kulkarni *[1], Deepa Metgud [2].

*[1] Post Graduate Student, Department of Pediatric Physiotherapy, KLES Institute of Physiotherapy, Belgaum, India.

[2] Associate Professor, Department of Pediatric Physiotherapy, KLES Institute of Physiotherapy, Belgaum, India.

ABSTRACT

Background and Objective: Malnutrition is one of the leading cause of death among young children of developing countries and occurs due to deficiency of essential nutrients. In infancy protein deficiency (PEM) can severely affect the different domains of development. Motor development, one of the domains of development has been previously assessed in older children with PEM and not in younger infants. Early detection of motor impairment in infants with PEM followed by early intervention will help to prevent motor delay. As AIMS is a reliable and valid tool to assess the gross motor development of younger infants, the objective of the study was to assess the gross motor development in infants with PEM using AIMS.

Materials and Method: It was a cross-sectional study conducted on 200 infants of age 6 to 18 months with PEM. After recording the baseline information , the gross motor development of the infants was assessed in four different positions ie supine, prone, sitting and standing. Infants were scored as per the movements observed. After summating the subscore in all the positions total score was obtained, using this the percentile rank was calculated.

Results: 74% infants belonged to < 10th percentile rank of AIMS indicating atypical motor performance and 19% infants belonged to < 25th percentile rank indicating suspected motor performance with statistical significance of $p < 0.001$.

Conclusion: The results of our study concludes that on assessment with AIMS , infants of age 6 to 18 months with Protein Energy Malnutrition showed lower motor performance signifying delayed gross motor development.

KEYWORDS: PEM, Gross motor development, AIMS, Infants

Address for correspondence: Dr. Amruta Kulkarni. PT. Post Graduate Student, Department of Pediatric Physiotherapy, KLEU Institute Of Physiotherapy, JNMC, Nehru Nagar, Belgaum-590010, Karnataka, India. Mobile No.: +919164128086 **E-mail:** dramrutakul@gmail.com

Access this Article online

Quick Response code

International Journal of Physiotherapy and Research
ISSN 2321- 1822
www.ijmhr.org/ijpr.html

Received: 18-06-2014 Accepted: 07-07-2014
Peer Review: 18-06-2014 Published: 11-08-2014

INTRODUCTION

Malnutrition, one of the significant cause of mortality among young children of developing countries alone estimates to account for over half of children's deaths annually[1]. During 2003-08 more than 23% of world's children particularly in developing countries under the age of 5 years weighed lesser than required for their age[2]. In India malnutrition is widespread and accommodates around one- third of malnourished children[3]. According to National Family Health Survey 2005 -06, in India both

chronic and acute undernutrition were found to be high with 48% children found to be under age of 5 years. [4]

Malnourishment could be due to either deficiency or excess of nutrients. Majority of problem in India, are related to deficiency states rather than excess of nutrients. Few of the most important reasons being poverty, ignorance, illiteracy, increased family size and maternal malnutrition. [4,5]

Protein Energy malnutrition occurs due to deficiency or insufficient intake of proteins. It has 4 grades as per 'IAP Classification of Malnutrition'. These include : Grade 1=70-80% weight for age ; Grade 2=61-70% weight for age ; Grade 3=51-60% weight for age ; Grade 4=less than 50% weight for age. The indicators of malnutrition are: Stunting (low height for age) ; Wasting (for low weight for height) ; Underweight (It interprets for low weight for age) [6] Gross motor development is an important aspect of brain development which helps to learn successive movements to produce efficient action and explore the environment.[7] Malnutrition is associated with both structural and functional pathology of the brain resulting in tissue damage, growth retardation, reduction in synapses, delayed myelination and reduced overall development of the maturing brain. It negatively affects a broad range of developmental domains that are closely interrelated including emotional regulation, motor development and motor activity.[8,9]

Motor development can be assessed using various tools like the Bayleys scale, the Denver II scale, the Peabody scale, AIMS, the Movement Assessment of Infants, the Test of Infant Motor Performance, Gross motor function measure, DASII, etc. Alberta Infant Motor Scale (AIMS) based on neuro maturation concept and dynamic theory, is an quick observational assessment tool used to evaluate the motor development in infants between the age of 0 to 18 months. It is comprises of 58 items observed in four different positions (i.e prone, supine, sitting and standing). It is a reliable (r = 0.85 to 0.97) and valid (sensitivity of 80%, specificity of 90%, positive predictive value of 70% and negative predictive value of 80%.) tool. According to the scores of AIMS, a percentile rank below 10 is considered to be atypical performance, between 11-25 is considered as suspected performance, between 26-75 is normal, 76-90 is very good performance and between 90-100 is excellent performance.[10,11]

Previously studies have analysed the effect of malnutrition on growth, cognition, mental and systemic development in children with malnutrition [12,13,14]. Literature even suggests that if malnutrition occurs in the vulnerable period of brain development it can result in motor impairment [15,16,17]. Early detection of motor impairment in infants with malnourishment followed by early intervention will help to prevent motor delay. There is a dearth of literature that has assessed gross motor development in younger infants with PEM. Also to the best of our knowledge there is no study in India that has used AIMS to assess gross motor development in infants with PEM. Hence the need is to assess the gross motor development in indian infants between the ages of 6 to 18 months with PEM using AIMS.

METHODOLOGY

This was a cross sectional study conducted on 200 full term infants of age 6 to 18 months with PEM.An approval for the study was obtained from the Institutional Ethical Committee. Infants were excluded if they had any neurological or cardiovascular-respiratory pathology in the past 6 months, any genetic disorder or any musculoskeletal deficit. Written informed assent was obtained from the infant's parents. Baseline information about the infant's nutritional profile including the duration of breastfeed and time of introduction of external feed, socioeconomic status based on modified B.G Prasad scale, anthropometric measurements were recorded. Following this the investigator assessed the infant's gross motor development using AIMS in four position i.e., Prone, supine, sitting and standing in an isolated room as per the instructions in the test manual. Sufficient time was given to the infant in the presence of the parent and their interaction was also encouraged to keep the infant active. Toys were used to play and motivate the infant during assessment. The assessment took around 20-30 minutes. According to the movements presented in the repertoire of the child, sub score for each

position was obtained. Total score was calculated by summating the sub scores. At the end of the evaluation the total score were converted into a percentile rank in a chart available in the score sheet of the test manual. Later these scores were analysed.

Statistical Analysis: Statistical analysis was done using SPSS version 16. Various statistical measures such as mean, standard deviation, chi-square test were used to analyze the available data.

RESULTS AND TABLES

The results of age wise distribution of infants with different grades of PEM did not show any statistical significance with p<0.35 as the distribution of infants in all the age groups was almost alike. (As in Table 1)

Table 1: Age-wise distribution of infants based on different grades of PEM.

AGE (months)	Grades of PEM					p-value
	1	2	3	4	Total	
≤8	6	13	29	6	54	<0.35
9-10	4	15	17	4	40	
11-12	7	20	11	3	41	
13-14	1	7	7	0	15	
15-16	4	5	6	0	15	
>17	5	12	13	5	35	
Total	27	72	83	18	200	

The different grades of PEM were higher in the lower socio-economic status (ie class 4 and 5) and was statistically significant with p <0.05 with more number of children in grades 2 and 3. (As in Table 2)

Table 2: Distribution of infants based on socio-economic status and PEM grades.

Socioeconomic Status as per B.G Prasad classification	PEM Grade					p-value
	1	2	3	4	Total	
1	1	1	0	0	2	<0.05
2	1	1	2	1	5	
3	3	11	2	4	20	
4	21	43	61	10	135	
5	1	16	18	3	38	
Total	27	72	83	18	200	

The anthropometric measurements of the infants were recorded indicating that the infants with PEM had lesser weight, smaller head circumference and smaller mid arm circumference. (As in Table 3)

Table 3: Age-wise distribution of infants based on anthropometric measurements.

Anthropometric Measures (Mean ± SD)	Age (Months)		
	≤10	11-14	≥15
Weight (Kgs)	5.30±0.92	6.29±0.63	6.68±0.89
Height (Cms)	62.39±8.08	69.59±5.53	72.08±5.95
BMI (Kg/m^2)	13.58±2.97	13.16±1.82	12.89±1.81
HC (Cms)	39.14±2.75	40.89±1.61	41.82±4.20
MUAC (Cms)	11.25±1.08	11.78±1.00	12.15±1.38

Distribution of infants based on duration of the breastfeeding and the time of introduction of external food suggested that 59 infants with PEM were breastfed above 12 months of age and 113 infants were introduced to external fed only after age of 8 months. (As in Table 4)

Table 4: Distribution of infants based on their duration of breastfeed and time of introduction of external food.

Duration of breast feeding (months)	Total number of infants			Time of introduction of External Food (months)	Total number of infants		
	Total	Male	Female		Total	Male	Female
0*	7	4	3	0*	64	31	33
≤8	53	28	25	≤6	23	13	10
9-10	40	21	19	7-8	67	43	24
11-12	41	19	22	9-10	39	16	23
13-14	14	7	7	11-12	5	2	3
15-16	13	9	4	13 and more	2	0	2
16 and above	32	17	15	Total	200	105	95
		105	95				

(*-no breastfeed given;
** -external food not yet introduced)

Among all the grades of PEM, 148 infants with lower AIMS score belonged to ≤ 10 percentile rank category which was not statistically significant with p <0.62. (As in Table 5)

Table 5: PEM grade-wise distribution of infants based on AIMS percentile rank.

PEM Grades	Percentile Rank of AIMS				p-value
	≤5%	5-10%	10-25%	25% and more	
1	16	1	7	3	0.62
2	48	5	12	7	
3	56	7	16	4	
4	15	0	3	0	
Total	135	13	38	14	

AIMS Percentile Rank distribution based on Socio-economic Status indicates that 129 infants belonging to class 4 and 5 of socio economic status had a percentile rank below 10th percentile (As in Table 6)

Table 6: Distribution of infants based on socio-economic status and AIMS percentile rank.

Socioeconomic Status as per B.G Prasad classification (Class)	AIMS Percentile Rank				
	≤5%	5-10%	10-25%	25% and more	
1	2	0	0	0	p-value 0.48
2	3	0	2	0	
3	12	2	4	2	
4	90	8	25	12	
5	28	3	7	0	

DISCUSSION

In our study, gross motor development in infants of age 6 to 18 months with PEM were assessed using AIMS. The results showed that 74% of the infants with PEM had atypical performance and 19% infants had suspected motor performance.

According to our findings out of 200 infants, 135 infants were less than 12 months of age with mean age of 11.42 months which were similar to the reports of a Nigerian study suggesting a common age group for PEM was around 6 to 12 months [18]. Higher number of infants (n=92) with PEM grade of 3 and 4 belonged to class 4 and 5 of socioeconomic status depicting an inverse relationship between prevalence of PEM and socio-economic status as reported in various studies[19,20]. The results of our study suggest that the overall mean weight of the infants was lesser than the weight for age based on the Weech's formula [21]. As explained by Chheda et al, MUAC between 12.5-13.5 cms indicates moderate PEM and MUAC < 12.5 cms indicates severe PEM[21]. We found the mean MUAC in all the age groups between 11cm -13.5 cms indicating that these infants were moderately to severely affected with PEM. Literature also suggest that weight and mid upper arm circumference were more sensitive to identify the nutritional status in infants.[22,23]

Along the lines of previous studies explaining an inverse association between prolonged breast feeding and weight gain in undernourished children compared to well nourished [24,25]. It was found that 59 infants in our study were breastfed above 12 months of age. 113 infants were introduced to external fed only after age of 8 months suggesting a delay in the time of introduction of the external food. This could be one of the contributing factors to the prevalence of malnourishment as reported previously.[4,6]

According to our results infants with PEM showed lower motor performance which could be due to early nutritional insults to the developing brain. Literature also suggests that the long-term effects of under-nutrition in infancy can be associated with reduced motor abilities during childhood and adolescence [17,28] Children with poorer nutritional status aged 5-12 years were assessed using Bruininks – Oseretsky Test of Motor Proficiency showed lower motor performance compared to age matched well nourished children and reported lower socio-economic status and poorer nutritional status as few contributing factors for lower motor proficiency in malnourished children.[15] Our study is similar to this report in terms of lower motor performance of children with nutritional deficiency but had focused on the younger infants as early detection of nutritional deficiency leading to motor delay will provide immense opportunity for early intervention and prevention of long term motor disability.

Globally AIMS has been used to evaluate the motor performance in different populations like preterm infants [26], high risk infants[27], infants with PEM[28] and full term infants[29]. But AIMS has not been previously used on Indian population. Therefore AIMS was used in our study to evaluate the gross motor development as it is a quick, reliable and valid tool that helps in early screening of gross motor performance in a younger age group. Early detection of motor impairment in infants with PEM followed by early intervention will help to prevent motor delay.

CONCLUSION

Lower motor performance was observed in infants with PEM as assessment of gross motor development with AIMS suggested that 74% of the infants had atypical performance and 19% of the infants had suspected motor performance.

Abbreviations:

AIMS: Alberta Infant Motor Scale
PEM: Protein Energy Malnutrition

MUAC: Mid Upper Arm Circumference

Source of Funding: Self

Conflicts of interest: None

REFERENCES

1. Charlotte G. Neumann. Child Nutrition In Developing Countries: Critical Role In Health.1-33.
2. K.Park. Textbook of Preventive And Social Medicine.21st Edition. Bhanot Publication.
3. S.K. Rasania, S.K. Singh, S. Pathi, S. Bhalla, T.R. Sachdev. Breast- Feeding Practices In A Maternal And Child Health Centre In Delhi. Health and Population - Perspectives and Issues 26 2003;(3):110-115.
4. J Vishwanath, A B Desai. Achar's Textbook of Paediatrics, Third edition, CBS Publication
5. O.P GHAI, Essentials of Paediatrics, seventh edition. CBS Publication.
6. Noah S Scheinfed,J D Faad, Williams D James; Protein Energy Malnutrition; Medscape; June 27, 2012.
7. Ambika Thakur, Shubhangna Sharma and Rita Rani. Assessment of Mental and Motor Development of Infants in Hamirpur District of Himachal Pradesh. Anthropologist. 2004 6(2): 147-150.
8. Michael K Georgieff. Nutrition and the developing brain: nutrient priorities and measurement. American Journal of Clinical Nutrition. 2007;85:614S–20S.
9. H S Joshi, M C Joshi, Arun Singh, Preeti Joshi, Nadeen Israr Khan. Determinants of Protein Energy Malnutrition (pem) in 0-6 years children in Rural Community of Bairelly. Indian Journal Of Preventive Social Medicine. 2011;42;2:154-158.
10. Tanja Mayson, Evidence Summary for Pediatric Rehabilitation Professionals. Sunny Hill Health Center For Children. 2007: 1-4.
11. Polyana Candeia Maia, Larissa Paiva Silva, Márcia Maria Coelho Oliveira, Maria Vera Lúcia Moreira Leitão Cardoso. Motor development of preterm and term infants - using the Alberta Infant Motor Scale. Acta Paul Enferm 2011; 24(5):670-5.
12. Myron Winickd Pedror. The Effect of Severe Early Malnutrition on Cellular Growth of Human Brain. Pediat. Res. 1969; vol 3; No 2:181-184.
13. Ernesto Pollitt, Abas Jahari, Mahdin Husaini, Patricia Kariger, Carmen Saco Pollitt. Developmental Trajectories of Poorly Nourished Toddlers that Received a Micronutrient Supplement with and without Energy. Journal of Nutrition.2002; 132: 2617–2625.
14. John Mcfie, Andhebe F. Welbourn. Effect of Malnutrition in Infancy on the Development of Bone, Muscle and Fat. Journal of Nutrition. 1962;76: 97-105.
15. Sutanu Dutta Chowdhury, Brian H. Wrotniak, Tusharkanti Ghosh. Nutritional and socioeconomic factors in motor development of Santal children of the Purulia district, India. Early Human Development. December 2010; 86(12):779-84.
16. Jaqueline da Silva Fronio, Alessandra Regina Rabbit, Aparecida Thanks Lillian, Luiz Claudio Ribeiro. Nutritional Status and Gross motor Development of Infants between six and eighteen months of age. Brazilian Journal of Human Growth and Development. 2011; 21(1): 30-38.
17. P. R. Bartel, R. D. Griesel , Lesley S. Burnett, Ida Freiman, E. U. Rosen, Johanna Geefhuysen. Long-Term Effects of Kwashiorkor on Psychomotor Development, South. African Medical. Journal.1978; 53:360-362.
18. Agozie C Ubesie, Ngozi S Ibeziako, Chika I Ndiokwelu, Chinyeaka M Uzoka ,Chinelo A Nwafor. Under-five protein energy malnutrition admitted at the University of Nigeria Teaching Hospital ,Enugu: a 10 year retrospective review. Nutrition Journal 2012; 11;43:1-7.
19. Bhoomika R Kar, Shobini L Rao, B A Chandramouli. Cognitive development in children with chronic protein energy Malnutrition. Behavioral and Brain Functions. 2008; 4;31:1- 12.
20. Ernesto Pollitt. Developmental Sequel from Early Nutritional Deficiencies. Conclusive and Probability Judgements. Journal of Nutrition. 2000;130: 350S–353S.
21. Mayoor Chheda. Practical Aspects Of Pediatrics. VI Edition. Bhalani Publication.
22. R.Khadgawat, P Dabadhgao, R N Mehrotra and V Bhatia. Growth charts Suitable For Evaluation Of Indian Children. Indian Pediatrics.1998;35:859-865.
23. Samai Mohamed, Samai Hajah H, Bash-Taqi Donald A, Gage George N and Taqi Ahmed M. The Relationship between Nutritional Status and Anthropometric Measurements of Preschool Children in a Sierra Leonean Clay Factory Displaced Camp. Sierra Leone Journal of Biomedical Research 2009; 1;1:21-27.
24. Kikafunda J K, Walker A F, Collet D, Tumwine JK. Risk factors for early childhood malnutrition in Uganda. Pediatrics 1998;102:e45.
25. Wafaie W Fawzi, M Guillermo Herrera, Penelope Nestel, Alawia El Amin and Kamal A Mohamed. A longitudinal study of prolonged breastfeeding in relation to child Undernutrition. International Journal of Epidemiology.1998;27:255-260.
26. Masayuki Uesugi, Eiki Tushima, Tomoaki Shimada. Percentile Ranks of the Alberta Infant Motor Scale for Japanese Infant. Rigakuryoho Kagaku.2009;24;1: 15–19.
27. Hoorweg J, Stanfield JP. The effects of protein energy malnutrition in early childhood on intellectual and motor abilities in later childhood and adolescence. Developmental Medicine and Child Neurology.1976;18:330–50.
28. Johanna Darrah, Martha Piper, Man-joe Watt. Assessment of gross motor skills of at-Risk infants: predictive validity of the Alberta Infant Motor Scale. Risk. Developmental Medicine and Child Neurology.1998; 40:485-491.
29. Early Human Development.1978;2:163–70.Stanfield JP. Some aspects of long-term effects of malnutrition on the behavior of children in the third world. Proc Nutr Soc 1993;52:201–10.

How to cite this article:

Amruta Kulkarni, Deepa Metgud. ASSESSMENT OF GROSS MOTOR DEVELOPMENT IN INFANTS OF AGE 6 TO 18 MONTHS WITH PROTEIN ENERGY MALNUTRITION USING ALBERTA INFANT MOTOR SCALE: A CROSS SECTIONAL STUDY. Int J Physiother Res 2014;2(4):616-620.