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A study on prevalence and factors associated with protein energy malnutrition among 1-5 years of children's: A cross sectional study

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Abstract
Background: Malnutrition is a major health problem, especially in developing countries. It affects almost 800 million people. Prevalence rates vary among different continents of the world. PEM is undoubtedly the most serious nutritional problem affecting several thousand young children in India.
Objective: To find the prevalence of Protein energy malnutrition between urban and rural areas to study the factors associated with PEM among children of age 1 – 5 years in Guntur District.
Study design: Cross-sectional study carried out during 01 Jan 2018 to 31 Dec 2018 in the Department of Paediatrics, KATURI Medical College & Hospital, Guntur, Andhra Pradesh, India. Comprised children of age group 1 – 5 years and total of 180 included in this study.
Method of Collection of Data: The instrument used is a predesigned and pretested semi structured questionnaire. Physical measurements such as height and weight measured using standard methods.
Statistical Analysis: Proportion, Chi square test, Independent 't' test.
Results: The prevalence of Protein energy malnutrition is 67.7% (122). The prevalence of PEM is high among rural children (71.1%) compared to urban children (64.4%) and this difference is found to be statistically significant. Many preventable variables are found to be significant associates of Protein energy malnutrition. Study subjects included were both boys and girls, boys constituted 43.3% (78) and girls 56.7% (102). Each Urban and rural area constituted 50% i.e urban – 50%(90) and rural – 50% (90). Among 180 study subjects, 70% of children have MAC more than 13.5cms and 22.3% of children have MAC between 12.5 cms and13.5 cms whereas only 7% of children have MAC less than 12.5%. Mean weight was more among urban children(10.86) compared to rural children(9.54) and also mean height was higher among urban children(84.98) than rural children(81.69).The prevalence of Protein energy malnutrition is 67.7% (122).The prevalence of PEM is high among rural children (71.1%) compared to urban children (64.4%).36% of study subjects have Grade I PEM followed by Grade II (24.6%), Grade III (21.4%) and Grade IV (18.0%).Among urban children Grade I(43.1%) is common whereas among rural children, Grade II and III are common. The prevalence of PEM is high in 2 – 3 years of age group (97.9%). The prevalence of PEM is more among boys (74.3%) compared to girls (62.7%). The prevalence of PEM is more among Hindus (78.9%) compared to Muslims (48.2%). The prevalence of PEM is high among the subjects who belong to family size more than five (72.1%). The prevalence of PEM is high among socioeconomic class IV (82.5%). The prevalence of PEM is high among those study subjects whose fathers are illiterates (76.9%). The prevalence of PEM is high among those study subjects whose mothers are educated up to primary (75.0%). The prevalence is found to be high in those students whose fathers are unemployed (50.0%) /unskilled (69.6%) /semiskilled (68.6%). The prevalence is found to be high in those students whose mothers are unemployed (68.4%) /unskilled (71.2%) /semiskilled (33.3%).The prevalence of PEM is high among study subjects of Nuclear family (76.3%). The prevalence of PEM is more among study subjects mother who had ANC visits of less than 6 (around 80%). There is no statistical difference in prevalence of PEM among study subjects based on mode of delivery. The prevalence of PEM is more among birth weight less than 2.5 kgs (85.4%). The prevalence of PEM is more among study subjects mother who had initiated breast feeding after four hours (85%).The prevalence of PEM is more among study subjects mother who had not fed colostrum (78.5%).The prevalence of PEM is high among non exclusive breast feeding (71%).Housing conditions revealed that prevalence of PEM is more among semi puccka house (73.0%), in adequate ventilation (73.8%), overcrowding (77.2%) and solid fuel user (74.0%).
Conclusion: Since it is a cross sectional study, no causal relationships can be established from this study. Dietary intake was assessed by 24-hour recall basis method and application of better and elaborate methods of dietary intake assessment was beyond the scope of the study.

Keywords: PEM, malnutrition, prevalence, urban & rural areas, antenatal checkup

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. 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.

In India, since Independence the infant mortality and death rate have come down to one third and half respectively. Unfortunately malnutrition, which is not much talked about, has come down only by one fifth. This is when the agricultural production has increased many fold and granaries are having the problem of storing food grains[1].

The term " Protein-energy malnutrition is used to describe a broad array of clinical conditions ranging from mild malnutrition manifesting itself in poor growth to serious type of Kwashiorkor and Marasmus, which have high fatality rate. School children are at risk of becoming severely malnourished[2]. Prevalence rate vary among different continents of the world. More than 70% of children with Protein-energy malnutrition live in Asia, 26% in Africa, and 4% in Latin America and the Caribbean[3].

Protein-energy malnutrition is undoubtedly the most serious nutritional problem affecting several thousand young children in India. Inadequate food, ignorance, undesirable social practices tend to impede child's early growth. Lack of spacing and large number of siblings are the order of the day amongst low income groups and in rural areas. The present study, therefore, will be undertaken to assess the prevalence of Protein-energy malnutrition in our area.

Objectives of the study

1. To find the prevalence of Protein-energy malnutrition (PEM) among children of age group 1- 5 years residing in Guntur district.
2. To compare the Prevalence of Protein-energy malnutrition (PEM) between urban and rural areas of Guntur District.
3. To study the factors associated with Protein-energy malnutrition (PEM) among the study population.

Materials and Methods

Study design: Cross-sectional study

Study setting: Guntur District

The study was conducted in rural and urban areas of Guntur. Rural areas included village and urban areas included wards.

Study Population

The study population consisted of children of age group 1 – 5 years among households of urban and rural areas of Guntur District.

Exclusion Criteria

1. Those not willing to participate in the study.
2. Locked houses at the time of data collection.

Sample Size: In this study 5% significance and 20% allowable error is considered.

Since the study aims to compare prevalence in urban and rural, 90 each subjects were taken from urban and rural area. So the total sample size was 180.

Method of Sampling: Multistage and Stratified Random Sampling Guntur district has urban and rural areas. Urban area includes wards and rural area includes villages.

First Guntur District was stratified into wards (Urban) and villages (rural).

- From rural stratum, village and from urban stratum, ward was selected by simple random sampling using a random table.
- Further, from each selected village and ward, house to house visit was made and parents/guardians of children aged 1-5 years were interviewed.
- If required number of children of age group 1-5 years was not enough in a selected village or ward, next village or ward was selected and similar procedure was followed.
- Totally two villages and three wards were chosen for the study.

Study Period: January 1st 2018 to December 31st 2018.

Method of collection of data

Study tool: Pre tested semi structured Questionnaire.

The Questionnaire was presented in the Department for critical review, following which necessary changes were made in the Questionnaire.

Data was collected using Pre tested semi structured Questionnaire by interview technique. The parents of children of age group 1- 5 years were informed about the study and each question was explained to gather the data, & simultaneously height, weight, head circumference, chest circumference and mid arm circumference was measured.

The following variables were collected:

Age: Age was recorded to the nearest completed months after verifying from birth certificates, anganwadi registers and by correlating to the nearby special events.

Illiterate: The person who cannot read and write.

Literate: The person who can read and write.

Primary education: The person who has studied up to 7th class.

High school/secondary education: The person who has studied up to 10 class.

Pre-University: The person who has studied up to 2nd year PUC.

Degree/Diploma: The person who has done a degree or diploma course.

Nuclear Family: It consists of married couples, their children while they are still considered as dependent.

Joint Family: It consists of a number of married couples and their children who live in the same household.

Three Generation Family: It consists of 3 generations related to each other by direct decent, living together.

Broken Family: Is the one where the parents are separated or where death has occurred of one or both parents.

Socio-Economic Status
The per capita income was classified using the modified B.G. Prasad's classification [4].

Birth Order: The living siblings were taken into consideration for birth order of living children.

Birth interval: The interval between the next living child and the study child was considered.

Family Size: It consists of the total number of children a mother has borne at the time of study.
Exclusive Breast Feeding: Feeding the child with only breast milk for a minimum duration of 6 months (vitamins, minerals and medicines can be given if required for child's health or for minor ailments.
A child fed on water; any other liquids or solids during the early 6 months will not be considered as exclusively breast-fed.

Appropriate Age at Weaning: This was considered as 6 months.

Pre lacteal feeds: Feeds given to the newborn before starting breast-feeding.

Top Milk Feeding: Any milk apart from breast milk introduced before the age of 6 months.

Complete Immunization Status: Children who had been administered all the recommended vaccines up to one year of age (i.e 1 dose of BCG, 3 doses of DPT, 3 doses of OPV and 1 dose of measles) as per UIP guidelines.

Incomplete Immunization Status: Children who have not received one or more recommended vaccines up to one year of age as per UIP guideline.

Anthropometric Measurements
Mid-Upper Arm Circumference: MUAC was measured using a non-stretchable fiberglass tape encircling the arm at the midpoint of the olecranon and acromion and recorded to the nearest 0.1 cms for children aged 1 to 5 years

Weight: Body weight was measured without any footwear and with minimal clothing nearest to 0.1 Kgs using a standard UNICEF Salter spring balance for children aged 1 to 5 years and by standard standing weighing machine for children aged 5 to 6 years. The scale was zeroed before each session.

Height: In children aged above 2 years standing height was measured without any foot wear to nearest 0.1 cms using a standard calibrated bar. The children were made to stand straight with heels, buttocks, shoulders and back of head touching the rod.
The supine length was measured in children < than 2 years of age using an infantometer. The child was placed on board with head positioned firmly against the fixed head board, the knees extended by firm pressure and the feet fixed at right angles to the lower legs.

Classification of PEM
1. IAP Classification

IAP Classification

1st Degree	71 – 80%
2nd Degree	61 – 70 %
3rd Degree	51 – 60 %
4th Degree	< 50% of Expected

In this study PEM was classified based on IAP classification primarily.

Ethical Consideration: The protocol designed for the present study was submitted to the Ethical committee, Katuri Medical College, Guntur. Ethical clearance certificate was issued by the institution. Informed written consent was taken by parents/guardians of children.

Statistical Analysis
The data analyzed by using appropriate statistical tool.

Results

Table 1: Age and Sex wise distribution of the children

Age	Sex				Total	
	Boys		Girls			
	N	%	N	%	N	%
12 -24 months	24	30.7	30	29.5	54	30.0
25 -36 months	21	26.9	27	26.5	48	26.7
37 -48 months	15	19.2	31	30.4	46	25.6
49 -60 months	18	23.1	14	13.7	32	17.8
Total	78	100	102	100	180	100

The age of the study subjects ranged from 12 to 60 months, maximum numbers of children are in the age group of 1 – 2 years (30.0%) and as well as in the age group 2 – 3 years(26.7%) which together constituted about 56.7% of study subjects. It was observed that 25.6% of study subjects belong to age 3 – 4 years and 17.8% belong to the age 4 – 5 years. Study subjects included were both boys and girls, boys constituted 43.3% (78) and girls 56.7% (102). There is no much difference in age for 1 – 3 years between boys and girls.

Table 2: Distribution of study subjects according to place

Place	Frequency	Percent
Urban	90	50
Rural	90	50
Total	180	100

Study subjects included from both urban and rural areas. Each area constituted 50% i.e urban – 50 %(90) and rural – 50% (90).

Anthropometric Indices

Table 3: Anthropometric indices of the children

Variable	Urban		Rural		P value*
	Mean	SD	Mean	SD	
Weight (Kg)	10.86	2.2	9.54	1.9	0.01
Height (Cms)	84.98	9.3	81.69	9.2	0.01
MAC(cms)	14.10	1.1	14.0	1.1	0.93
Head circumference (cms)	46.51	3.6	46.48	1.8	0.47
Chest circumference (cms)	47.85	4.2	47.84	2.9	0.55

Comparison of anthropometric indices between urban and rural children revealed that mean weight was more among urban children(10.86) compared to rural children(9.54) and also mean height was higher among urban children(84.98) than rural children(81.69).This difference is found to be statistically significant. There was no much difference in Mid arm circumference, Head circumference and Chest circumference.

Mid arm circumference

Table 4: Distribution of study subjects based on Mid arm circumference

MAC	Place				Total	
	Urban		Rural			
	N	%	N	%	N	%
<12.5 cm	09	10.0	05	05.5	14	07.7
12.5 – 13.5 cm	23	25.5	17	18.8	40	22.3
>13.5 cm	58	64.5	68	75.5	126	70.0
Total	90	100	90	100	180	100

Chi square test – 2.84 df – 2 p value – 0.24 (not significant)

Among 180 study subjects, 70% of children have MAC more than 13.5cms and 22.3% of children have MAC between 12.5 cms and 13.5 cms whereas only 7% of children have MAC less than 12.5%.

Prevalence of Protein Energy Malnutrition

Overall prevalence of protein energy malnutrition

Table 5: Overall prevalence of protein energy malnutrition among study subjects

Protein Energy Malnutrition	Urban	Rural	Total
Present	58 64.4%)	64 (71.1%)	122 (67.7%)
Absent	32 (35.6%)	26 (28.9%)	58 (32.3%)
Total	90 (100%)	90 (100%)	180 (100%)

The prevalence of Protein energy malnutrition is 67.7% (122). The prevalence of PEM is high among rural children (71.1%) compared to urban children (64.4%) and this difference is found to be statistically significant.

Grading of protein energy malnutrition

Table 6: Grading of protein energy malnutrition among study subjects

PEM grading	Urban	Rural	Total
Grade I	25 (43.1%)	19 (29.6%)	44(36.0%)
Grade II	14 (24.1%)	16 (25.0%)	30 (24.6%)
Grade III	10 (17.2%)	16 (25.0%)	26 (21.4%)
Grade IV	09 (15.6%)	13 (20.3%)	22 (18.0%)
Total	58 (100%)	64 (100%)	122 (100%)

Chi square test - 2.78 df- 3 p value – 0.42

36% of study subjects have Grade I PEM followed by Grade II (24.6%), Grade III (21.4%) and Grade IV (18.0%). Among urban children Grade I(43.1%) is common whereas among rural children, Grade II and III are common. 20.3% of rural children have Grade IV PEM compared to 15.6% of urban children. But this difference was not statistically significant.

Grading of protein energy malnutrition across age group

Table 7: Prevalence of protein energy malnutrition grading according to the age group

Age	PEM grades								Total
	Urban				Rural				
	I	II	III	IV	I	II	III	IV	
12 -24 months	09 (18.7%)	05 (10.4%)	03 (6.2%)	04 (8.3%)	09 (18.0 %)	09 (18.7%)	05 (10.4%)	04 (8.3%)	48 (100%)
25 -36 months	10 (21.2%)	05 (10.6%)	04 (8.5%)	04 (8.5%)	06 (12.7%)	06 (12.7%)	06 (12.7%)	06 (12.7%)	47 (100%)
37 -48 months	05 (27.7%)	02 (11.1%)	03 (16.6%)	01 (5.5%)	03(16.6%)	01 (5.5%)	03 (16.6%)	00	18 (100%)
49 -60 months	01 (11.1%)	02 (22.2%)	00	00	01 (11.1%)	00	02 (22.2%)	03 (33.3%)	09 (100%)
Total	25 (20.4%)	14 (11.4%)	10 (8.2%)	09 (7.3%)	19 (15.5%)	16 (13.1%)	16 (13.1%)	13 (10.6%)	122 (100%)

It can be deducted from the above table that, among urban children, Grade I PEM (27.7%) & Grade III (16.6%) is more common in 3 – 4 year age group, Grade II PEM (22.2%) is high in 4 – 5 year age group whereas Grade IV is more in 2 – 3 year age group.

In rural children, Grade I & Grade II, and Grade III & Grade IV is high in 1 – 2 year and 4 – 5 years respectively.

Sex-wise grading of PEM

Table 8: Sex wise Grading of PEM

Sex	PEM grades								Total
	Urban				Rural				
	I	II	III	IV	I	II	III	IV	
Boys	10 (1.7%)	08 (13.7%)	05 (8.6%)	03 (5.1%)	09 (15.5%)	09 (15.5%)	08 (13.7%)	06 (10.3%)	58 (100%)
Girls	15 (23.4%)	06 (9.3%)	05 (7.8%)	06 (9.3%)	10 (15.6%)	07 (10.9%)	08 (12.5%)	07 (10.9%)	64 (100%)
Total	25 (20.4%)	14 (11.4%)	10 (8.2%)	09 (7.3%)	19 (15.5%)	16 (13.1%)	16 (13.1%)	13 (10.6%)	122 (100%)

Among urban children, Grade I is high in girls (23.4%), Grade II is high in boys (13.7%), Grade III(8.6%) is high in boys and no difference in Grade IV. Among rural children, Grade II is high in boys (15.5%), Grade III (13.7%) is high in boys and no difference in Grade I and Grade IV.

Factors associated with protein energy malnutrition
Age and PEM

Table 9: Relation between age and PEM

Age group	PEM		Total
	Present	Absent	
12 – 24 months	48(88.8%)	06(11.2%)	54(100%)
25 – 36 months	47(97.9%)	01(02.1%)	48(100%)
37 – 48 months	18(39.1%)	28(60.8%)	46(100%)
49 – 60 months	09(28.1%)	23(71.9%)	32(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

Chi square test -- 71.3 df- 3 p value

The prevalence of PEM is high in 2 – 3 years of age group (97.9%), followed by 1 – 2 years (88.8%), 3 – 4 years (39.1%) and 4 – 5 years (28.1%). This association between age and PEM is found to be statistically significant.

Gender and PEM

Table 10: Relation between Sex and PEM

Protein energy malnutrition	Boys	Girls	Total
Present	58(74.3%)	64(62.7%)	122(67.7%)
Absent	20(25.7%)	38(37.3%)	58(32.3%)
Total	78(100%)	102(100%)	180(100%)

Chi square value – 2.73 df-1 p value – 0.09

The prevalence of PEM is more among boys (74.3%) compared to girls (62.7%) but the association between gender and PEM is not statistically significant.

Religion and PEM

Table 11: Relation between religion and PEM

Religion	PEM		Total
	Present	Absent	
Hindu	94(78.9%)	25(21.1%)	119(100%)
Muslim	28(48.2%)	30(51.8%)	58(100%)
Others	00	03(100%)	03(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

Chi square value – 23.2 df – 2 p - 0.01

The prevalence of PEM is more among Hindus (78.9%) compared to Muslims (48.2%) and the association between Religion and PEM is statistically significant.

Family size and PEM

Table 12: Relation between family size and PEM

Family size	PEM		Total
	Present	Absent	
Up to 5	26(55.3%)	21(44.7%)	47(100%)
More than 5	96(72.1%)	37(27.9%)	133(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The students were classified into those who have family size up to five and more than five. This table depicts that the prevalence of PEM is high among the subjects who belongs to family size more than five (72.1%) compared to subjects who belong to family size up to five (55.3%). It is statistically significant.

Socio economic status and PEM

Table 13: Relation between socio economic status and PEM

Socioeconomic Status	PEM		Total
	Present	Absent	
Class I	14(42.4%)	19(57.6%)	33(100%)
Class II	10(52.6%)	09(47.4%)	19(100%)
Class III	23(67.6%)	11(32.4%)	34(100%)
Class IV	33(82.5%)	07(17.5%)	40(100%)
Class V	42(77.7%)	12(22.3%)	54(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The prevalence of PEM is high among socioeconomic class IV (82.5%) followed by class V (77.7%), class III (67.6%), class I (57.6%) and class II (52.6%). By this it is evident that Socio economic status is inversely related to PEM. This association is found to be statistically significant.

Paternal education and PEM

Table 14: Relation between paternal education and PEM

Paternal education	PEM		Total
	Present	Absent	
Illiterate	30(76.9%)	09(23.1%)	39(100%)
Primary	40(71.4%)	16(28.6%)	56(100%)
Secondary	23(69.7%)	10(30.3%)	33(100%)
Higher secondary	19(65.5%)	10(34.5%)	29(100%)
Pre university	10(62.5%)	06(37.5%)	16(100%)
Degree and above	00	07(100%)	07(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

Chi square value – 16.89 df-5 p value – 0.01

The prevalence of PEM is high among those study subjects whose fathers are illiterates (76.9%) followed by primary (71.4%), secondary (69.7%), higher secondary (65.5%) and pre university (62.5%). Actually according to this table, the prevalence increased as the education of father decreases. The observed difference is statistically significant.

Maternal education and PEM

Table 15: Relation between maternal education and PEM

Maternal Education	PEM		Total
	Present	Absent	
Illiterate	28(71.7%)	11(28.3%)	39(100%)
Primary	42(75.0%)	14(25.0%)	56(100%)
Secondary	30(69.7%)	13(30.3%)	43(100%)
Higher secondary	22(66.6%)	11(33.4%)	33(100%)
Pre university	00	06(100%)	06(100%)
Degree and above	00	03(100%)	03(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The prevalence of PEM is high among those study subjects whose mothers are educated up to primary (75.0%) followed by illiterate (71.7%), secondary (69.7%) and higher secondary (66.6%). The prevalence increased as the education of mother decreases. The observed difference is statistically significant.

Paternal occupation and PEM

Table 16: Relation between paternal occupation and PEM

Paternal Occupation	PEM		Total
	Present	Absent	
Unemployed	01(50.0%)	01(50.0%)	02(100%)
Unskilled	62(69.6%)	27(30.4%)	89(100%)
Semiskilled	57(68.6%)	26(31.4%)	83(100%)
Skilled	00	04(100%)	04(100%)
Professional	00	01(100%)	01(100%)
Business & others	00	01(100%)	01(100%)
Total	122 (67.7%)	58 (32.3%)	180 (100%)

According to this table, The prevalence is found to be high in those students whose fathers are unemployed (50.0%) /unskilled (69.6%) semiskilled (68.6%) and nil among skilled sectors and others. The observed difference is statistically significant.

Maternal occupation and PEM

Table 17: Relation between maternal occupation and PEM

Maternal occupation	PEM		Total
	Present	Absent	
Unemployed	26(68.4%)	12(31.6%)	38(100%)
Unskilled	94(71.2%)	38(28.8%)	132(100%)
Semiskilled	02(33.3%)	04(66.7%)	06(100%)
Skilled	00	03(100%)	03(100%)
Professional	00	01(100%)	01(100%)
Business & others	00	00	00
Total	122 (67.7%)	58 (32.3%)	180 (100%)

According to this table, The prevalence is found to be high in those students whose mothers are unemployed (68.4%) /unskilled (71.2%)/ semiskilled (33.3%) and nil among skilled sectors and others. The observed difference is statistically significant.

Family type and PEM

Table 18: Relation between Family type and PEM

Family type	PEM		Total
	Present	Absent	
Nuclear	84(76.3%)	26(23.7%)	110(100%)
Joint	35(57.3%)	26(42.7%)	61(100%)
Three generation	03(33.3%)	06(66.7%)	09(100%)
Total	122 (67.7%)	58 (32.3%)	180 (100%)

Chi square value – 11.62 df-2 P value – 0.001

The prevalence of PEM is high among study subjects of Nuclear family (76.3%) compared to joint (57.3%) and three generation (33.3%) and this association is statistically significant.

ANC visits	PEM		Total
	Present	Absent	
< 3	42(77.7%)	12(22.3%)	54(100%)
3 – 6	65(86.6%)	10(13.4%)	75(100%)
> 6	15(29.4%)	36(70.6%)	51(100%)
Total	122 (67.7%)	58 (32.3%)	180 (100%)

ANC visits and PEM

Table 19: Relation between ANC visits and PEM

ANC visits	PEM		Total
	Present	Absent	
< 3	42(77.7%)	12(22.3%)	54(100%)
3 – 6	65(86.6%)	10(13.4%)	75(100%)
> 6	15(29.4%)	36(70.6%)	51(100%)
Total	122 (67.7%)	58 (32.3%)	180 (100%)

The prevalence of PEM is more among study subjects mother who had ANC visits of less than 6 (around 80%) compared to mothers who had more than six visits (29.4%) and the association between ANC visits and PEM is statistically significant.

Pregnancy complications and PEM

Table 20: Pregnancy complications and PEM

Pregnancy Complications	PEM		Total
	Present	Absent	
Yes	09(52.9%)	08(47.1%)	17(100%)
No	113(69.3%)	50(30.7%)	163(100%)
Total	122(67.7%)	58 (32.3%)	180 (100%)

The prevalence of PEM among study subjects whose mothers who had experienced complications in pregnancy is 52.9% and who had no is69.3%. The association between pregnancy complications and PEM is not statistically significant.

Mode of delivery and PEM

Table 21: Relation between mode of delivery and PEM

Mode of delivery	PEM		Total
	Present	Absent	
Normal vaginal	95(67.8%)	45(32.2%)	140(100%)
LSCS	27(67.5%)	13(32.5%)	40(100%)
Total	122 (67.7%)	58 (32.3%)	180 (100%)

There is no statistical difference in prevalence of PEM among study subjects based on mode of delivery i.e. between normal vaginal delivery (67.8%) and LSCS (67.5%).

Place of delivery and PEM

Table 22: Relation between place of delivery and PEM

Place of delivery	PEM		Total
	Present	Absent	
Hospital	31(59.6%)	21(40.4%)	52(100%)
Home	91(71.0%)	37(29.0%)	128(100%)
Total	122 (67.7%)	58 (32.3%)	180 (100%)

The prevalence of PEM is more among home deliveries (71.0%) compared to hospital deliveries (59.6%) but the association between place of delivery and PEM is not statistically significant.

Birth weight and PEM

Table 23: Relation between birth weight and PEM

Birth Weight	PEM		Total
	Present	Absent	
< 2.5 kgs	41(85.4%)	07(14.6%)	48(100%)
>/= 2.5 kgs	81(61.3%)	51(38.7%)	132(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The prevalence of PEM is more among birth weight less than 2.5 kgs (85.4%) compared to birth weight more or equal to 2.5 kgs (61.3%) and the association between birth weight and PEM is statistically significant.

Breast feeding initiation and PEM

Table 24: Relation between initiation of breast feeding and PEM

Breast feeding initiation	PEM		Total
	Present	Absent	
< 1 hr	80(64.5%)	44(35.5%)	124(100%)
1 – 4 hr	19(65.5%)	10(34.5%)	29(100%)
>4 hr	23(85.1%)	04(14.9%)	27(100%)
Total	122(67.7%)	58 (32.3%)	180 (100%)

The prevalence of PEM is more among study subjects mother who had initiated breast feeding after four hours (85%) compared to mothers who had initiated in less than four hours (around 65%) but the association between initiation of breast feeding and PEM is not statistically significant.

Colostrum feeding and PEM

Table 25: Relation between colostrums feeding and PEM

Colostrum feeding	PEM		Total
	Present	Absent	
Yes	89(64.4%)	49(35.6%)	138(100%)
No	33(78.5%)	09(21.5%)	42(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The prevalence of PEM is more among study subjects mother who had not fed colostrum (78.5%) compared to mothers who had fed colostrum (64.4%) and the association between colostrum feeding and PEM is statistically significant.

Exclusive breast feeding and PEM

Table 26: Relation between exclusive breast feeding and PEM

Exclusive breast feeding	PEM		Total
	Present	Absent	
Yes	68(65.3%)	36(34.7%)	104(100%)
No	54(71.0%)	22(29.0%)	76(100%)
Total	122 (67.7%)	58 (32.3%)	180 (100%)

The prevalence of PEM is high among non exclusive breast feeding (71%) compared to exclusive breast feeding (65.3%) and the association between Exclusive breast

feeding and PEM is statistically significant.

Recommended calorie received and PEM

Table 27: Relation between recommended calorie received and PEM

RDA Calorie Received	PEM		Total
	Present	Absent	
Yes	54(61.3%)	34(38.7%)	88(100%)
No	68(73.9%)	24(26.1%)	92(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The prevalence of PEM is more among study subjects who had not received recommended calories (73.9%) compared to those who had received recommended calories (61.3%) and the association between RDA calorie received and PEM is statistically significant.

RDA protein received and PEM

Table 28: Relation between recommended protein received and PEM

RDA protein received	PEM		Total
	Present	Absent	
Yes	34(51.5%)	32(48.5%)	66(100%)
No	88(77.1%)	26(22.9%)	114(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The prevalence of PEM is more among study subjects who had not received recommended protein (77.1%) compared to those who had received recommended protein (51.5%) and the association between RDA protein received and PEM is statistically significant.

Present illness and PEM

Table 29: Relation between present illness and PEM Present illness and PEM

Present Illness	PEM		Total
	Present	Absent	
Yes	109(69.4%)	48(30.6%)	157(100%)
No	13 (56.5%)	10(43.5%)	23 (100%)
Total	122(67.7%)	58 (32.3%)	180 (100%)

The prevalence of PEM is more among study subjects who are ill (69.4%) compared to those who are not ill (56.5%) and the association between present illness and PEM is not statistically significant.

Past illness and PEM

Table 30: Relation between past illness and PEM

Past illness	PEM		Total
	Present	Absent	
Yes	35(70.0%)	15(30.0%)	50(100%)
No	87(66.9%)	43(33.1%)	130(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The prevalence of PEM is more among study subjects who past history of illness (70.0%) had compared to those who did not have pat history of illness l (66.9%) and the association between past illness and PEM is not statistically significant.

Immunization and PEM

Table 31: Relation between Immunization and PEM

Immunization status	PEM		Total
	Present	Absent	
Fully immunized	115(68.8%)	52(31.2%)	167(100%)
Partial immunized	06(60.0%)	04(40.0%)	10(100%)
Un immunized	01(33.3%)	02(66.7%)	03(100%)
Total	122(67.7%)	58(32.3%)	180(100%)

The prevalence of PEM among fully immunized is 68.8%, among partial immunized is 60.0% and among unimmunized is 33.3%. This association is not statistically significant.

Housing conditions and PEM

Table 32: Relation between housing conditions and PEM

Variables	Total no. (%)	PEM N (%)	P value*
Overall	**180 (100%)**	**122 (67.7%)**	-
Type of house			
Kuchha	35(100%)	21(60.0%)	0.21
Puccka	93(100%)	63(67.7%)	
Semi puccka	52(100%)	38(73.0%)	
Ventilation			
Adequate	92(100%)	57(61.9%)	0.02
Not adequate	88(100%)	65(73.8%)	
Overcrowding			
Yes	101(100%)	78(77.2%)	0.001
No	79(100%)	44(55.6%)	
Solid fuel used			
Yes	127(100%)	94(74.0%)	0.01
No	53(100%)	28(52.8%)	

Housing conditions revealed that prevalence of PEM is more among semi puccka house (73.0%), in adequate ventilation (73.8%), overcrowding (77.2%) and solid fuel user (74.0%). The association of inadequate ventilation, overcrowding, solid fuel and PEM are statistically significant.

Discussion

General Profile

A study was conducted to know the prevalence of protein energy malnutrition among 1-5 years of children residing in urban and rural area of Guntur District and along with this objective this study throws light upon determinants of protein energy malnutrition.

The age of the study subjects ranged from 12 to 60 months, maximum numbers of students were in the age group of 1 – 3 years which constituted about 56.7% of study subjects. It was observed that 25.6% of study subjects belong to age 3 – 4 years and 17.8% belong to the age 4 – 5 years. Similar age distribution was found in a study conducted by S chakraboty *et al*. in Rajasthan, India [5].

Study subjects included were both boys and girls, boys constituted 43.3% (78) and girls 56.7% [6]. The proportion of females was higher which is comparable to a study by Bhatia *et al*. [7]

Comparison of anthropometric indices between urban and rural children revealed that mean weight was more among urban children (10.86) compared to rural children (9.54) and also mean height was higher among urban children (84.98) than rural children (81.69). This difference in mean weight

was observed in a study conducted by S chakraboty *et al.* in Rajasthan, India [5].

In this study, 70% of children have MAC more than 13.5cms and 22.3% of children have MAC between 12.5 cms and 13.5 cms whereas only 7% of children have MAC less than 12.5%. So based on the mid arm circumference only 29.3% of the children in 12-60 months age group were found to be malnourished. This indicator failed to pick up many other malnourished children. In a study done in a rural area, revealed that MUAC was not a sensitive indicator to detect malnutrition [8].

Prevalence of Protein energy malnutrition

The prevalence of protein energy malnutrition among 12 – 60 months age group of children in Guntur District is found to be 67.7% taking the criteria of IAP classification of Protein energy malnutrition. A study done by swami *et al.* on nutritional status of preschool children in Chandigarh, was my reference study with a prevalence of PEM to be 51.6%.

The present study revealed that the combined prevalence of PEM is 67.7%. The prevalence of PEM in urban area is 64.4% and in rural area is 71.1%. This shoes that prevalence is high in rural area compared to urban area. Comparing the results of this study with other studies in India revealed that the prevalence of PEM is consistent with other studies [5, 9].

In the present study, 36% of study subjects have Grade I PEM followed by Grade II (24.6%), Grade III (21.4%) and Grade IV (18.0%).

Among urban children Grade I(43.1%) is common whereas among rural children, Grade II and III are common. 20.3% of rural children have Grade IV PEM compared to 15.6% of urban children. But this difference was not statistically significant, Grade I PEM (27.7%) & Grade III (16.6%) is more common in 3-4 year age group, Grade II PEM (22.2%) is high in 4-5 year age group whereas Grade IV is more in 2 – 3 year age group.

In rural children, Grade I & Grade II, and Grade III & Grade IV is high in 1 – 2 year and 4 – 5 years respectively. Among urban children, Grade I is high in girls (23.4%), Grade II is high in boys (13.7%), Grade III(8.6%) is high in boys and no difference in Grade IV. Among rural children, Grade II is high in boys (15.5%), Grade III (13.7%) is high in boys and no difference in Grade I and Grade IV.

In a study conducted in Rajsthan [5], prevalence of PEM was observed to be 67%, however it was found to be significantly higher (80.9%) in the age group of 1-3 years as compared to other age groups. This age group also exhibited significantly higher prevalence (x 2 =14.67, $p<0.05$) of Grade I, II, III PEM. Sen *et al.* [10] also reported a higher prevalence in the age group of 1-3 years., It was found that in Rajasthan study female had an overall higher prevalence of PEM (70.6%) as also Grade I PEM (36.6%) in comparison to males who had overall higher prevalence of PEM and Grade I PEM as 62.6 and 19.7% respectively. Contradictory results were reported by Srivastava [11] (1985) as overall higher prevalence among males. However, Grade II, III, and IV PEM was found to be significantly higher (x 2 =1.41, $p<0.05$) in males (27.4, and 4.3% respectively) than in females (23.8, 7.3 and 2.7% respectively) in Rajasthan study.

Factors associated with Protein energy malnutrition

Age and PEM

The prevalence of PEM is high in 2 – 3 years of age group (97.9%), followed by 1 – 2 years (88.8%), 3 – 4 years (39.1%) and 4 – 5 years (28.1%). This association between age and PEM is found to be statistically significant. Similar findings were noted in a study done by chakraboty [5] & Sen *et al.* [10] also reported higher prevalence in 1- 3 years of age group.

Sex and PEM

The prevalence of PEM is more among boys (74.3%) compared to girls (62.7%) but the association between gender and PEM is not statistically significant.

Christiaensen and Alderman [12] (2001) found that more boys than girls younger than five years old had malnutrition in Ethiopia and this was the same for a study in Turkey by Kilic *et al.* (2004) [13] that found 14 male and seven female infants with marasmus and nine male and six female infants with kwashiorkor.

Family size and PEM

The students were classified into those who have family size up to five and more than five. The prevalence of PEM is high among the subjects who belongs to family size more than five (72.1%) compared to subjects who belong to family size up to five (55.3%). In South Africa the size of a household can therefore be a predictor of malnutrition [6].

Socioeconomic status and PEM

The prevalence of PEM is high among socioeconomic class IV (82.5%) followed by class V (77.7%), class III (67.6%), class I (57.6%) and class II (52.6%). By this it is evident that Socio economic status is inversely related to PEM. This association is found to be statistically significant.

In the present study children of highersocio-economic status were less undernourished than children of lower socio-economic status. In another study conducted in Uttar Pradesh the prevalence of underweight was maximum at 75% among children of low socio- economic status while only 24% among children of high socio- economic status ($\chi 2=5.66$, DF=2, $p<0.02$).

Maternal education and PEM

The prevalence of PEM is high among those study subjects whose mothers are educated up to primary (75.0%) followed by illiterate (71.7%), secondary (69.7%) and higher secondary (66.6%). The prevalence increased as the education of mother decreases. The observed difference is statistically significant. This declining trend of under nutrition with increase in mother's educational level was also observed in our study [14].

Paternal education and PEM

The prevalence of PEM is high among those study subjects whose fathers are illiterates (76.9%) followed by primary (71.4%), secondary (69.7%), higher secondary (65.5%) and pre university (62.5%). The prevalence increased as the education of father decreases. The observed difference is statistically significant.

Family type and PEM

The prevalence of PEM is high among study subjects of Nuclear family (76.3%) compared to joint (57.3%) and three generation (33.3%) and this association is statistically significant.

Pregnancy history, birth weight and breast feeding practices and PEM

The prevalence of PEM is more among study subjects mother who had ANC visits of less than 6 (around 80%) compared to mothers who had more than six visits (29.4%) and the association between ANC visits and PEM is statistically significant. There is no statistical difference in prevalence of PEM among study subjects based on mode of delivery i.e. between normal vaginal delivery (67.8%) and LSCS (67.5%).

No studies have included above variables to find their association with PEM but even though this study considered these variables, they found to be insignificant associates. The prevalence of PEM is more among birth weight less than 2.5 kgs (85.4%) compared to birth weight more or equal to 2.5 kgs (61.3%) and the association between birth weight and PEM is statistically significant. In a study done in Limpopo, South Africa most children twelve to 24 months old that had a birth weight of less than 2.5kg, were more likely to develop stunting. About 25% of the stunted children weighed less than 2.5kg at birth [6].

The prevalence of PEM is more among study subjects mother who had initiated breast feeding after four hours (85%) compared to mothers who had initiated in less than four hours (around 65%) but the association between initiation of breast feeding and PEM is not statistically significant. The prevalence of PEM is more among study subjects mother who had not fed colostrum (78.5%) compared to mothers who had fed colostrum (64.4%) and the association between colostrum feeding and PEM is statistically significant. The prevalence of PEM is high among non exclusive breast feeding (71%) compared to exclusive breast feeding (65.3%) and the association between Exclusive breast feeding and PEM is statistically significant.

In 2005 only 178 (37%) of facilities in South Africa were baby friendly according to the Baby Friendly Hospital Initiative, with a target of 15% set for 2007, which was already reached.

According to UNICEF, less than 40% of infants in the developing world receive immediate breastfeeding after birth. Only 39% of babies are put to the breast one hour after birth despite the fact that early initiation of breastfeeding can contribute to reduced neonatal mortality through skin-to-skin contact that can prevent hypothermia [15].

In the study done in tribal area the authors have observed lack of exclusive breast- feeding as a contributory factor to under nutrition [16].

RDA calories and PEM

The prevalence of PEM is more among study subjects who had not received recommended calories (73.9%) compared to those who had received recommended calories (61.3%) and the association between RDA calorie received and PEM is statistically significant. The prevalence of PEM is more among study subjects who had not received recommended protein (77.1%) compared to those who had received recommended protein (51.5%) and the association between RDA protein received and PEM is statistically significant. Similar observations were found in other studies [17].

Illness and PEM

The prevalence of PEM is more among study subjects who are ill (69.4%) compared to those who are not ill (56.5%) and The prevalence of PEM is more among study subjects who had past history of illness (70.0%%) compared to those who did not have pat history of illness l (66.9%). This association was also found in other studies [6].

Immunization and PEM

The prevalence of PEM among fully immunized is 68.8%, among partial immunized is 60.0% and among unimmunized is 33.3%. This association is not statistically significant.

In a study done in Calcutta, West Bengal a significantly higher ($p<0.05$) prevalence of malnutrition was observed among partially immunized and non-immunized children (81.25% and 88.23% respectively) in comparison to fully immunized children (62.07%).

Housing conditions and PEM

Housing conditions revealed that prevalence of PEM is more among semi puccka house (73.0%), in adequate ventilation (73.8%), overcrowding (77.2%) and solid fuel user (74.0%). Some other studies [18, 19] revealed that malnutrition is linked to the type of house (especially in urban areas), type of toilet in the home, fuel used in cooking, presence of refrigerator or stove and television and the educational level of the parents. When paraffin is used as fuel instead of electricity, it can lead to a higher risk for and Jeyaseelan and Lakshman (1997) found that using dung or firewood as fuel were risks for developing malnutrition [20]. The possession of a flush toilet in the house has a positive effect on height [21].

Conclusion

Still a higher prevalence of protein energy malnutrition is observed in urban slums areas of guntur, worse during the weaning age of the child and low socioeconomic status, and is significantly affected by age of mother at marriage, mother's education, birth order of child, child rearing practices like giving colostrum, exclusive breast feeding, immunisation status of child, and history of ARI and Diarrhoea during past one year, and with the improvement in these socio-demographic factors, improvement in the nutritional state of the child is expected. Government of India launched a welfare programme of integrated child development scheme, which provides preschool education, food, and primary healthcare to children under five years of age and their mothers. Another welfare programme, Mid-Day Meal Scheme, was launched to improve the nutritional status of children in classes one through five in government schools. These kind of welfare schemes helps to improve the nutritional level especially for the valuable group of under-five children.

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