

EPIDEMIOLOGY, PREVALENCE AND INCIDENCE OF PEM

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ABSTRACT

Protein Energy Malnutrition (PEM) in children is a leading public health problem in developing countries like India and is a direct or indirect cause of most of infant and child morbidity and mortality. It is a varied range of closely related pathological conditions arising from lack of proteins and calories. This affects the child at the most crucial period of time of development, which can lead to permanent impairment in later life. PEM is a critical problem with many determinants playing a role in causing this vicious cycle of undernutrition. Malnutrition is the outcome of many factors that include physical, social and cultural factors. All forms of PEM are associated with increased risk of infectious illnesses and cognitive deficit. In present study a survey of PEM cases with reference to their age, sex, socioeconomic status, complications and mortality has been carried out. It was observed that malnutrition was highly prevalent in lower socioeconomic groups. Maximum cases of malnutrition were seen below 3 years of age. Males predominated females in all the age groups. More children suffer from the burden of PEM. Risk factors like age, sex, socioeconomic status contribute greatly to develop PEM.

Keywords: Protein energy malnutrition, Undernutrition, Kwashiorkor, Marasmic-kwashiorkor, Marasmus

INTRODUCTION

Malnutrition is the most serious human health and social problem that affects vast areas of the world, being much more prevalent and endemic in developing and underdeveloped countries. According to World Health Organization, protein energy malnutrition (PEM) refers to “an imbalance between the supply of protein and energy and the body's demand for them to ensure optimal growth and function”. Malnutrition is a complex syndrome where several nutrient deficiencies exist simultaneously. It affects particularly the preschool children (<6 years) with its dire consequences ranging from physical to cognitive growth and susceptibility to infection. Undernutrition makes the child susceptible to infection and complements its effect in contributing to child mortality. This paper describes the various determinants of PEM in children and their interrelation in causation of PEM.

OBJECT

Present study is undertaken to make a survey of cases of PEM with reference to their age, sex, socioeconomic status, complications and mortality.

REVIEW OF LITERATURE

Protein-energy malnutrition (PEM) is a common childhood disorder and is primarily caused by deficiency of energy, protein, and micronutrients (Tahmeed Ahmed et al). The disorder has mild, moderate, and severe degrees. PEM is fairly common worldwide in both children and adults and accounts for about 250 000 deaths annually.

A study to assess the prevalence of protein energy malnutrition (PEM) in 1 – 5 yrs of age and factors associated with it was carried out by Ehtisham Ahmad et al. (2011). They found that overall prevalence of PEM was 56.4% in study population, with higher prevalence in female (58.6%) as compared to males (54.2%). Significant relationship was seen between PEM and sex, social class, caste, literacy status of parents and mother.

Olaf Muller (2003) carried out a study on the association between protein–energy malnutrition, malaria morbidity and all-cause mortality in West African children. They found that there was no association between PEM and malaria morbidity, but malnourished children had a more than two-fold higher risk of dying than non-malnourished children. Both malaria and protein–energy malnutrition (PEM) are highly prevalent in young children of sub-Saharan Africa. Our results confirm PEM being a major risk factor for all-cause mortality in West African children but provide no evidence for PEM being associated with malaria morbidity.

Similar to our study McGregor 1988 and Shankar 2000 reported that PEM is associated with increased malaria and morbidity.

Ubesie, Agozie C (2012) observed that a large percentage of children that suffer from PEM also have other co-morbid conditions. The most common co-morbidities are diarrhea (72.2% of a sample of 66 subjects) and malaria (43.3%). However, a variety of other conditions have been observed with PEM, including sepsis, severe anaemia, bronchopneumonia, HIV, tuberculosis, scabies, chronic suppurative otitis media, rickets, and keratomalacia. These co-morbidities tax already malnourished children and may prolong hospital stays initially for PEM and may increase the likelihood of death.

Simon S Rabinowitz et al, (2021) found that although protein energy malnutrition is more common in low-income countries, children from higher-income countries are also affected, including children from large urban areas in low socioeconomic neighbourhoods. This may also occur in children with chronic diseases, and children who are institutionalized or

hospitalized for a different diagnosis. Risk factors include a primary diagnosis of intellectual disability, cystic fibrosis, malignancy, cardiovascular disease, end stage renal disease, oncologic disease, genetic disease, neurological disease, multiple diagnoses, or prolonged hospitalization. In these conditions, the challenging nutritional management may get overlooked and underestimated, resulting in an impairment of the chances for recovery and the worsening of the situation.

HBPE Gernaat et al (2022) concluded that protein-energy malnutrition or PEM is the condition of lack of energy due to the deficiency of all the macronutrients and many micronutrients. It can occur suddenly or gradually. It can be graded as mild, moderate or severe. In developing countries, it affects children who are not provided with calories and proteins.

Khor GL et al (2011) found that approximately 70% the worlds malnourished children live in Asia , resulting in the region having the highest conc. of Childhood malnutrition.

Ron Thomas Varghese (2009) observed that prevalence of Protein Energy Malnutrition (PEM) was 27.5 % as classified by the Indian Academy of Pediatrics (IAP), 48 % of subjects were found to be stunted. 50 % had wasting and 13 % were overweight. Boys were more likely to develop PEM (O.R=2.9), stunting (O.R=1.9) and wasting (O.R=2.2). Girls were more likely to be overweight/obese (O.R= 2.00). Those classified ‘Below Poverty Line’ (BPL) were less likely to develop PEM (O.R= 0.3), stunting (O.R=0.4) or wasting (O.R=0.8). Those ‘Above Poverty Line’ (APL) were more likely to be overweight (O.R=1.60).

Tanu Midhal et al (2018) carried out a study on prevalence and determinants of protein energy malnutrition among under five children in slums of Kannauj district. They found that the prevalence of PEM in the study population was found to be 59.1%. The study revealed a significant association of age (OR=0.438), timing initiation of breast feeding (OR=0.682), colostrum feeding (OR=0.364), practice of breast feeding (OR=3.611) and initiation of complementary feeding at 6 months (OR=2.651) were significantly associated with PEM.

Mohammed Ahmed A Ahmad et al(2021) concluded that Protein Energy Malnutrition in children of Gadarif Sudan is due to low socioeconomic status, illiteracy and large family size.

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Zafar Iqbal Bhatti et al (2021) carried out a study on the prevalence and determinants of Protein Energy Malnutrition (PEM) among children under five years of age in rural communities of Lahore, Pakistan. They concluded that risk factors like age, sex, type of family, number of siblings, mother’s literacy, father’s educational level, socioeconomic status, Knowledge of mother regarding diet, housing condition contribute greatly to develop PEM. There is a need to take measures to prevent the nation from this suffering. Steps must be taken to implement polices to prevent PEM. Government should launch educational interventions on large scale to alleviate this suffering. Health professional must pay special attention to this debilitating issue.

METHODOLOGY

Present study was conducted on 350 cases of Protein Energy Malnutrition (PEM) attending the outpatient department (OPD) of paediatrics and wards of S.V.B.P. Hospital, attached to L.L.R.M. Medical College, Meerut. 70 normal healthy children were included in this study to serve as controls.

RESULTS

Distribution of PEM cases into different study groups

| Weight(% of 50 th percentile of standard weight) | With or Without Oedema | Total No. of Cases | Percentage |
|---|--|--------------------|------------|
| Control Group | | 70 | |
| Study Group 80-60% | Without Oedema | 60 | 17.14 |
| | Undernutrition With Oedema Kwashiorkor | 23 | 6.57 |
| Less than 60% | With Oedema | 43 | 12.29 |
| | Marasmic kwashiorkor Without Oedema Marasmus | 224 | 64.00 |

| | | |
|-------|-----|--------|
| Total | 350 | 100.00 |
|-------|-----|--------|

On the basis of Wellcome Trust Classification (1970) of protein energy malnutrition, total 350 PEM cases studied were distributed in four groups-

- (a) Undernutrition (n=60; 17.14%)
- (b) Kwashiorkor (n=23; 6.57%)
- (c) Marasmic kwashiorkor (n=43; 12.29%)
- (d) Marasmus (n=224; 64.0%)

Socioeconomic Distribution of PEM cases

| Socioeconomic Classes | Income (In Rs.) per Annum | No. of PEM Cases | Percentage |
|-----------------------|---------------------------|------------------|------------|
| I | 48,000 | 16 | 4.6 |
| II | 30,000 | 54 | 15.4 |
| III | 18,000 | 132 | 37.7 |
| IV | 6,000 | 148 | 42.3 |
| Total | | 350 | 100.00 |

PEM cases were distributed in four classes according to income per annum. Maximum 42.3 % cases were observed in class IV with income of < Rs. 6,000 per annum followed by 37.7% cases in class III with income of < Rs. 18,000 per annum than 15.4% cases in class II with income < Rs. 30,000 per annum and only 4.6% cases in class I with income < Rs. 48,000 per annum.

Distribution of control cases according to Age and Sex

| Age Group (years) | M ale | | Female | | Total | |
|-------------------|-------------|-------|-------------|-------|-------------|--------|
| | No.of cases | %age | No.of cases | %age | No.of cases | %age |
| 0.5-1.0 | 6 | 12.24 | 2 | 9.52 | 8 | 11.43 |
| 1.0-1.5 | 13 | 26.53 | 6 | 28.57 | 19 | 27.14 |
| 1.5-3.0 | 7 | 14.29 | 6 | 28.57 | 13 | 18.57 |
| 3.0-6.0 | 6 | 12.24 | 3 | 14.29 | 9 | 12.86 |
| 6.0-9.0 | 11 | 22.45 | 3 | 14.29 | 14 | 20.00 |
| 9.0-12.0 | 6 | 12.24 | 1 | 4.76 | 7 | 10.00 |
| Total | 49 | 70.00 | 21 | 30.00 | 70 | 100.00 |
| Sex Ratio | 2.33:1 | | | | | |

In control group maximum 19 (27.14%) cases were observed in 1.0-1.5 year age group followed by 14(20.00%) cases in 6.0-9.0 year age group. Out of 70 controls 49 cases were male and 21 cases were female. So male female sex ratio was 2.33;1 in control group.

Distribution of PEM cases according to Age and Sex

| Age Group (years) | M ale | | Female | | Total | |
|-------------------|-------------|-------|--------------|-------|--------------|-------|
| | No.of cases | %age | No. of cases | %age | No. of cases | %age |
| 0.5-1.0 | 52 | 21.05 | 27 | 26.21 | 79 | 22.57 |
| 1.0-1.5 | 78 | 31.58 | 22 | 21.36 | 100 | 28.57 |
| 1.5-3.0 | 67 | 27.13 | 26 | 25.24 | 93 | 26.57 |
| 3.0-6.0 | 19 | 7.69 | 12 | 11.65 | 31 | 8.86 |
| 6.0-9.0 | 23 | 9.31 | 11 | 10.68 | 34 | 9.71 |
| 9.0-12.0 | 8 | 3.24 | 5 | 4.86 | 13 | 3.71 |
| Total | 247 | 70.57 | 103 | 29.43 | 350 | 100.0 |
| Sex Ratio | 2.40:1 | | | | | |

Maximum 100 (28.57%) PEM cases were observed in 1.0-1.5 year age group followed by 93 (26.57%) PEM cases in 1.5-3.0 year age group. All 23 cases of kwashiorkor group were below 6 years of age. Out of 350 PEM cases 247 (70.57%) were male and 103 (29.43%) were female. So male:female ratio was 2.40:1 in PEM cases.

Distribution of PEM Cases according to Complications, Recovery and Mortality

| Study Groups (No. of Cases) | Uncomplicated Recovered | | Complicated Recovered | | Expired | |
|-----------------------------|-------------------------|-------|-----------------------|-------|----------------|------|
| | (No. of Cases) | %age | (No. of Cases) | %age | (No. of Cases) | %age |
| Undernutrition | 50 | 83.33 | 9 | 15.00 | 1 | 1.67 |

| | | | | | | |
|---------------------------|-----|-------|----|-------|----|-------|
| (60) | | | | | | |
| Kwashiorkor (23) | 9 | 39.13 | 6 | 26.09 | 8 | 34.78 |
| Marasmic kwashiorkor (43) | 20 | 46.51 | 13 | 30.23 | 10 | 23.26 |
| Marasmus (224) | 167 | 74.55 | 39 | 17.41 | 18 | 8.04 |
| Total (350) | 246 | 70.28 | 67 | 19.14 | 37 | 10.57 |

Out of 350 PEM cases, 246(70.28%) cases were uncomplicated and recovered fully, 67 (19.14%) cases revealed different complications and responded slowly to the treatment but recovered and only 37(10.57%) cases expired despite of appropriate therapy and management. Main complications observed in PEM cases were marked hepatomegaly, infections especially of lower respiratory tract fluid, electrolyte imbalance due to diarrhoea and severe dermatosis.

Incidence of Mortality in Follow up Study

| Study Groups | Day 0 | | Day 7 th | | Day 15 th | | Day 30 th | | Day 45 th | | Total Mortality | |
|----------------------|--------------|---|---------------------|------|----------------------|------|----------------------|------|----------------------|------|-----------------|-------|
| | No. of cases | % | No. of cases | % | No. of cases | % | No. of cases | % | No. of cases | % | No. of cases | % |
| Undernutrition | | | 1 | 0.29 | | | | | | | 1 | 0.29 |
| Kwashiorkor | | | | | 1 | 0.29 | 7 | 2.00 | | | 8 | 2.29 |
| Marasmic kwashiorkor | | | | | 3 | 0.86 | 4 | 1.14 | 3 | 0.86 | 10 | 2.86 |
| Marasmus | | | | | 5 | 1.43 | 8 | 2.29 | 5 | 1.43 | 18 | 5.14 |
| Total (350) | | | 1 | 0.29 | 9 | 2.57 | 19 | 5.43 | 8 | 2.29 | 37 | 10.57 |

Out of 350 PEM cases, 37(10.57%) cases expired because of various complications. Maximum 18 (5.14%) cases expired in Marasmus group followed by 10 (2.86%) cases in Marasmic kwashiorkor, 8 (2.29%) cases in kwashiorkor and only 1 (0.29%) case in Undernutrition group.

Frequency of various Symptoms and Signs in PEM study groups

| Symptoms | Under-nutrition | | Kwashiorkor | | Marasmic kwashiorkor | | Marasmus | | Total | |
|----------------------|-----------------|-------|--------------|-------|----------------------|-------|--------------|-------|--------------|-------|
| | No. of cases | %age | No. of cases | %age | No. of cases | %age | No. of cases | %age | No. of cases | %age |
| Oedema | | | 23 | 100.0 | 43 | 100.0 | | | 66 | 18.86 |
| Retarded growth | 26 | 43.33 | 23 | 100.0 | 43 | 100.0 | 224 | 100.0 | 316 | 90.28 |
| Abdominal distension | 4 | 6.67 | 5 | 21.74 | 9 | 20.93 | 84 | 37.50 | 102 | 29.14 |
| Ocular symptoms | 13 | 21.67 | 9 | 39.13 | 30 | 69.77 | 157 | 70.09 | 209 | 59.71 |
| Fever | 17 | 28.33 | 18 | 78.26 | 34 | 79.07 | 194 | 86.61 | 263 | 75.14 |
| Diarrhoea | 39 | 65.00 | 18 | 78.26 | 35 | 81.39 | 107 | 47.77 | 199 | 56.86 |
| Cough | 36 | 60.00 | 9 | 39.13 | 26 | 60.47 | 113 | 50.45 | 184 | 52.57 |
| Vomiting | 13 | 21.67 | 10 | 43.48 | 17 | 39.53 | 145 | 64.73 | 185 | 52.86 |
| Anorexia | 18 | 30.00 | 19 | 82.61 | 13 | 30.23 | 41 | 18.30 | 91 | 26.00 |
| Irritability | 8 | 13.33 | 13 | 56.52 | 39 | 90.70 | 185 | 82.59 | 245 | 70.00 |
| Total | 60 | 17.14 | 23 | 6.57 | 43 | 12.29 | 224 | 64.00 | 350 | 100.0 |

Various symptoms in PEM cases revealed retarded growth in 90.28% cases, Fever in 75.14% cases, irritability in 70% cases, ocular symptoms in 59.71% cases, diarrhoea in 56.86% cases, vomiting in 52.86% cases and cough in 52.57 % cases.

Frequency of various Physical Signs in PEM study groups

| Physical Signs | Under-nutrition | Kwashiorkor | Marasmic kwashiorkor | Marasmus | Total |
|----------------|-----------------|-------------|----------------------|----------|-------|
| | | | | | |

| | No. of cases | %age |
|-------------------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|--------------|-------|
| Hepatomegaly | 5 | 8.33 | 20 | 86.96 | 29 | 67.44 | 67 | 29.91 | 121 | 34.57 |
| Splenomegaly | 5 | 8.33 | 8 | 34.78 | 13 | 30.23 | 56 | 25.00 | 82 | 23.43 |
| Lymphadeno pathy | 17 | 28.33 | 14 | 60.87 | 25 | 58.14 | 127 | 56.69 | 183 | 52.28 |
| Hypovitaminosis A | 23 | 38.33 | 13 | 56.52 | 30 | 69.76 | 123 | 54.91 | 189 | 54.00 |
| Dehydration | 3 | 5.00 | 13 | 56.52 | 14 | 32.56 | 105 | 46.87 | 135 | 38.57 |
| Hair changes | 29 | 48.33 | 23 | 100.0 | 43 | 100.0 | 133 | 59.38 | 228 | 65.14 |
| Skin changes | 13 | 21.67 | 19 | 82.61 | 43 | 100.0 | 62 | 27.68 | 137 | 39.14 |
| Pallor | 26 | 43.33 | 17 | 73.91 | 37 | 86.05 | 167 | 74.55 | 247 | 70.57 |
| Total | 60 | 17.14 | 23 | 6.57 | 43 | 12.29 | 224 | 64.00 | 350 | 100.0 |

DISCUSSION

Protein energy malnutrition (PEM) is a major public health problem in India. Malnutrition is usually a composite syndrome of multiple nutrient deficiencies. These nutritional deficiencies may be varied with co-existing mineral and vitamin deficiencies. The effects of malnutrition and infection on children are synergistic and their combined effect on child mortality can be devastating. Factors such as lack of health education illiteracy poor sanitation contaminated food % water and overcrowding are important in worsening the situation.

HBPE Gernaat et al (2000) concluded that protein-energy malnutrition or PEM is the condition of lack of energy due to the deficiency of all the macronutrients and many micronutrients. It can occur suddenly or gradually. It can be graded as mild, moderate or severe. In developing countries, it affects children who are not provided with calories and proteins.

In present study maximum 28.57% PEM cases were observed in (1.0-1.5) year age group followed by 26.57% PEM cases in (1.5-3.0) year age group. Our findings are similar to those of Narkhede Vinod et al (2011) with maximum PEM cases in 13-24 months. A study by Srivastava Anurag et al from Bareilly also supports our result.

In our study, 59.1% subjects had PEM, which is almost similar to the findings (46.06%) of Mittal A et al (2007) in a study from Patiala and of Chaturvedi Manish et al (2006) from Agra who reported a prevalence of PEM of 53.2% among children. Khor GL et al found that approximately 70% the world's malnourished children live in Asia, resulting in the region having the highest conc. of Childhood malnutrition. Ehtisham Ahmad et al (2011) found that overall prevalence of PEM was 56.4% in study population.

In present study Males predominated females in all the age groups. Male:Female sex ratio was 2.40:1 in PEM cases. Similar to our study Olaf Müller (2003) observed that the percentage of malnutrition was more in male children (61.7%) as compared to female children (56.4%). Contrary to our study Ehtisham Ahmad et al (2011) found higher prevalence of PEM in female (58.6%) as compared to males (54.2%). Significant relationship was seen between PEM and sex, social class, caste, literacy status of parents and mother.

In present study maximum cases of malnutrition were found below 3 years of age. Zafar Iqbal Bhatti et al also found prevalence of PEM to be 52.8% in children under five years of age.

In present study malnutrition was highly prevalent in lower socioeconomic groups (42.3%). Mohammed Ahmed A Ahmed et al (2021) also concluded that Protein Energy Malnutrition in Children of Gadarif Sudan is due to low socioeconomic status, illiteracy and large family size. Tanu Midha (2018) observed that the reason for malnutrition being more prevalent among lower socioeconomic groups may be due to unavailability of food, insufficient purchasing power, inappropriate distribution and inadequate utilization which might make the children vulnerable to malnutrition in a deprived community.

In present study out of 350 PEM cases, 37(10.57%) cases expired because of various complications. Sriram Gonakoti et al (2021) concluded that PEM is an independent mortality predictor for those with bacterial pneumonia, with an increased risk of systemic complications as well.

PEM has been associated with a number of impairments in the immune response. Caryn Gee Morse (2015) and Tahmeed Ahmed et al (2020) also found that all forms of PEM are associated with increased risk of infectious illnesses and cognitive deficit. Ubesie, Agozie C (2012) found that a large percentage of children that suffer from PEM also have other co-morbid conditions. The most common co-morbidities are diarrhoea (72.2% of a sample of 66 subjects) and malaria (43.3%). However, a variety of other conditions have been observed with PEM, including sepsis, severe anaemia, bronchopneumonia, HIV, tuberculosis, scabies, rickets and keratomalacia. Kharisma et al (2022) in their study on the Nutritional Status and Severity of

Pneumonia among Inpatient of Children Under Five Years found that there is a relationship between nutritional status and pneumonia severity.

CONCLUSION

A survey of PEM cases with reference to their age, sex, socioeconomic status complications and mortality was carried out. It was observed that malnutrition was highly prevalent in lower socioeconomic groups. It was due to poverty among rural population. The PEM cases studied belonged to 6 months to 12 years of age. Maximum cases of malnutrition were seen below 3 years of age. Males predominated females in all the age groups. More children suffer from the burden of PEM. Risk factors like age, sex, socioeconomic status contribute greatly to develop PEM. There is a need to take measures to prevent the nation from this suffering. Steps must be taken to implement policies to prevent PEM. Government should launch educational interventions on large scale to alleviate this suffering.

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