INTRODUCTION
Protein Energy Malnutrition (PEM) is one of the most common nutritional problems of developing countries of the world and an important cause of childhood mortality and morbidity leading to permanent impairment of physical and mental growth.\(^1,2\) It is estimated that PEM is the primary or associated cause of nearly half of the deaths in children under the age of 5 years. India is home to nearly one-third of the world’s malnourished children.\(^3,5\) As per National family health survey 3 (NFHS-3) report prevalence of underweight, stunting and wasting in India is 43%, 48% and 20% respectively.\(^5\) So planning for the prevention and strategies for the treatment of PEM are becoming key issue for all countries to aid in reduction of child mortality and other diseases.\(^3,6,7\) The World Health Organization (WHO) defines malnutrition as “The cellular imbalance between the supply of nutrients and energy, and the body’s demand for them to ensure growth, maintenance, and specific functions.” The term protein-energy malnutrition applies to a group of related disorders that include Marasmus, kwashiorkor, and intermediate states of marasmic-kwashiorkor. Marasmus is characterized by gross wasting of muscles and subcutaneous tissues resulting in emaciation, while kwashiorkor is characterized by retarded growth, psychomotor changes and edema.\(^8\) PEM initially leads to failure in maintaining adequate weight gain and growth rate in early stages, as the condition progresses there is loss of weight associated with loss of subcutaneous tissue and muscle mass. PEM affects every organ system, as PEM progresses organ dysfunction develops and leads to variety of clinical features; several metabolic derangements are expected. Hepatic synthesis of serum proteins decreases and depressed levels of circulating proteins are observed. With increasing severity there is increasing failure in the homeostatic mechanism of the body and it damages the immune defence, which may result in infection and death.\(^6,9\) Zinc is essential nutrients for human beings as it required for the

**Keywords:** Protein Energy Malnutrition (PEM), Serum Zinc.
Influence of protein energy malnutrition on level of functional activity of several enzyme systems. Trace element deficiencies are common in children with protein energy malnutrition and, as a result, they may suffer from various nutrient-specific deficiency disorders. Clinical features of zinc deficiency like poor appetite, growth failure, skin lesions, diarrhea, poor wound healing and impaired immune response are also observed in children with severe PEM. Inadequate zinc intake may limit the growth of these children during recovery from malnutrition. Zinc exerts a beneficial influence on host defence mechanisms, a finding that has important implications for the management of malnourished children.

**MATERIALS AND METHODS**

The present study is a Cross-sectional study, consisted children of age group 1-5 years selected from civil hospital and BJ Medical College, Ahmedabad, Gujarat. Study is conducted during the period of January 2014 to December 2014. Fifty children with PEM were included in the study as cases (PEM group) and equal number of age and sex matched healthy children formed the control group. Children with protein energy malnutrition as per IAP classification of PEM (which is based on weight for age) i.e. whose weight for age was less than 80% of expected for age constituted cases (PEM group) they were further subdivided into Grade I-IV as per IAP classification of PEM. Children whose weight was more than 80% of expected weight formed control group. 2ml of blood collected with clot activator vacutate and samples are transported to the laboratory at 2-8°C within half an hour. Serum was removed from the clot within 2 hours of draw. If testing was delayed for more than 24 hours, serum specimens are stored at 2-8°C and analyzed next day (Ueland PM 1993). All samples were immediately subjected to assay Serum zinc after thawing at 37°C on an Erba XL 640 Fully Automated Analyzer by kits of crest biosystems, a division of coral clinical systems. Numerical variables were reported in terms of mean and standard deviation. Comparison between two groups is made. Analysis was carried out using graphpad prism version 3.03 statistical software.

**RESULT**

Table -1 and figure- 1 shows the results of serum Zinc expressed as mean±standard deviation. Serum Zinc level shows significant decrease in case group as compare to normal healthy control group (p<0.001).

**Table-1: Comparison of S. Zinc levels between case & control group:**

<table>
<thead>
<tr>
<th>Group</th>
<th>S. Zinc (case)</th>
<th>S. Zinc (control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>57.50</td>
<td>96.76</td>
</tr>
<tr>
<td>Standard Deviation (SD)</td>
<td>22.25</td>
<td>37.38</td>
</tr>
<tr>
<td>Sample Size</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Std. error of Mean (SEM)</td>
<td>3.14</td>
<td>5.28</td>
</tr>
<tr>
<td>Minimum</td>
<td>22.2</td>
<td>29.5</td>
</tr>
<tr>
<td>Maximum</td>
<td>115.2</td>
<td>160.2</td>
</tr>
</tbody>
</table>

**Figure 1:** Comparison of mean ± SD of serum Zinc in Case & control group:

**DISCUSSION**

Protein energy malnutrition continues to be a major problem throughout the developing world. In India almost half of children under the age of 5 years are suffering from various grades of PEM. As already stated PEM leads to failure in homeostatic mechanism of the body leading to increased susceptibility of an individual to infections. Globally, nearly half of under-five deaths are attributed to PEM either as direct/ indirect cause. Present study was undertaken to know the status of Serum zinc level in children with PEM. In the present study 50 children of age group 12-60 months with PEM were enrolled as cases, equal number of healthy children formed the control wing. Majority of children enrolled were in the age group 12-18 months (36% in cases and 38% in controls). Higher prevalence of PEM in this age group explains the importance of the need for continued breast feeding and appropriate introduction of complementary feeds. Both cases and control group were age and sex matched.
Influence of protein energy malnutrition on level

Table 2: Comparison of serum Zinc levels (Mean ±SD):

<table>
<thead>
<tr>
<th>Groups</th>
<th>Present study (n=50)</th>
<th>Singla, P.N., et al.10(n=90)</th>
<th>MN Ashour et al.14(n=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc (mg/dl)</td>
<td>57.50±22.25</td>
<td>102.85 ± 19.45</td>
<td>92.76 ± 14.67</td>
</tr>
<tr>
<td>Cases</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Control</td>
<td>96.76±37.38</td>
<td>128.5 ± 18.32</td>
<td>121.09 ± 13.56</td>
</tr>
</tbody>
</table>

*p<0.05, ***p<0.001

Results of the present study correlate with studies conducted by MN Ashour et al.14 and Singla, P.N., et al.10 they found that serum zinc levels were significantly lower in the PEM than the control group (P < 0.001). The children with severe PEM had significantly low levels of serum zinc.

CONCLUSION

The following conclusions can be drawn from this study: PEM children have low serum Zinc levels as compared to healthy controls (p<0.001). The reasons for zinc deficiency in malnourished children are low dietary intake, poor bioavailability, mal-absorption, or increased losses due to diarrhoea. Since approximately 65% of plasma zinc is bound to albumin, hypo-albuminemia in severe PEM may contribute to low zinc levels.

REFERENCES