# NUTRITIONAL STATUS OF PRE-SCHOOLING CHILDREN OF DIFFERENT SOCIO-ECONOMIC STATUSES AS INFLUENCED BY VARIOUS DISEASES

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*SUMMARY: The study was carried out on 100 children (85 malnourished and 15 apparently healthy) of pre-schooling age (0-4 years). The malnourished children were randomly selected from those admitted to Pediatrics wards of Allied and National Hospitals at Faisalabad (Punjab). The test patients were divided into four age groups (up to 12, 13-23, 24-35 and 36-48 months), three socio-economic statuses, i.e. lower class (maximum earning of Rs. 5000 per month), middle class (Rs. 5000 - 15000 per month) and upper class (minimum earning of Rs. 15000 per month), sex and on the basis of area of living, i.e. industrial or non-industrial. Parameters of study included anthropometrics (BMI, mid-arm circumference and percent weight). The obtained results revealed that diarrhoea, fever and malnutrition were the major complaints. Mid-arm circumference, percent of weight and body mass index were low in malnourished children. They were also low among malnourished children of 3rd degree. In each socio-economic status, age and sex groups, serum iron and copper were higher in malnourished children and in females than in males. Malnutrition was more prevalent in children of up to 12 months of age, in males, in children of low socio-economic status and of non-industrial area. Several types of milk were more frequently offered to males and breast-feeding was more often offered by uneducated and under-matriculate mothers.*

*Key Words: Nutritional status, pre-schooling children, socio-economic status, diseases.*

## INTRODUCTION

In the modern age, malnutrition remains as a devastating problem in certain parts of the world, although the proportion and absolute number of chronically under-nourished people have declined. Under-nutrition is the most serious form of malnutrition and is universal among the poor families and nations resulting from consumption of poor diet over long periods of time (1). A previous study (2) has shown that about 13 million infants and children less than five years of age die every year in developing countries and most of these deaths were attributed to under-nutrition.

Trace elements deficient patients usually show common symptoms such as malaise, loss of appetite, anaemia, infection, skin lesions and low-grade neuropathy (3). However, these data regarding serum levels of microelements, total proteins and their fractions (albumin, globulin) are lacking with reference to local healthy children and those suffering from diseases and resultant of

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malnutrition. Therefore, serum concentrations of iron, copper, zinc, total proteins and their fractions were determined and anthropometrical measurements were made in healthy pre-schooling (0-4 years) children and those suffering from some common diseases and belonging to different socio-economic statuses. In addition, relationship between the biochemical parameters and degree of malnutrition was also studied.

## MATERIALS AND METHODS

This study was conducted on children admitted to Pediatrics wards of Allied and National Hospitals of Faisalabad. Children, included in the study, were suffering from some common diseases and had developed signs of malnutrition. Serum samples were obtained from these patients and analyzed for various biochemical parameters in the laboratory of Department of Rural Home Economics and High-Tech Laboratory, University of Agriculture, Faisalabad.

Totally 100 children of 0-4 years of age were randomly selected for the study. Of these, 85 were suffering from some common diseases including diarrhoea, pneumonia, jaundice and gastroenteritis, while 15 apparently healthy children were also included. Histories of these children were recorded by using a standard performa. These subjects were grouped according to their socio-economic status, age, sex and area of living i.e. industrial or non-industrial. Socio-economic status was established on the basis of the following criteria:

Lower class : Maximum earning of Rs. 5.000 per month,
Middle class : Earning of Rs. 5.000 to Rs. 15.000 per month,
Upper class : Earning of more than Rs. 15.000 per month.

The age groups were as follows:
Group I : up to 12 months,
Group II : 13-23 months,
Group III : 24-35 months,
Group IV : 36-48 months.

**Blood sample collection**

Blood samples of about 3 ml were collected from these children with the help of a disposable syringe. They were allowed to clot and centrifuged to obtain the serum and stored at -20°C for further studies.

**Anthropometric measurements**

Height, body weight and mid-arm circumference were recorded by the standard methods. Percent weight of each child was calculated and degrees of malnutrition were determined by using the Gomez classification, as follows:

1st degree malnutrition: If weight was 75-90 percent of the target or expected weight.

2nd degree malnutrition: If weight was 60-75 percent of the target or expected weight.

3rd degree malnutrition: If weight was below 60 percent of the target or expected weight.

Body mass index of each child was also calculated by the following formula:

$$\frac{\text{Weight (kg)}}{(\text{Height})^2\ (\text{m})}$$

Mid-arm circumference was recorded in cm as mid point between shoulders and elbow joints.

**Biochemical analysis**

Serum total proteins were determined by the Biuret method described earlier (4). The calorimetric determination of total proteins was based on the formation of blue copper peptide complex in alkaline solution (the Biuret test). In this method, when proteins reacted with alkaline copper sulphate gave violet colour. Absorbance of the samples was read at 546 nm wavelength against Biuret reagent blank.

Serum albumin was determined by the following method described previously (5). The method is based on the formation of an albumin complex with bromocresol green dye. The absorbance of the test sample and the standard was read at 640 nm wave-

Table 1: Percent occurrence of degree of malnutrition in children of various groups.

| | Malnutrition degree | | |
|---|---|---|---|
| | 1st | 2nd | 3rd |
| **Age Groups** | | | |
| Up to 12 months | 50.0 | 34.5 | 46.5 |
| 13-23 months | 21.4 | 20.7 | 11.6 |
| 24-35 months | 14.3 | 27.6 | 20.9 |
| 36-48 months | 14.3 | 17.2 | 20.9 |
| Significant level | | | (p<0.01) |
| **Sex** | | | |
| Male | 78.6 | 62.1 | 58.1 |
| Female | 21.4 | 37.9 | 41.9 |
| **Socio-economic status** | | | |
| Low | | 82.8 | 81.4 |
| Middle | 71.4 | 13.8 | 18.6 |
| High | 28.6 | 3.4 | - |
| Significant level | | (p<0.001) | (p<0.001) |
| **Place of living** | | | |
| Village | 14.3 | 37.9 | 37.2 |
| City | 7.1 | - | 60.5 |
| Town | 78.6 | 41.4 | 2.3 |
| Significant level | (p<0.01) | (p<0.001) | (p<0.001) |
| **Area of living** | | | |
| Industrial | 35.7 | 17.2 | 18.6 |
| Non-industrial | 64.3 | 82.8 | 81.4 |
| Significant level | | (p<0.001) | (p<0.001) |

Table 2: Percent occurrence of various diseases in children of three degrees of malnutrition.

| Diseases | Malnutrition degree | | |
|---|---|---|---|
| | 1st | 2nd | 3rd |
| Diarrhoea | 50.0 | 55.2 | 72.1 |
| Meningitis | 7.1 | - | 4.7 |
| Asthma | 7.1 | 3.4 | - |
| Mental retardation | 7.1 | - | - |
| Rickets | 7.1 | 3.4 | - |
| Fever | 7.1 | - | 4.7 |
| Malnutrition | 7.1 | 10.3 | 2.3 |
| Fits | 7.1 | 3.4 | - |
| Pyloric stenosis | - | 3.4 | - |
| Jaundice | - | 3.4 | - |
| Anaemia | - | 3.4 | - |
| Ciliac disease | - | 3.4 | - |
| Paralysis | - | 3.4 | 2.3 |
| Tuberculosis | - | - | 9.3 |
| Enteric Fever | - | - | 2.3 |
| Hernia | - | - | 2.3 |
| Significance level | (p<0.001) | (p<0.001) | (p<0.001) |

Table 3: Percent occurrence of type of feeding to children of various groups.

| | Fed one | | | | |
|---|---|---|---|---|---|
| | Breast | Mixed | Formula | Fresh | Solid |
| **Sex** | | | | | |
| Male | 60.0 | 71.4 | 63.6 | 70.60 | 46.4 |
| Female | 40.0 | 28.6 | 63.4 | 20.4 | 53.6 |
| **Education of mother** | | | | | |
| Uneducated | 45.0 | 64.3 | 63.6 | 58.8 | 64.3 |
| Undermatric | 45.0 | 21.4 | 18.2 | 35.3 | 25.0 |
| Matric | 10.0 | 7.1 | 9.1 | 5.9 | 7.1 |
| Undergraduate | - | 7.1 | 9.1 | - | 3.6 |
| **Socio-economic status** | | | | | |
| Low | 75.0 | 64.7 | 72.7 | 88.2 | 82.1 |
| Middle | 20.0 | 35.7 | 27.3 | 11.8 | 14.3 |
| High | 5.0 | - | - | - | 3.6 |
| **Age groups** | | | | | |
| Up to 12 | 70.0 | 57.1 | 54.5 | 41.2 | 7.1 |
| 13-23 | 15.0 | 14.3 | 27.3 | 17.6 | 14.3 |
| 24-35 | 10.0 | 21.4 | 18.2 | 23.5 | 28.6 |
| 36-48 | 5.0 | 7.1 | - | 17.6 | 50.0 |
| Significant level | (p<0.001) | (p<0.05) | | | (p<0.01) |

length against the reagent blank. Serum globulin was estimated by subtracting albumin from total proteins.

**Microelements determinations**

Serum zinc was determined by flame photometric method. Serum copper was determined by using atomic absorption spectrophotometer at 324.8 nm while serum iron was determined by using atomic absorption spectrophotometer at 24.3 nm (6).

## RESULTS

**Percentage occurrence of malnutrition**

Analysis of the data revealed that significantly ($p<0.05$) higher proportion of the children in 3rd degree of malnutrition were up to 12 months of age (Table 1) but in 1st and 2nd degrees of malnutrition the difference was non-significant ($p>0.05$). First degree of malnutrition was proportionally higher in males and was so in 2nd degree but with lesser difference. However, proportion of male to female was relatively close in 3rd degree of malnutrition. Also significantly ($p<0.01$) higher malnourished children were of low socio-economic status in all the three degrees of malnutrition and children in 1st degree of malnutrition belonged to towns, while those in 2nd and 3rd degrees belonged to cities. In all degrees of malnutrition, significantly ($p<0.001$) higher proportion of children belonged to non-industrial area and to mothers uneducated (Table 1).

Diarrhoea was the major disease occurring in higher ($p<0.01$) proportion of children in all the three degrees of malnutrition. Fever and malnutrition were the second most prevalent diseases in the 2nd degree of malnutrition (Table 2).

The results of the present study indicated that the breast-feeding to male children was proportionally ($p<0.001$) higher than to female children. While fresh milk offering and mixed feeding were significantly higher for males than females. Solid food was relatively more frequently offered to females. Breast-feeding and fresh milk feeding were more frequently ($p<0.001$) practiced by mothers with no education or who were undermatric compared with higher levels of education, as well as by mothers of low socio-economic statuses. Present data have indicated that 70% of the children at the age of 12 months and below

Table 4: Means ± SD of mid-arm circumference, percent weight and body mass index of children of different ages in different degrees of malnutrition.

| Age groups | Degrees of malnutrition | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | Control |
| **Mid-arm circumference** | | | | |
| Up to 12 months | 13.00 ± 0.82Aba | 10.25 ± 0.98Bb | 10.50 ± 1.84b | 13.16 ± 0.29Ba |
| 13-23 months | 12.33 ± 0.58Bab | 12.83 ± 0.98Aab | 11.20 ± 1.75b | 14.25 ± 0.25Aa |
| 24-35 months | 13.50 ± 2.12ABab | 12.00 ± 1.41Aabc | 10.61 ± 1.19c | 14.67 ± 0.58Aa |
| 36-48 months | 14.50 ± 0.71Aa | 14.50 ± 0.71Aa | 12.70 ± 1.64Ab | 14.50 ± 0.50Aa |
| **Overall mean** | 13.14 ± 1.10b | 11.69 ± 1.61c | 10.49 ± 1.54d | 14.14 ± 0.74a |
| **Percent weight** | | | | |
| Up to 12 months | 77.71 ± 2.29b | 60.00 ± 6.41Bc | 52.60 ± 5.84d | 101.68 ± a |
| 13-23 months | 77.00 ± 2.87b | 65.83 ± 3.43Ac | 56.60 ± 3.36d | 104.50 ± 15.34a |
| 24-35 months | 81.00 ± 2.82b | 63.81 ± 3.89ABc | 53.72 ± 6.78d | 99.93 ± 3.90 |
| 36-48 months | 79.00 ± 1.41b | 66.40 ± 4.04Ac | 58.88 ± 6.13d | 96.56 ± 3.35a |
| **Overall mean** | 78.21 ± 2.22b | 63.36 ± 5.34c | 53.57 ± 5.83d | 100.32 ± 8.92a |
| **Body mass index** | | | | |
| Up to 12 months | 15.62 ± 2.56a | 13.39 ± 1.69b | 11.77 ± 1.66b | 17.33 ± 1.15a |
| 13-23 months | 19.07 ± 6.14a | 13.47 ± 0.63b | 11.87 ± 1.07b | 13.69 ± 0.94b |
| 24-35 months | 14.49 ± 0.53 | 17.87 ± 10.06 | 12.12 ± 1.88 | 15.06 ± 0.95 |
| 36-48 months | 15.89 ± 8.49 | 17.11 ± 6.76 | 12.72 ± 1.58 | 16.66 ± 2.66 |
| **Overall mean** | 15.87 ± 3.55a | 15.28 ± 6.11a | 12.05 ± 1.63b | 15.87 ± 2.10a |

Values with different small letters in row are significantly different ($p<0.05$).

Values with different capital letters in a column are significantly different ($p<0.05$).

were breast-fed while 15% of them were between 13-23 months of age and this percentage was lowered as the age of the child increased. A similar pattern was observed with milk feeding formula, while offering of solid food increased proportionally with the increase in age of the child (Table 3).

**Anthropometry**

Anthropometrical measurements of children recorded included mid-arm circumference, percent weight and body mass index. The results in different degrees of malnutrition with respect to age, sex, socio-economic status and residential area were recorded as follows:

*Age*

Malnourished children of 2nd and 3rd degrees up to 12 months of age were significantly ($p<0.05$) lower than healthy children. In 13-23 months of age group, malnourished children of 3rd degree were lower than healthy children. In the age group of 24-35 and 36-48 months, malnourished children of 3rd degree were significantly ($p<0.05$) lower than healthy children, while in the age group of 36-48 months the children of 2nd degree were significantly ($p<0.05$) lower than apparently healthy children. Among the children of up to 12 months were significantly higher than 2nd and 3rd degrees while 2nd age group showed significant difference. In 24-35 months of age, children were significantly ($p<0.05$) lower than 1st and 2nd degrees (Table 4).

Mid-arm circumference between age groups revealed significant ($p<0.05$) difference in 1st and 2nd degrees of malnutrition as well as in apparently healthy children. Percent weight showed significant ($p<0.05$) difference between malnourished and apparently healthy children, with lower values in malnourished children. Percent weight in each age group was significantly ($p<0.05$) different only in 2nd degree of malnutrition with lower values in up to 12 months of age than 13-23 and 36-48 months of age of children. Body mass index showed significant ($p<0.05$) difference between malnourished children and apparently

Table 5: Means ± SD of mid-arm circumference, percent weight and body mass index of children of different sex in different degrees of malnutrition.

| Sex | Degrees of malnutrition | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | Control |
| **Mid-arm circumference** | | | | |
| Male | 13.18 ± 0.98a | 11.92 ± 1.57b | 10.24 ± 1.72c | 13.90 ± 0.74a |
| Female | 13.00 ± 1.73a | 11.32 ± 1.68b | 10.83 ± 1.20b | 14.50 ± 0.41a |
| **Percent weight** | | | | |
| Male | 78.18 ± 2.36a | 63.86 ± 5.91b | 52.26 ± 5.88c | 100.20 ± 3.19a |
| Female | 78.33 ± 2.08b | 62.55 ± 4.39c | 55.39 ± 5.40d | 100.41 ± 6.79a |
| **Body mass index** | | | | |
| Male | 16.35 ± 3.85a | 16.24 ± 7.59a | 12.09 ± 1.62b | 16.31 ± 1.68a |
| Female | 14.08 ± 1.32ab | 13.71 ± 1.45ab | 11.99 ± 1.68b | 15.50 ± 3.19a |

healthy children in children of up to 12 months and 13-23 months of age. Moreover, body mass index showed non-significant difference between age groups in malnourished as well as in apparently healthy children (Table 4).

*Sex*

Non-significant difference of in mid-arm circumference was observed between male and female children in each degree of malnutrition as well as in apparently healthy children (Table 5). Non-significant difference was observed in percent weight between male and female children in each degree of malnutrition as well as in apparently healthy children. Similarly, non-significant difference in body mass index was observed between male and female children in each degree of malnutrition as well as in apparently healthy children (Table 5).

*Socio-economic status*

Mid-arm circumference showed non-significant difference between children of different socio-economic statuses in each malnourished degree as well as apparently healthy children (Table 6). Same was true for percent weight and body mass index (Table 6).

*Area of living*

Both in the industrial and non-industrial areas, non-significant difference of mid-arm circumference was observed between male and female children in each degree of malnutrition as well as in apparently healthy children (Table 7).

In children of industrial area, body mass index was significantly ($p<0.05$) lower in 3rd degree of malnutrition compared to apparently healthy children and 1st degree of malnutrition. While in children of non-industrial area it was significantly lower in 3rd degree of malnutrition than apparently healthy children and 2nd degree of malnutrition. Non-significant difference of body mass index was observed between male and female children in each degree of malnutrition as well as in apparently healthy children (Table 7).

**Trace Elements**

The results of these studies with respect to age, sex, socio-economic status and area of living are as follows:

*Age*

Copper showed significant ($p<0.05$) difference between malnourished and apparently healthy children with higher values in malnourished than apparently healthy children. Among malnourished children difference was also significant between three degrees of malnutrition with lower values in 3rd than 1st degree of malnutrition (Table 8). Significant difference was also observed between malnourished and apparently healthy children with higher values in malnourished children of each age group but difference between three degrees of malnutrition among malnourished children was non-significant. Copper also showed non-significant difference between age groups (Table 8).

Zinc showed non-significant difference between malnourished children of three degrees and apparently healthy children. Iron showed significant ($p<0.05$) difference between malnourished and apparently healthy chil-

Table 6: Means ± SD of mid arm circumference, percent weight and body mass index of children of different socio-economic status in different degrees of malnutrition.

| Socio-economic status | Degrees of malnutrition | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | Control |
| **Mid-arm circumference** | | | | |
| Low | 13.40 ± 1.17a | 11.88 ± 1.65b | 10.53 ± 1.40b | 14.27 ± 1.65a |
| Middle | 12.50 ± 0.58ab | 11.00 ± 1.41bc | 10.31 ± 1.79c | 14.25 ± 0.35a |
| High | | 10.00 ± 2.35b | | 14.50 ± 0.59a |
| **Percent weight** | | | | |
| Low | 78.70 ± 2.31b | 63.94 ± 3.94c | 53.24 ± 6.19d | 97.70 ± 3.25a |
| Middle | 77.00 ± 1.63b | 59.25 ± 10.94c | 55.00 ± 3.85c | 102.70 ± 8.92a |
| High | | 66.00 ± 14.56b | | 100.00 ± 25.36a |
| **Body mass index** | | | | |
| Low | 16.25 ± 4.17 | 15.58 ± 6.69 | 14.00 ± 1.57 | 14.00 ± 2.54 |
| Middle | 14.91 ± 0.72a | 13.89 ± 1.29ab | 12.01 ± 1.99b | 14.34 ± 3.30a |
| High | | 13.78 ± 1.35 | | 16.91 ± 2.15 |

dren with lower values in malnourished children. The difference was also significant between malnourished and apparently healthy children in each age group except the second age group. In age group I, iron values were higher in malnourished children than apparently healthy children. In group III, values were higher in malnourished children of 1st and 2nd degrees compared to apparently healthy children. In group IV, values were higher in children of 2nd degree of malnutrition than apparently healthy children. However, among malnourished children in each age group non-significant difference was observed between three degrees of malnutrition (Table 8).

*Sex*

Serum copper in male children revealed non-significant difference between malnourished and apparently healthy children. However, in female children the values were higher in malnourished compared to apparently healthy children. Among malnourished children of both sexes non-significant difference was observed between three degrees of malnutrition. Zinc levels showed non-significant difference in both sexes, between malnourished children of different degrees and apparently healthy children. Among malnourished children of both sexes, the difference was again non-significant between three degrees

Table 7: Means ± SD of mid-arm circumference, percent weight and body mass index of children of different areas in different degrees of malnutrition.

| Area | Degrees of malnutrition | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | Control |
| **Mid-arm circumference** | | | | |
| Industrial | 13.00 ± 1.00a | 12.10 ± 0.74ab | 11.13 ± 1.92b | 13.63 ± 1.00a? |
| Non-industrial | 13.22 ± 1.20b | 11.60 ± 1.74c | 10.34 ± 1.43d | 14.43 ± 0.41a |
| **Percent weight** | | | | |
| Industrial | 78.20 ± 1.30b | 66.40 ± 3.36c | 51.88 ± 6.56d | 100.25 ± 3.68a |
| Non-industrial | 78.22 ± 2.68b | 62.73 ± 5.50c | 53.96 ± 5.69d | 100.35 ± 6.79a |
| **Body mass index** | | | | |
| Industrial | 17.20 ± 5.11a | 13.16 ± 1.82bc | 11.65 ± 1.86c | 16.38 ± 1.93ab |
| Non-industrial | 15.13 ± 2.38ab | 15.72 ± 6.61a | 12.14 ± 1.58b | 15.50 ± 3.19a |

Values with different small letters in row are significantly different ($p<0.05$)

Table 8: Mean ± SD of copper, zinc and iron in children of different ages in different degrees of malnutrition.

| Age groups | Degrees of malnutrition | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | Control |
| **Copper** | | | | |
| Up to 12 months | 63.43 ± 15.90 a | 51.00 ± 16.11a | 46.00 ± 17.95a | 10.33 ± 3.51b |
| 13-23 months | 61.33 ± 29.28 a | 55.33 ± 19.87ab | 58.00 ± 35.21ab | 16.00 ± 6.54b |
| 24-35 months | 62.00 ± 25.45 a | 52.50 ± 19.73a | 47.33 ± 18.38a | 11.67 ± 3.51b |
| 36-48 months | 59.00 ± 9.90a | 47.20 ± 4.38a | 50.44 ± 24.16a | 8.00 ± 2.15b |
| **Overall mean** | 62.14 ± 17.57a | 51.65 ± 16.15ab | 48.61 ± 21.31 | 10.00 ± 3.59c |
| **Zinc** | | | | |
| Up to 12 months | 58.00 ± 12.33 | 53.00 ± 12.80 | 47.80 ± 8.97 | 47.33 ± 6.03 |
| 13-23 months | 42.66 ± 13.01 | 55.00 ± 18.32 | 44.00 ± 4.00 | 52.00 ± 23.10 |
| 24-35 months | 51.00 ± 9.90 | 46.00 ± 6.05 | 49.55 ± 15.84 | 50.33 ± 4.51 |
| 36-48 months | 48.00 ± 8.49 | 52.80 ± 12.69 | 47.55 ± 9.84 | 49.33 ± 11.32 |
| **Overall mean** | 52.29 ± 12.30 | 51.45 ± 12.53 | 47.67 ± 1072 | 50.00 ± 3.93 |
| **Iron** | | | | |
| Up to 12 months | 418.28 ± 217.14a | 422.20 ± 156.46a | 315.90 ± 17368a | 98.67 ± 9.87b |
| 13-23 months | 286.00 ± 89.42a | 353.00 ± 246.16 | 289.60 ± 82.48 | 18.00 ± 6.23 |
| 24-35 months | 306.00 ± 73.54a | 306.00 ± 88.03a | 271.55 ± 140.89ab | 106.33 ± 11.85b |
| 36-48 months | 285.00 ± 43.84ab | 356.00 ± 6258a | 256.66 ± 146.08ab | 80.00 ± 11.23b |
| **Overall mean** | 354.86 ± 167.14a | 364.41 ± 152.95a | 291.16 ± 150.89a | 64.50 ± 17.32b |

Values with different small letters in row are significantly different ($p<0.05$).

of malnutrition. Serum iron in males revealed non-significant difference between malnourished and apparently healthy children. However, in female children the values were higher in malnourished than apparently healthy children. Among malnourished children of both sexes non-significant difference was observed between three degrees of malnutrition (Table 9).

*Socio-economic status*

Serum copper showed significant ($p<0.05$) difference between malnourished and apparently healthy children of each socio-economic status with higher values in malnourished children. Serum zinc showed non-significant difference between malnourished and apparently healthy children as well as between different degrees of malnutrition among them. While serum iron showed significant ($p<0.05$) difference between malnourished children and apparently healthy children with higher values in malnourished children than apparently healthy children in low and high socio-economic statuses. In children of middle socio-economic status, the values were significantly higher in those suffering from 1st and 2nd degrees of malnutrition compared to apparently healthy children.

*Area of living*

Serum copper showed significant ($p<0.05$) difference between malnourished and apparently healthy children in each area of living, i.e., industrial and non-industrial with higher levels in malnourished children. Among malnourished children, significant difference was also observed in children of non-industrial area with higher values in children suffering from 1st degree than other degrees of malnutrition. Serum zinc, however, showed non-significant difference between malnourished children and apparently healthy children. Serum iron showed significant ($p<0.05$) difference between malnourished children and apparently healthy children in industrial and non-industrial areas with higher levels in malnourished children. Among malnourished children, difference was also significant in children of industrial area where the levels were higher in children suffering from 2nd than 3rd degree of malnutrition.

**Serum proteins**

Serum proteins including total proteins, albumin and globulins were studied. The results are presented below with respect to age, sex, socio-economic status and area of living.

Table 9: Means ± SD of copper, zinc and iron in children of different sexes in different degrees of malnutrition.

| Sex | Degrees of malnutrition | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | Control |
| **Copper** | | | | |
| Male | 62.91 ± 18.07 | 52.44 ± 15.93 | 51.68 ± 22.51 | 10.00 ± 4.92 |
| Female | 59.33 ± 18.90 | 50.36 ± 17.20 | 44.33 ± 19.32 | 10.83 ± 4.90 |
| **Zinc** | | | | |
| Male | 52.36 ± 13.47 | 55.44 ± 13.80 | 47.36 ± 12.22 | 50.20 ± 3.70 |
| Female | 52.00 ± 8.72 | 44.91 ± 6.35 | 48.11 ± 6.84 | 48.50 ± 2.89 |
| **Iron** | | | | |
| Male | 352.00 ± 173.81 | 402.88 ± 166.26 | 292.96 ± 157.22 | 104.20 ± 12.62 |
| Female | 365.33 ± 174.13 | 301.45 ± 107.16 | 288.66 ± 146.09 | 64.50 ± 57.79 |

*Age*

The overall means of total proteins revealed non-significant difference between malnourished and apparently healthy children in each age group. The difference between malnourished children in each degree of malnutrition was also non-significant. Among four age groups the overall difference was also non-significant. Serum albumin and globulins values showed non-significant difference between malnourished and apparently healthy children in each age group. The difference between three degrees of malnutrition was also non-significant in each age group (Table 10).

*Sex*

Serum total proteins, albumin and globulins showed non-significant differences between malnourished and apparently healthy children both in male and female groups. Among degrees of malnutrition in both sexes, there was non-significant difference. Non-significant difference was also observed between male and female chil-

Table 10: Means ± SD of serum total protein, albumin and globulins in children of different ages in different degrees of malnutrition.

| Age groups | Degrees of malnutrition | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | Control |
| **Total protein** | | | | |
| Up to 12 months | 8.01 ± 1.65 | 9.30 ± 2.83 | 9.16 ± 3.06 | 9.22 ± 1.94 |
| 13-23 months | 8.35 ± 3.33 | 8.56 ± 1.34 | 7.59 ± 1.06 | 9.79 ± 6.35 |
| 24-35 months | 7.55 ± 0.97 | 11.09 ± 4.31 | 9.49 ± 4.52 | 9.94 ± 0.63 |
| 36-48 months | 8.89 ± 0.77 | 10.31 ± 1.32 | 9.53 ± 2.27 | 9.59 ± 5.72 |
| **Overall mean** | 8.14 ± 1.80 | 9.82 ± 2.96 | 9.13±3.09 | 9.62 ± 2.80 |
| **Albumin** | | | | |
| Up to 12 months | 3.19 ± 0.89 | 3.13 ± 0.35 | 3.18 ± 0.61 | 3.44 ± 0.44 |
| 13-23 months | 3.12 ± 0.42 | 3.29 ± 0.75 | 2.61 ± 0.24 | 3.30 ± 2.35 |
| 24-35 months | 2.90 ± 0.63 | 3.13 ± 0.46 | 3.28 ± 0.72 | 3.41 ± 0.44 |
| 36-48 months | 3.30 ± 0.11 | 2.96 ± 0.46 | 3.19 ± 0.61 | 3.44 ± 0.23 |
| **Overall mean** | 3.15 ± 0.66 | 3.13 ± 0.48 | 3.13 ± 0.62 | 3.41 ± 0.29 |
| **Globulin** | | | | |
| Up to 12 months | 4.82 ± 1.11 | 6.17 ± 2.84 | 5.98 ± 2.93 | 5.78 ± 2.03 |
| 13-23 months | 5.23 ± 2.96 | 5.27 ± 1.01 | 4.99 ± 1.02 | 6.49 ± 1.06 |
| 24-35 months | 4.66 ± 0.34 | 7.96 ± 4.20 | 6.21 ± 4.40 | 6.53 ± 0.66 |
| 36-48 months | 5.60 ± 0.87 | 7.35 ± 1.77 | 6.34 ± 1.94 | 6.14 ± 5.81 |
| **Overall mean** | 4.99 ± 1.44 | 6.68 ± 2.95 | 5.99 ± 2.92 | 6.21 ± 2.83 |

dren in each degree of malnutrition as well as in apparently healthy children.

*Socio-economic status*

Serum total proteins showed significant ($p<0.05$) difference between malnourished and apparently healthy children of low socio-economic status. The values were lower in 3rd degree of malnutrition, however non-significant difference was observed between three degrees of malnutrition in children of middle socio-economic status. Serum albumin showed non-significant difference between malnourished and apparently healthy children in each socio-economic status. Serum globulin showed significant ($p<0.05$) difference between malnourished and apparently healthy children of low socio-economic status. The values were lower in 3rd degree of malnutrition, however non-significant difference was observed between three degrees of malnutrition in children of middle socio-economic status.

*Area of living*

Serum total proteins showed non-significant difference between malnourished and apparently healthy children of both industrial and non-industrial areas. Among malnourished children of industrial and non-industrial areas, the values again showed non-significant difference between three degrees of malnutrition. Serum albumin and globulin showed non-significant difference between malnourished and apparently healthy children of both industrial and nonindustrial areas. Among malnourished children of industrial and non-industrial areas, there was non-significant difference between three degrees of malnutrition.

## DISCUSSION

The result of the present study showed that three degrees of malnutrition were more prevalent in children of up to 12 months of age while prevalence decreased with the increase in age of these children. This suggests that children in early age suffer more frequently from the diseases and weight loss was also more rapid in this group than elderly patients. It has been observed that weight loss in younger children was more than in older children. It might be because the requirement of the protein was greater in very young children (7). The present study has also suggested that malnutrition occurs more frequently in the males than females, which might be due to metabolic and hormonal differences between male and female. Hence the weight loss in the males was perhaps more than in females. However, due to the likeliness for the male children, they were hospitalized earlier and given more care and attention. Higher prevalence of all degrees of malnutrition in children of low socio-economic status has also been reported earlier (8). Crowded environment, poor nutrition and unhygienic conditions were reported to be more likely factors of sickness in the children of low socio-economic status.

A higher prevalence of malnutrition in children of non-industrial than industrial area was noted. This might be due to the fact that majority of the children in the towns (non-industrial areas) where the hygienic conditions were poor and so was the family status of the children. Also health care facilities were not very good in towns that might have also contributed to the higher occurrence of malnutrition in children belonging to the towns.

The present study has further showed that all types of milk offering were more frequent to males than females, while solid food was relatively more frequently given to females. This also supported the earlier statement that male children were given more care than females that were probably the neglected ones. The breast-feeding was less frequently offered by the educated mothers while more frequently by uneducated and undermatric mothers. This might be due to that educated mothers probably have less time for their children than for themselves and give less attention to their children. This is why the food offering to the children was even more frequent by the uneducated mothers. Moreover, all types of food offerings were more frequent by mothers of low socio-economic status.

Present data also showed significantly ($p<0.05$) lower values of mid-arm circumference and percent weight in malnourished children than apparently healthy children. Amongst the apparently healthy children, the values of these parameters were lower in children suffering from 3rd degree of malnutrition. It has previously been reported that mid-arm circumference and percent weight were lower in malnourished children (9). The body mass index showed significant difference in children below 23 months of age with lower values in 3rd degree of malnutrition which indicates that loss of weight was more rapid and that children below 23 months of age have suffered more frequently from serious illness.

The mid-arm circumference, percent weight and body mass index were significantly lower in severely malnourished children of both sexes. The mid-arm circumference and percent weight were lower in malnourished children irrespective of socio-economic status and these were lower in severe degree of malnutrition and was highly related with degree of malnutrition. Hence, body mass index was affected only in children of middle socio-economic status. These values were lower in severe degree of malnutrition, which has also been reported earlier (10).

Mid-arm circumference, percent weight and body mass index were significantly lower in malnourished children than apparently healthy children irrespective of area of living. This suggests that these parameters have nothing to do with the area of living. The present study was conducted on children admitted in hospital with some common diseases. The results obtained showed that the diarrhoea was more frequently encountered disease in children of pre-schooling age which resulted in ultimate malnutrition. It has also been previously reported that malnutrition and diarrhoea have strong correlation (11). During the present study it is observed that malnutrition, fever and tuberculosis were the other salient diseases/disorders. These were probably due to poor hygienic and overcrowded conditions as these diseases were more frequently observed in children of low socio-economic status. Mode of feeding has also been reported to have direct correlation with malnutrition (12).

## CONCLUSIONS

The study revealed that all types of milk offering to male children were more common by all types of mothers. Serum copper and iron were higher affected while zinc was not affected in the studied children suffering from malnutrition.

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