# Prevalence of Anaemia in Semi-Urban Areas of Peshawar, Pakistan: A Challenge for Health Professionals and Policy Makers

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## Abstract

Iron deficiency anaemia is a serious problem among Pakistani children. Pre-intervention haematological status of children under two years was assessed as part of a double-blind, randomized controlled community-based study conducted in two semi-urban areas of Peshawar. The primary objective was to assess the impact of iron deficiency anaemia and iron intervention on growth and morbidity. Three hundred and twenty children who met the criteria of a "healthy child" were Eecruited for the study. Blood samples were drawn from 275 children for haemoglobin (Hb) and serum ferritin (SF) analyses. The children were classified as anaemic (Hb cli g/dI); iron deficient (SF <12 ng/ml) and iron deficient anaemic (Hb<11g/dl and SF<12ng/ml). Ninety percent of the children were anaemic, 67% iron deficient and 63% iron deficient anaemic. Anaemia was more prevalent in boys who had significantly lower Hb and SF values than girls. The magnitude of anaemia in these children tended to increase with age. The study demonstrates that iron deficiency is the predominant cause of anaemia (69%) in children under two years. Minimization of iron deficiency anaemia should be a public health priority in order to prevent suffering of children and avert the associated cognitive and physical deficits in child development (JPMA 47:49, 1997).

## Introduction

Pakistan, like other developing countries, is facing a problem of high population growth and limited resources which hinder socio- economic development in the country. Limited health care, poor hygiene and sanitation, high illiteracy among women are the characteristics considered to be responsible for a high under five mortality rate which is estimated at 137/1000 live births[1]. Diarrhoea and acute respiratory infections are the leading causes of childhood morbidity and mortality in Pakistan. It has been estimated that 313,400[2] deaths occur annually from diarrhoea and 250,000[3] from acute respirators infection and that these factors account for over two-thirds of all deaths in children under the age of five. In addition, to adverse socio-economic conditions, nutrient deficiencies are suspected of playing a pivotal mle in increasing the frequency, severity and duration of diarrhoea and acute respiratory infections.

In Pakistan, iron deficiency is the most prevalent nutritional deficiency among infants and children accounting for 83%of all anaemia[4]. The causes of iron deficiency appear to be low iron stores at birth. rapid body growth, short birth intervals, poor hygiene and sanitation, poor dietary practices and frequent diarrhoea, respiratory infection and malaria[2]. The ill consequences of iron deficiency on child's behaviour, psychomotor development and cognitive functions have been well documented[5-7]. However, the relationship between iron deficiency and the immune system has been a controversial issue among researchers. Limited data from human studies are available. These studies report that iron

deficiency both increases[8-10] and decreases[11] the risk of gastrointestinal infections. Although a number of studies[4,12,13] related to iron deficiency have been conducted in Pakistan, none of these have explored the role of iron in childhood morbidity. The alarming rate of childhood morbidity and mortality and the possible contributing role of iron deficiency in diarrhoea and respiratory infections led us to design a study to assess the magnitude of anaemia in children under two yearsof age.

## Patients and Methods

This study was carried out in Palosi and Regi, two semi-urban areas of Peshawar District about 20 kilometers north east of Peshawar, the provincial capital of North West Frontier Province(NWFP). These areas were selectedbecause of their similarity to other semi-urban areas of NWFP with respect to basic social services and living conditions; the easy road communication and their proximity to the local laboratory for quick blood transportation and analysis. Each area has about 25,000 inhabitants. Over 90% of the houses were constructed with mud bricks, lack a proper arrangement for solid waste disposal, have no proper drainage or sewage systems and a majority of them have no access to safe drinking water. Primary health care coverage was inadequate for the population, i.e., one basic health unit with a medical officer and auxilliary staff for approximately 25,000 inhabitants. Agriculture and low paid, wage labour occupations were the major economic activities.

A list of under two year children was obtained from the office of the Basic Health Unit of the respective areas. All households containing children under two years of age were visited by the health workers for enrollment. The ages of the children were reconfirmedby the health workers with the help of a local events calendar. Informed consent was obtained from the individual families. A total of 362 children were screened by a female medical officer. Those who met one or more of the following criteria were excluded from the study; children on iron-fortified formula or' on iron-containing medication, family history and/or clinical features of thalassemia, severely malnourished and clinical symptoms of acute and chronic infections (pneumonia, typhoid, tuberculosis and congenital heart and lungs problems). The purpose of the child's exclusion 'criteria was to control the potential intervening variables which may either affect the child's iron status or interfereinits biochemical assessment. A total of 320 children met the inclusion criteria and were enrolled for the study. However, at preintervention time (Ti), blood samples for haemoglobin were collected from only 275 children while at post-intervention time (T2) the number of childrenwhovolunteeredforblooddrawnwas furtherreduced to 248. The difference in number of children enrolled and blood drawn was attributed to parent's refusal to have their childrens' blood drawn, shifting of families to otherplaces and death of children.

### Blood analyses

Samples of about 2 to 3 ml blood were taken from each child. The samples were placed in ice-chest and transported to the laboratory for storage and analyses. Haemoglobin (Hb) concentration was determined by cyanmethemoglobin method within threehours of blood collection[14,15]. The World Health Organization (WHO) classification was used tO characterize children into anaemic (Hb <11 g/dl) and non-anaemic (Hb> 11 g/dl) groups[16]. The anaemic children were further subdivided into mildly anaemic (Hb 10 to <11 g/dl), moderately anaemic (Hb 7 to <10 g/dl) and severely anaemic (Hb <7 gJdl)[17]. Serum was separated from the whole blood and stored at -20°C until analysis. Serum femtin (SF) was detennined by radioimmunoassay using the method of Addison et al[18] at the Institute of Radiotherapy and Nuclear Medicine (IRNUM), Peshawar. About 10 % of the samples were sent to the Institute of Nutrition at Mahidol University, Bangkok, Thailand for SF analysis to check the quality and validity of the local laboratory analyses. Moreover, a control was run witheachbatch at the beginning, middle and at the end of the sample analyses to minimize the possibility of overestimating the prevalence rate of anaemia in children under two years. The validity of the laboratory tests was further

confirmed by comparing the SF values obtained in the local and overseas laboratories. On the basis of SF values, the children were grouped into iron deficient (SF <12 nglml) and normal iron stores (SF12 ng/ml)[19]. The children withHb <11 g/dl and SF <12 ng/ml were characterized as iron deficient anaemic, those with Hb>I1 g/dl and SF>12 ng/ml as iron sufficient non-anaemic and those who did not fulfill either of these two groups were classified as intermediate status. The prevalence of anaemia due to iron deficiency was computed as: the number of iron deficient children with anaemia; the total number of anaemic children from which iron deficient children were identified.

The serum ferritin concentration of five anaemic children could notbe determined due to insufficient amount of serum samples. The denominator value was thus calculated as total anaem c children minus five.

## Statistical analysis

Programmes for error checking and distribution of the data were executed using the Epilnfo and the SAS software packages[20,21]. Unpaired student's t-test were performed on the data to examine the mean differences in haemoglobin and serum femtin values according to area, gender and age grouping by anaemia and iron status. Analysis of variance was also run to compare the mean differences among the different biochemical variables. Two sided p-values were considered to be statistically significant at p<0.05.

## Results

Blood samples were collected from 275 children out of the total 320 enrolled children. The samples of the 45 children could not be collected due to the parent's refusal (n=3 1); shifting of families to other places (n9) and death of the children (n=5).

Table I. Prevalence of anaemia in children under two years age in two semi-urban areas of Peshawar (n=275).

| Area | Anaemic (Hb <11.0 g/dl) | | | Non-anaemic (Hb ≥ 11.0 g/dl) | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | % | Hb (Mean±SD) | No. | % | Hb (Mean±SD) | No. | % | Hb (Mean±SD) |
| Palosi | 129 | 87 | 9.43±1.15* | 20 | 13 | 11.38±0.33 | 149 | 100 | 9.69±1.27** |
| Regi | 119 | 94 | 8.96±1.27 | 7 | 6 | 11.27±0.31 | 126 | 100 | 9.08±1.34 |
| Total | 248 | 90 | 9.20±1.23 | 27 | 10 | 11.35±0.33 | 275 | 100 | 9.41±1.33 |

*Significant (p<0.001) difference in Hb concentration between the anaemic children of the two areas.
**Significant (p<0.001) difference in Hb concentration of the children between the two areas.

Table 1 depicts the mean haemoglobin (Hb) concentration of the 275 children under two years of age in the two areas. The prevalence of anaemiavariedbetween 87% and 94% and there was a significant (p<0.001) difference in the mean Hb concentration of the children between the two areas. The magnitude of anaemia based on standard cut-off levels of I-lb concentration revealed that 35% of the children were mildly anaemic (range 28-41%), 60% moderately anaemic (56-65%) and 5% severely anaemic (3-7%) (Table II).

Table II.Haemoglobin status of anaemic children under two years age by its severity (n=248).

| Area | Mildly anaemic (10< Hb <11.0 g/dl) | | | Moderately anaemic (7≤ Hb ≤10 g/dl) | | | Severely anaemic (Hb <7 g/dl) | | |
|---|---|---|---|---|---|---|---|---|---|
| | No | % | Hb (mean±SD) | No. | % | Hb (Mean±SD) | No. | % | Hb (Mean±SD) |
| Palosi | 53 | 41 | 10.40±0.25 | 72 | 56 | 8.92±0.71* | 4 | 3 | 5.60±1.12 |
| Regi | 33 | 28 | 10.34±0.22 | 78 | 65 | 8.67±0.77 | 8 | 7 | 6.00±0.51 |
| Total | 86 | 35 | 10.38±0.24 | 150 | 60 | 8.80±0.75 | 12 | 5 | 5.87±0.74 |

*Significant (p<0.05) difference in Hb concentration between the moderately anaemic groups of the two areas.

Table III. Haemoglobin status of all children under two yearsage by gender (n=275).

| Gender | Anaemic (Hb <11.0 g/dl) | | | Non-anaemic (Hb ≥11.0 g/dl) | | | Total | | |
|--------|------|-----|---------------|------|-----|---------------|------|-----|---------------|
| | No. | % | Hb (mean±SD) | No. | % | Hb (Mean±SD) | No. | % | Hb (Mean±SD) |
| Boys | 140 | 95 | 9.02±1.25* | 8 | 5 | 11.24±0.14 | 148 | 100 | 9.14±1.31** |
| Girls | 108 | 85 | 9.43±1.17 | 19 | 15 | 11.39±0.37 | 127 | 100 | 9.72±1.29 |
| Total | 248 | 90 | 9.20±1.23 | 27 | 10 | 11.35±0.33 | 275 | 100 | 9.41±1.33 |

*Significant (p<0.001) difference in Hb concentration between the anaemic boys and girls.
**Significant (p<0.001) difference in Hb concentration between the boys and girls.

Table III presents the mean Hb concentration of the children by gender. Boys had significantly lower Hb concentration than that of the girls (p<0.001). More boys (95%) than girls (85%) were found to be anaemic and the anaemic boys had significantly lower mean Hb concentration than those of the anaemic girls (P<0.001). The proportion of children with anaemia in less than 12 months age group was lower than the proportion of older age groups (Table IV).

Table IV. Haemoglobin status of all under two years old children by age in months (n=275).

| Age Months | Anaemic (Hb <11.0 g/dl) | | | Non-anaemic (Hb≥11.0 g/dl) | | | Total | | |
|------------|------|-----|---------------|------|-----|---------------|------|-----|---------------|
| | No. | % | Hb (Mean±SD) | No. | % | Hb (Mean±SD) | No. | % | Hb (Mean±SD) |
| <12 | 40 | 85 | 9.55±1.23* | 7 | 15 | 11.24±0.32 | 47 | 100 | 9.80±1.29** |
| 12-15 | 140 | 91 | 9.23±1.26 | 14 | 9 | 11.36±0.35 | 154 | 100 | 9.42±1.35 |
| ≥15 | 68 | 92 | 8.94±1.11 | 6 | 8 | 11.43±0.29 | 74 | 100 | 9.15±1.27 |
| Total | 248 | 90 | 9.20±1.23 | 27 | 10 | 11.35±0.33 | 275 | 100 | 9.41±1.33 |

*Significant (p<0.001) difference in Hb concentration among the three anaemic age groups.
**Significant (p<0.001) difference in Hb concentration among the three age groups.

Sixty-seven percent of the children were iron deficient while 33% had normal iron stores. There were significant differences (p<0.0001) in the mean serum ferritin (SF) values between the boys and girls but no statistically significant differences were observed in the mean SF values of the children from the two areas (Table V).

## Table V. Children's classification by serum ferritin (n=264*).

| Groups | Classification | No | % | SF ng/ml(Mean±SD) |
|---|---|---|---|---|
| Iron status | Deficient | 178 | 67 | 5.41**±2.86 |
| | Sufficient | 86 | 33 | 28.65±17.96 |
| Sex | Boys | 143 | 54 | 9.26***±10.76 |
| | Girls | 121 | 46 | 17.37±18.13 |
| Area | Palosi | 140 | 53 | 13.68±16.16 |
| | Regi | 124 | 47 | 12.19±13.90 |

*The difference in number of children between haemoglobin (n=275) and serum ferritin (n=264) is because of insufficient serum (n=5) and outliers (n=6).

**Significant (p<0.0001) difference in SF values between the two iron status groups.

***Significant (p<0.0001) difference in SF values between the boys and girls.

Sixty-three percent of children were iron deficient anaernic, 31% were anaemic but not iron deficient based on SF levels and the remaining 6% were iron sufficient non-anaemic. The prevalence of anaemia due to iron deficiency was found to be 69% (Table VI).

## Table VI. Children's classification by serum ferritin and haemoglobin (n=264).

| Groups | No. | % | SF ng/ml (Mean±SD) | Hb g/dl (Mean±SD) |
|---|---|---|---|---|
| Iron deficient anaemic (IDA)* | 167 | 63 | 5.28**±2.85 | 9.05***±1.22 |
| Intermediate**** | 82 | 31 | 24.27±16.76 | 9.78±1.27 |
| Iron sufficient non-anaemic (ISNA) | 15 | 6 | 36.95±22.57 | 11.36±0.34 |

*Anaemia prevalence due to iron deficiency=
the number of iron deficient children with anaemia
the total number of anaemic children from which
iron deficient children were identified 167/243 = 69%
** Significant (p<0.0000) difference in SF values among the three groups.
***Significant (p<0.0000) difference in Hb values among the three groups.
****Did not meet the criteria of either IDA or ISNA.

The serum ferritin (SF) results of the sub-sample analyzed at the Institute of Nutrition at Mahidol University (INMU), Bangkok compared to the results from the Institute of Radiotherapy and Nuclear Medicine (IRNUM), Peshawar showed no statistical difference in the mean SF value of the children obtained from the two different laboratories. The somewhat higher SF values obtained in the local laboratory suggest that prevalence of iron deficiency in any case is not over-estimated. The difference

in identifying the number of iron deficient children between the two laboratories was only one (n=43 versus n=42). The mean SF value of the iron deficient children obtained at the IRNUM was 5.84±2.91 ng/ml as compared to 4.57±2.93 ng/rnl at the INMU, but the difference was not significant.

## Discussion

The results of the present study indicate that anaemia is prevalent in the two semi-urban areas to a much greater extent than was reported in earlier studies[4,12,23], Prevalence of iron deficiency anaemia in the studied children was similar to 85% reported by Raziq[13] in children underfive years age. Although our overall anaemia rate was higher, iron deficiency anaemia accounting for almost two-thirds of all anaemia in our study group was lower than 83% reported by Khan and Jalil[4]. The remaining one-third of the anaemic children without iron deficiency in our study suggests that anaemia other than iron deficiency is also prevalent in this population. This needs tobe investigated to ascertain the type of anaemia for proper therapeutic treatments. The difference in prevalence rates of anaemia among different studies could be attributed to differences in the study designs and methodologies, use of cutoff values, population ages, sample sizes and ethnic and socio- economic backgrounds.
The haematological results stratified by gender were contraty to the general prevailing conception of sex inequality and discrimination in respect of a child's feeding. The higher prevalence of anaemia in boys than girls in both the areas indicate that even though the majority of the population is illiterate and has a preference for baby boys over girls for family support and socio-economic reasons, however, nutritional discrimination against girls does not appear to be intentionally practiced among the families. One canalso argue that even though mothers wanted to have healthy boys but lack of nutritional knowledge and limited family resources resulted in low haemoglobin and iron status of the boys. These results are similar to those found by Burman[24] who reported higher (0.4 g/dl) mean haemoglobin concentration for girls than boys of under two years. The rapid weight gain of boys as compared to girls during early childhood could be the reason of lower haemoglobin concentration in boys[25]. Although the growthvelocity of children slows dOwn in their second year, resulting in relatively lower iron demand for increasing blood volume and mass than that required in the first year of life, the prevalence rate of anaemia in older children was still high. The results suggest that once the children pass the age of four months, their iron stores become depleted and limited exogenous iron intake increase children's vulnerability to iron deficiency anaemia. The period between 6 to 24 months of age may be viewed as a critical period of iron deficiency anaemia in under-privileged children. These results are inline withthe observations of earlierresearchers[26] who reported similar findings. The high prevalence of anaemia in infancy is of particular developmental importance because the peak velocity in post-natal growth of the brain is in the first year of life and the danrnging effects of its deficiency are long lasting[22]. Most of the anaemic children have been characterized as mildly to moderately anaemic, which are reported to be disadvantageous in learning, social behavioral and cognitive development[27,28]. A study on Chilean infants reported that moderately anaernic infants had significantly lower mental and motordevelopment scores than infants who had mild anaemia or who were not anaemic. This suggests that even mild anaemia is harmful during the period of early growth and development[6].
The results of this study indicate that iron deficiency anaemia is a serious public health problem among children under two years in semi-urban areas of district Peshawar, NWFP, Pakistan. The study provides evidence that the prevalence of anaemia in this area starts at a very young and developmentally crucial age. This deficiency coincides with the period offasterbody growth and brain development which require more nutrients that are usually not provided by the unpnvileged women[29]. Adverse effects of iron deficiency on behavioral, psychomotor development and cognitive functions during the period of

growth and development are well documented[5,6,22] . Iron deficiency in this area needs to be prevented in order to enable the children to develop and grow normally. However, it requires strong will, committment and support from the policy makers, clinicians and allied health professionals to coordinate and direct activities to combat this nutritional disorder.

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