



Determinants of anemia amongst children under 3 years of age

KEYWORDS

hemoglobin levels, psychomotor development, morbidity profile, type of dwelling

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ABSTRACT

Objective: Assessment of nutritional and non-nutritional factors associated with anemia in children (<3y) in Vadodara
Design and setting: Nine out of 46 anganwadis were randomly selected.

Methods: Data was collected on socio-economic status, health services utilization, psychomotor development, anthropometric measurements, dietary intakes, morbidity profile and hemoglobin (Hb) levels (n=362).

Results: Prevalence of anemia was found to be 71.1%. Mean Hb level was 10.18g/dl. Univariate analysis showed anemia prevalence was higher (76.7%) among subjects with monthly per capita income (PCI) ≤Rs.750 than those (66.1%) having PCI >Rs.750. Prevalence was 70.8% in the first born compared to 83.3% in those with birth order >3. It was lower in the children whose growth was monitored regularly (71.1%) compared to the other group (80%). Higher percent of subjects (77.8%) who had experienced morbidities had hemoglobin levels <11g/dl, compared to subjects who had not experienced any morbidity (63.7%). Mean iron intake was higher in non-anemic subjects (5.48mg/day) than moderately and severely anemic subjects (5.16mg/day). Multiple regression analysis showed that the Height for age Z scores, infectious morbidities, house construction, drainage facility and mothers education explained 12% variation seen in Hb levels.

Conclusion: The associated factors can be used to identify children at high risk of anemia and the iron supplementation and supplementary food can be targeted towards them.

The National Family Health Survey II, conducted in 1998-99, documented that about 74% children between the ages of 6-35 months were anemic in India, the prevalence being same in Gujarat (75%). The NFHS III (2006-07) data shows that the prevalence of anemia in this group has increased to 80.1% in Gujarat. There is increasing evidence that deficiency of certain micronutrients, especially iron deficiency, may adversely affect the physical and mental growth of children. Micronutrient deficiency is often referred to as a silent epidemic because its health impacts may not be as obvious as with protein-energy malnutrition but can be just as significant (Tulchinsky 2010). Very few studies have investigated the role of other nutritional and non-nutritional factors except low dietary intake of iron and poor bio-availability of dietary iron in the development of anemia in young children.

The present study was planned with the **MAJOR OBJECTIVE** of assessing the nutritional status of children below 3 years of age and identifying the factors, both nutritional and non-nutritional, associated with under nutrition and anemia.

Nine anganwadis were randomly selected out of 46 under a NGO in Vadodara. A total of 362 children were enrolled during the study. The data was collected on socio-economic status, utilization of health services, psychomotor development, anthropometric measurements, dietary Intake data, frequency consumption of Iron and Vitamin C Rich Food, morbidity profile and hemoglobin levels (Cyanmethemoglobin method) on all samples (362). Data on maternal obstetric history and IYCF practices birth weight and, birth order were collected on children ≤24m of age (n=94).

RESULTS

Psychomotor Development

The mean psychomotor score were highest in the older subject (58.34), compared to the younger subjects (23.39). Sex wise distribution did not show any significant difference.

Relationship between Hemoglobin levels and Psychomotor

Functions

It was found that mean psychomotor scores were higher in non anemic (53.18) girls compared to the anemic girls (51.74), and non-anemic boys (52.98) compared to anemic boys (51.5). Non-anemic subjects (26.6) (≤11m) had higher mean psychomotor score compared to the anemic subjects (22.25).

Frequency of Consumption of Iron and Vitamin C Rich Foods

The data on the dietary intakes obtained through the food frequency method and the 24-hour Dietary Recall method, showed that consumption of iron rich foods by the subjects was low.

Vitamin C rich fruits, like amla, guava and orange, were consumed only during the season. Guava was consumed more frequently as compared to amla and orange.

Mean Hemoglobin Levels and Prevalence of Anemia

The overall prevalence of anemia among the subjects was 71.1% (hemoglobin levels <11 g/dl). A large number of children (43.6%) had hemoglobin levels below 10g/dl, of which 4 children (1.1 %) had hemoglobin levels below 7g/dl, i.e. they were severely anemic.

Effect of Prevalence of Anemia on Infectious Morbidity

64.4% of the anemic subjects had experienced infectious morbidities in the preceding two weeks compared to 47.5% normal subjects.

Relationship between Prevalence of Anemia and Nutritional Status

It was found that mean WAZ was significantly lower (-1.50) in subjects with hemoglobin levels <10 g/dl, compared to subjects with Hb levels ≥11g/dl (-1.08) and Hb levels <10g/dl 10 to 10.99g/dl (-1.21)

An increase in the mean WHZ was observed with increase in hemoglobin levels. This was however not significant. WHZ was highest in subjects (-0.51) with normal Hb levels (≥11g/dl),

followed by those with mild anemia (-0.55, Hb 10-10.99g/dl) and the lowest (-0.53) in those with moderate/severe anemia (Hb <10g/dl).

Subjects with hemoglobin levels ≥ 11 g/dl had significantly higher mean HAZ (-0.95) than those with hemoglobin levels 10-10.99g/dl (-1.16) and <10g/dl (-1.63). The HAZ values of the subjects with mild anemia were also significantly higher than those with moderate/severe anemia.

The percent of the severely underweight subjects was higher (12.7%) in subjects with moderate and severe anemia (in ≤ 9.99 g/dl category), compared to subjects (5.8%) with mild anemia (10 to 10.99g/dl). Prevalence of moderate wasting was higher (11.4%) in subjects with moderate and severe anemia as compared to subjects (5.8%) with mild anemia. The percent prevalence of stunting was the lowest in subjects with normal hemoglobin levels and the highest in those with hemoglobin levels <10g/dl. Percent prevalence of moderate and severe stunting was also the highest in those with moderate/severe anemia.

NUTRITIONAL AND NON-NUTRITIONAL FACTORS ASSOCIATED WITH HEMOGLOBIN LEVELS – UNIVARIATE ANALYSIS

Relationship between Socio-economic Status of Children with Prevalence of anemia in children

Of the total 19 variables tested five were significantly found to be associated with mean hemoglobin levels of the subjects. These included per capita income, father's occupation, and birth order of the child, facilities available for disposal of human waste and the drainage facility available. The mean hemoglobin levels of subject with income >750 was 10.06g/dl and in the category of PCI > 750 was 10.41g/dl. A significant positive correlation was found between PCI and hemoglobin levels ($r=0.157, P<0.05$).

The prevalence of anemia was higher (76.7%) among subjects with a monthly PCI of \leq Rs.750 compared to those (66.1%) having a per capita income of >Rs.750.

Subjects whose fathers were engaged in private or government offices had higher hemoglobin levels (10.44g/dl) than subjects whose fathers were self-employed or did some petty trade (9.95g/dl). The mean hemoglobin level of subject with birth order one was 10.34 g/dl while those of birth order more than two had mean hemoglobin level of 9.81g/dl. These findings were supported by the significant negative correlation found between birth order and hemoglobin levels ($r=-0.135, P<0.01$).

The mean hemoglobin levels of the subjects who had toilet facilities in their houses (10.2g/dl) were significantly higher mean hemoglobin levels than those who used public toilets (9.67g/dl).

The prevalence of anemia was 73.7% in the age category of less than 12 months, 78.8% in the age category of 12 to 23 months and 70.35% in the age category of 24 to 36 months. The prevalence of anemia was higher in the male subjects (75.6%) than in the female subjects (68.6%), but the difference was not significant.

Mother's education had an influence on the mean hemoglobin levels ($r = 0.146, p<0.01$). The children of illiterate mothers had a mean hemoglobin level of 9.94g/dl while children of mothers with education till secondary or more had a mean hemoglobin level was 10.36g/dl. The education of the father was also found to be significantly correlated with hemoglobin levels ($r=0.109, p<0.05$).

The mean hemoglobin level of the subjects living in kuccha houses was lowest (9.66g/dl) and of those living in pucca houses was the highest (10.38g/dl). A significant association was found between type of dwelling and hemoglobin levels

($r=0.138, p<0.01$). About 84% of subjects living in kuccha houses were anemic while 65.7% of subjects living in pucca houses were anemic.

The mean hemoglobin levels of those with an environmental score ranked 'very goods' were higher (10.27 g/dl) than those with a score of 'poor' (10.06 g/dl).

Relationship between Birth Weights of Index Child with Prevalence of Anemia in children

The mean hemoglobin level of subjects with birth weight of >2750g was 10.51 g/dl while those with birth weight of ≤ 2500 g had mean hemoglobin level of 9.77g/dl.

Relationship between Utilization of health services by children and Hemoglobin levels

The mean hemoglobin level of subjects who went for regular growth monitoring (10.16g/dl) was significantly higher than those who did not (9.74g/dl). The children whose growth was monitored regularly also had a lower prevalence of anemia (71.1%) compared to the other group (80%).

Relationship between IYCF Practices and Hemoglobin Levels

No significant relationship was found in any of the IYCF practices tested and hemoglobin levels.

The mean hemoglobin level of subjects fed breast milk within an hour of birth was 10.38g/dl, while in those given after ≥ 2 days it was 9.82g/dl and prevalence of anemia being 68.8% and 85% respectively.

The mean hemoglobin level was higher in subjects fed colostrum (10.04g/dl) than in those who were not (9.91g/dl). The hemoglobin levels were observed to be lower in the subjects who were exclusively breast fed for <6m (9.93g/dl) as compared to the subjects who were exclusively breast fed for 6m (10.35g/dl) and the prevalence of the anemia being 77.8% and 66.7% respectively.

Subjects who were introduced top milk in 6m of age (9.99g/dl) had lower mean hemoglobin than the subjects who were introduced top milk in at 6m of age (9.95g/dl) and the prevalence of the anemia being 27.7% and 22.7% respectively. The hemoglobin levels were observed lower in the subjects who were given complementary foods < 6m (9.92g/dl) as compared to those given at 6m (10.03g/dl). Prevalence of moderate/severe anemia was higher in the subjects who received complementary feeding < 6m (56.3%) compared to those given complementary foods at 6m of age (41.7%).

Relationship between IYCF Score and Prevalence of anemia in children

The mean hemoglobin was higher in the subjects (10.24g/dl) with very good IYCF scores compared to the subjects (9.82g/dl) with poor IYCF scores and the prevalence of the anemia being 14.3% and 27.8% respectively.

Relationship between Maternal Obstetric History and Prevalence of Anemia in children

The hemoglobin levels were $10.20 \pm 0.35, 10.01 \pm 0.19, 9.76 \pm 0.25$ for women with 1,2 and >2 children respectively. The percent prevalence of anemia increased with the increase in number of children from 72.2% when number was one to 84.6% when the number of children was more than two.

Relationship between BMI of Mothers and Hemoglobin Levels of Children

The mean hemoglobin levels of the subjects whose mother's BMI was in the range of 23 to 24.9 (11.39g/dl) was higher than those whose mother's BMI was <18.5 (9.97g/dl).

When the BMI of the mother was <18.5 the prevalence of severe anemia was higher (43.8%), compared to when the mother's BMI was within range of 23 to 24.9, (33.6%).

Relationship between Morbidity Profiles of Children and Hemoglobin Levels

The mean hemoglobin levels of the subjects were significantly affected by the morbidities experienced (8.58**), number of episodes (9.84*) and the duration of the morbidity experienced (8.49*). Figure in parentheses show chi square values: * Significant at p <0.05, ** Significant at p <0.01

Relationship between Nutrient Intakes and Prevalence of Anemia

The mean iron intake decreased with decrease in hemoglobin levels. Iron intakes were found to be lowest amongst subjects with moderate or severe anemia (Figure 1).

Iron Density

Iron density of the diets consumed by the subjects was 8.5 g iron per 1000 Kcal for the diets of the 6-12m old subjects, 6.20g iron/1000 Kcal for diets of the 13-24m old subjects and 6.21g iron/1000 Kcal for diets of the 25-36m old subjects.

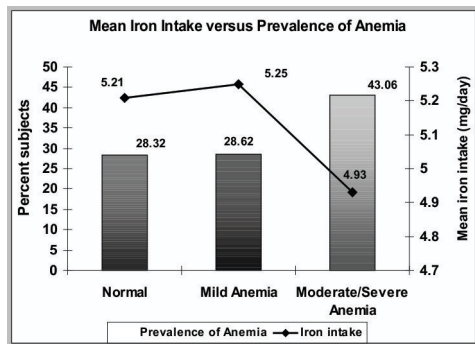


Figure 1: Mean Iron Intake versus Prevalence of Anemia

Mean Hemoglobin Levels in Relation to Nutritional Status

Subjects in the normal grade for WAZ had significantly higher mean hemoglobin level (10.37g/dl) than those with moderate (9.93 g/dl) and severe (9.54 g/dl) underweight. Similar findings were observed for WHZ and HAZ. Table 1.01

Table 1.01: Mean Hemoglobin levels with Nutritional Status of Children

Nutritional Grade (Z Score)	N	Hemoglobin Levels (g/dl) Mean ± SE	"F" Value	"t" Value
Weight for Age	167	10.37 ± 0.95	4.22**	1 vs.3-2.04*
Normal (a)	114	10.13 ± 0.11		
Mild underweight (b)	48	9.93 ± 0.23		
Moderate underweight (c) Severe underweight (d)	33	9.54 ± 0.29		
Height for Weight	245	10.21 ± 0.08	4.44*	1 vs.3-3.51***
Normal (a)	83	10.27 ± 0.15		
Mild wasting (b)	28	9.30 ± 0.30		
Moderate wasting (c) Severe wasting (d)	6	10.71 ± 0.76		
Height for Age	161	10.53 ± 0.10	8.28**	1 vs.3-3.60***
Normal (a)	102	9.99 ± 0.12		
Mild stunting (b)	62	9.83 ± 0.17		
Moderate stunting (c) Severe stunting (d)	37	9.59 ± 0.25		

FACTORS SIGNIFICANTLY ASSOCIATED WITH HEMOGLOBIN LEVELS – MULTIPLE REGRESSION ANALYSIS

As many of the variables were correlated with each other, the univariate analysis provided only limited information multiple regression analysis was also done.

Mean of Iron Density was 6.98±0.24, it was found to be 6.21 ± 0.03, 6.20 ± 0.08 and 8.5 ± 2.08 for age groups 25m-36m, 13m-

24m and 6m-12m respectively.

The findings of the multiple regression analysis are presented in Table 1.07. The height for age Z score, an indicator of chronic malnutrition, was the first factor to enter the multiple regression and explained 6.1% of the variation seen in hemoglobin level. The episodes of infectious morbidities entered on the second step, and explained 2.4% of the variation seen. The type of dwelling entered on the third step followed by the drainage facility available on the fourth step and mother's literacy status on the fifth step, together accounting for 4.4% of the variation seen in hemoglobin level. The type of dwelling was positively correlated with hemoglobin levels (0.138 p<0.01) the education of mother was also positively correlated with hemoglobin level (r=0.146, p<0.01).

Thus, the multiple regression analysis, while strengthening some of the effects seen with univariate analysis, brought out additional factors that were important. These were mothers educational status (r=0.146, p<0.01), infectious morbidities experienced, the house construction (r=0.138, p<0.01) and the chronic nutritional status, HAZ, (0.252, p<0.01).

Table 4.68: Factors Significantly Associated with Hemoglobin levels (g/dl) - Multiple Regression Analysis

Variables	Adjusted R ²	SE	Variation Explained (%)	'F' Value
HAZ	0.061	1.32	6.1	24.42***
Episodes of Infectious Morbidities	0.085	1.30	2.4	10.48***
House type	0.104	1.29	1.9	8.65**
Drainage	0.115	1.28	1.1	5.24*
Education of mother	0.129	1.27	1.4	6.81**

* p<0.05, ** p<0.01, *** p<0.001

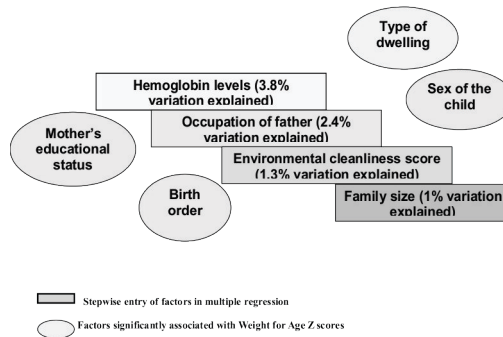


Figure 2: Factors Significantly Associated with Weight for Age Z Scores

Conclusion:

The present study identified a set of factors that influenced the nutritional status and hemoglobin levels of children < 3 years belonging to the low socio – economic group of urban Vadodara.

Thus, along with supplementary food, complementary interventions are required which would help in negating the effect of the adverse factors.

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