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Prevalence of Undernutrition and Anemia among the Child Beneficiaries of Mid-Day Meal Program

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Abstract Estimates suggest that over one third of the World's population suffer from anemia; primarily due to iron deficiency and India is projected to be one of the countries with very high prevalence. The National Family Health Survey (NFHS-III) reveals that the prevalence of anemia is 70-80% among Indian children. Anemia is an indicator of gross under nutrition and it affects the physical growth, cognitive performance and behavior of children. The objective of Mid-Day Meal program (MDM) was to control under nutrition and the probable anemic state among school children. In this background the present study was undertaken to examine the prevalence of anemia among the child beneficiaries of 8 to 10 years of age. The Male and Female children (no: 776) attending the Urban municipal upper primary schools in Tirupati (AP) composed the subjects of the study. A general information survey revealed that all the children belonged to low socio economic status. The data on anthropometry indicate that 37.5 and 36.1% children belong to the stunted and stunted & wasted type of malnutrition. Only 26.4% children were in the normal category. Prevalence of anemia was assessed through Cyanmethaemoglobin method. The results were interpreted using WHO cut-off values for classification of anemia into different degrees. The data revealed that of the 776 children studied, 19.6, 40.6 and 0.2% were in mild, moderate and severe anemic states, respectively. About 40% children were in the normal category having Hb values $\geq$ 11.5g/dl. While MDM program is satisfactory in terms its nutrition contribution, the low food intake of children during other meals appear to bring down the days nutrient intake resulting in under nutrition and anemia. The results thus focus on the need for routine iron supplementation for the school going children to decrease the very high prevalence of iron deficiency anemia, till the time the child's daily nutritional needs are taken care-of.
Keywords *Mid-day Meal; School Children; Anemia; Malnutrition*

1. Introduction

Anemia occurs when the tissue stores of iron are depleted, leading to a lowered level of serum iron, a decrease in transferrin saturation and an increase in erythrocyte protoporphyrin. When tissue stores are seriously depleted, hemoglobin levels decline. Thus, low levels of hemoglobin may be taken to indicate IDA (Seshadri and Gopaldas, 1989).

Iron is an essential trace element, involved in three major functions. The delivery of oxygen for the sustenance of life is accomplished by Hb and myoglobin which contain iron as an intrinsic component. As a constituent of cytochrome, iron is also needed for cellular respiration. It is involved in the detoxification of lethal peroxide species formed in the tissues. Iron is a cofactor (the metal component) of many enzymes like cytochromes, catalase, and peroxides, which carry out several vital functions in the body.

ID has profound negative effects on human health and development. In infants and young children, functional consequences include: impaired immune function; showed psychomotor development, coordination, and scholastic achievement; and decreased physical activity levels (UNICEF/ UNU/ WHO, 2001).

IDA, which affects 1.2 billion persons, is the most prevalent nutritional deficiency worldwide. In 1991, above 290 million school-aged children were anemic, of whom 150 million attended school (Viteri, 1991). ID is the most common nutrient deficiency and anemia, as an indicator of iron deficiency, affects nearly 2 billion people worldwide, or about a third of the world's population. Overall, it is estimated that worldwide 39 percent of preschool children and 52 percent of pregnant women are anemic, the majority living in developing countries. Many school- age children, adults (male and female), and the elderly also suffer from anemia. ID can affect all age groups and presents a major hurdle to national development (UNICEF/ UNU/ WHO, 2001).

Two billion people worldwide are estimated to suffer from anemia; approximately 50 percent of all anemias can be attributed to iron deficiency WHO/ UNICEF, 2004. The WHO estimates that most preschool children and pregnant women in developing countries and at least 30-40 percent in developed countries are iron deficient. The prevalence of anemia in developing countries is three to four times higher than that for developed countries. In developing countries, the most affected population groups are pregnant women (52 percent) - although all women in the age 15-59 yrs are affected (42 percent), school age children (48 percent), and preschool children (39 percent). Moreover 45 percent of the elderly and 30 percent of adult men are anemic, highlighting that the problem extends to other population groups. The problem is more extensive in Southeast Asia and sub-tropical Africa where anemia is linked to poverty (WHO/ UCF/ UNU, 2001). The direct contribution of anemia to global burden of disease is 14 DALYs per 1000 population (Viteri, 1999).

In India an analysis of the work carried out during the last about half a century indicates high prevalence of anemia among infants (80 percent) and in preschool children (74-78 percent). The study conducted by the ICMR in 16 districts of 11 states reported that about 90 percent among adolescent girls had hemoglobin levels indicative of anemia. Moderate and severe anemia ranged from about 22 percent among adolescent girls to about 50 percent in pregnant women. The prevalence was uniformly high in different states. The percent prevalence among preschool children and adolescence in Andhra Pradesh was 70.8 and 72.8 percent respectively (ICMR, 2001).

The prevalence of anemia is particularly high in developing countries, where 39 percent of children under five years old, 48 percent of 5-14 yrs old children, 42 percent of all women, and 52 percent of pregnant women are anemic (WHO/ UCF/ UNU, 2001). It is estimated that about half of the anemia is due to ID (Zimmermann and Hurrell, 2006) and the remainder due to other causes, such as nutritional deficiencies (e.g. deficiencies of vit-A, riboflavin), infectious disorders (particularly malaria, HIV and Tuberculosis), hemoglobinopathies, and ethnic differences in normal Hb distributions (Nestel, 2002; Lynch, 2005). The present investigation provides the findings of a pilot study to identify the prevalence of anemia among school children residing in Tirupati urban.

2. Materials and Methods

The present study was carried out on 776 children (342 males and 434 females) between the age group of 8 to 10 years from Tirupati urban, municipal upper primary schools. Which are the beneficiaries of Mid-Day Meal Program? All the subjects were from low income families. The purpose of the study was explained to the children.

Height was measured using portable anthropometric rod and weight by plot form weighing balance with minimum clothing. The height and weight were measured nearest to 0.1 cm and 0.5 kg respectively (Jelliffe, 1966). The measurements were compared with NCHS standards. Venous blood was drawn from 776 children using disposable syringe. Hemoglobin (Hb) level was assessed by cyanmethaemoglobin method (Dacie and Lewism, 1991). Magnitude of prevalence of anemia was assessed using the (WHO, 2001) cut offs.

3. Results and Discussion

Table 1 show that out of the total of 776 children screened only 26.4 percent were found to be normal and the remaining 74 percent belonged to stunted (31.5 percent) and stunted & wasted (36.1 percent) types of malnutrition. The age related distribution reveals that in both boys and girls a high percent of stunted children (41.7 and 41.8 percent respectively) occurred in the 8 yrs age group. Whereas stunting and wasting was high in the 9 yrs age group of both boys and girls (39.7 and 38.4 percent respectively). The percent of normal children was comparatively higher in boys than girls. At the age of 8 yrs an equal percent of boys and girls were in stunted category. Girls were more stunted than boys at 9 and 10 yrs. The percent of SW children increased in boys with the age.

Malnutrition continues to be a problem of considerable magnitude in most developing countries of the world (Som et al., 2006). In the present study, the overall age and sex combined prevalence of N, W, S and SW were 26.4, 0.0, 37.5 and 36.0 percent respectively. While wasting reflects a failure of attainment of wt-for-age only; Stunting reflects a failure to reach linear growth potential due to sub optimal health and / or nutritional conditions; SW reveals low body mass relative to chronological age which is influenced by both, a child's ht and wt (WHO, 1995).

The percent distribution of children according to Hb status is presented in Table 2. The aggregate data combined for boys and girls on Hb status reveal that 60.4 percent children have Hb levels below the normal values (<11.5 g/dl) indicating anemia.

Table 1: *Prevalence of Undernutrition among School Going Children as Assessed from Water Low's Classification*

Nutritional Grades	Boys				Girls				Grand Total %(n)
	8 yrs %(n)	9 yrs %(n)	10 yrs %(n)	Total %(n)	8 yrs %(n)	9 yrs %(n)	10 yrs %(n)	Total %(n)	
Normal	27.1 26	29.3 34	31.5 41	29.5 101	22.5 29	24.4 40	24.8 35	24.0 104	26.4 205
Wasted	-	0.9 1	-	0.3 1	-	-	-	-	0.04 1
Stunted	41.7 40	30.1 35	29.2 38	33.1 113	41.8 54	37.2 61	44.7 63	41.0 178	37.5 291
Stunted & Wasted	31.2 30	39.7 46	39.2 51	37.1 127	35.7 46	38.4 63	30.5 43	35.0 152	36.0 279

(WHO, 2001); out of which 40.6 percent were moderately anemic and 19.6 percent were mildly anemic and 0.2 percent were severely anemic. The age wise distribution of the data revealed that in

the 8 yrs age group 35.6 percent were found to be normal, 12.9 percent were mildly anemic and 50.6 percent were moderately anemic and only 0.9 percent were severely anemic. In the 9 yrs age group the categories of anemia in the same order were 39.3, 22.1 and 38.6 percent and none of them were severely anemic. In the 10 yrs age group the categories of anemia occurred as 43.2, 22.5, 34.3 percent and none of them were severely anemic. A high percent of moderate anemia was prevalent in all the three age groups.

Table 2: *Percent Prevalence of Anemia among School Going Children*

Status (Hb µg/dl)	Boys				Girls				Grand Total %(n)
	8 yrs %(n)	9 yrs %(n)	10 yrs %(n)	Total %(n)	8 yrs %(n)	9 yrs %(n)	10 yrs %(n)	Total %(n)	
Non anemic (≥ 11.5)	36.5 (35)	38.8 (45)	45.4 (59)	40.6 (139)	34.9 (45)	39.6 (65)	41.1 (58)	38.7 (168)	39.6 (307)
Mild anemia (10 to <11.5)	15.6 (15)	41.4 (48)	35.4 (46)	31.9 (109)	10.8 (14)	8.5 (14)	10.6 (15)	9.9 (43)	19.6 (152)
Moderate anemia (7.5 to <10)	47.9 (46)	19.8 (23)	19.2 (25)	27.5 (94)	52.7 (68)	51.8 (85)	48.2 (68)	50.9 (221)	40.6 (315)
Severe anemia (<7.5)	-	-	-	-	1.6 (2)	-	-	0.5 (2)	0.2 (2)

The gender wise segregation of the data revealed that 40.6 percent of boys were non-anemic and the remaining 59.4 percent belonged to the mild (31.9 percent), moderate (27.5 percent) degrees of anemia. A high percent (45.4) of boys in the 10 yrs age group were normal while high percent (41.4) of 9 yrs olds boys were mildly anemic. Further, a high percent (47.9) of 8 yrs age group boys were suffering from moderate anemia.

With regard to girls the percentage in non-anemic group was 38.7. Of the remaining 61.3 percent of anemic group a highest percent 50.9 were in the moderate degree of anemia followed by a lower percent (9.9), in mild anemia when compared with boys. The percent of girls in the non-anemic group was 34.9' 39.6 and 41.1 in the 8, 9, 10 yrs respectively. With the increasing age the percentage of girls in the non-anemic state also increased as in the case of boys. However, the moderate degree of anemia showed a highest prevalence in all age groups of girls when compared to boys.

Due to the utilization of different thresholds to judge Fe deficiency among children belonging to other communities, a comparison of the prevalence rates recorded in the current study may not project the true trends. It is generally observed that ID is the most common micronutrient deficiency. The frequency of ID among school children other developing countries have been reported to vary from 16 to 21.6 percent (Al-Othaimeen et al., 1999; Hashizume et al., 2003). This is higher than that of the 54 percent observed in the present study which is conducted in the same town, Tirupati. The high prevalence observed in ID may be due to the fact that all children are from the low income families.

Any attempts to examine the role of diet in the aetiology of ID must take into account the factors that inhibit or enhance Fe absorption. The consumption of heme Fe having better bioavailability is observed to be low among these children of low socioeconomic classes. Meat products such as red meat, poultry and fish represent excellent sources of heme iron. However, the cost of these products often restricts access to the poorest in developing countries (Bhargava et al., 2001). The limited economic potentiality of Low SES households could probably explain why boys and girls of poor families were found to have lower consumption of red meat and fish and hence lower intake of highly bioavailable iron.

Polyphenol-containing beverages, such as tea, are known to reduce nonheme iron bioavailability by the formation of insoluble complexes (Reddy et al., 2000). Tea consumption is observed to be frequent among the children.

ID was probably the most common cause of anemia. However, anemia could also be due to other factors such as deficiencies of folate, vit-B_{12} or vit-A, chronic infections and inflammations and hemorrhages (WHO, 2001). Low intake of Fe, poor bioavailability of Fe from the Indian diet and rising trend of consumption of “empty calorie” foods were suggested to be the main causes of anemia in the school going children (Verma et al., 1998).

In the present study the nutritional state viz., the Hb levels were different for the different nutritional grades. The Hb levels of N group were in the normal range and that of the S and SW children recorded values below the cut offs. It is evident that better nutrition status maintains better the micronutrient levels of the children.

In the present context 60 percent of school going children was anemic with Hb levels < 11.5 g/dl. The data thus reveal that a high percent of children in every age group were suffering from moderate degree of anemia followed by mildly anemic state. There is a wide range in the prevalence of anemia reported among children. An in-depth survey of 2,998 children ages 8-9 and 12-13 yrs in Ghana and Tanzania revealed that 77 percent of children in Tanzania and 41 percent of children in Ghana were suffering from IDA (Partnership for child development, 1998). In a study of 1,210 primary school children aged 7-14, in Riyadh, Saudi Arabia, an anemia level of 55.4 percent was found. The highest level (71.4 percent) was found among 14 yrs old girls (Alothainmeen et al., 1999).

In a survey of nearly 14,000 rural school children in Africa and Asia, the prevalence of IDA was more than 40 percent in five African countries (Mali, Tanzania, Mozambique, Ghana and Malawi) amongst children aged 7-11 yrs and in four African countries amongst children aged 12-14 yrs. In the two Asian countries studied, the overall prevalence of IDA was found to be considerably lower than in Africa which was around 12 percent in Vietnam and 28 percent in Indonesia among 7-11 yrs olds. Children aged 7-11 yrs were found to have lower mean hemoglobin concentrations, while IDA was found to be more common in the older age group. Girls also were found to have lower hemoglobin concentrations than boys, although the overall prevalence of IDA was higher in boys, particularly in the 12-13 yrs age group. An association between late enrollment in school, as compared to enrolling closer to the correct age, and a higher prevalence of anemia was also found (Partnership for child development, 2001). These data and findings of the present study suggest that ID and IDA continue to be a major nutritional problem projecting the need for effective control measures.

Furthermore, the higher incidence of ID reported for adolescent school girls, compared to boys shows that female gender exerts an extra effect on the prevalence of this medical condition, probably due to accessional iron losses gender might need closer surveillance (Tatala et al., 1998; Abalkhail and Shawky, 2002; Musaiger, 2002; Hashizume et al., 2004). There is a need to understand the factors associated with the high prevalence of ID among urban school children, which may predispose these children to risk of anemia during adolescence.

Among school going children low intakes of Fe, poor bioavailability of Fe from the Indian diet were suggested to be the main cause of anemia (Verma et al., 1998). Iron deficiency was probably the most common cause of anemia (WHO, 2001). The prevalence of anemia corroborates to an extent with dietary intakes of Fe. The differences in iron intake by region could explain variations in anemia prevalence.

4. Conclusion

The results of the study indicate that anemia is widespread among school going children residing in the Tirupati area. Although severe anemia was found in the 8 year old children, as most of the children studied girls were found to have an inferior nutritional status than boys. Not only a higher percentage of girls were anemic, a higher proportion of girls in comparison to boys suffered from more serious grade (moderate) anemia.

The prevalence of anemia clearly point to that particularly in the developing countries. And anemia even now remains a public health problem as evidenced from the prevalence data of the past few decades and the recent.

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