IRON DEFICIENCY ANEMIA THROUGHOUT THE LIFECYCLE IN RURAL BANGLADESH

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IPHN

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National Vitamin A Survey
1997-98

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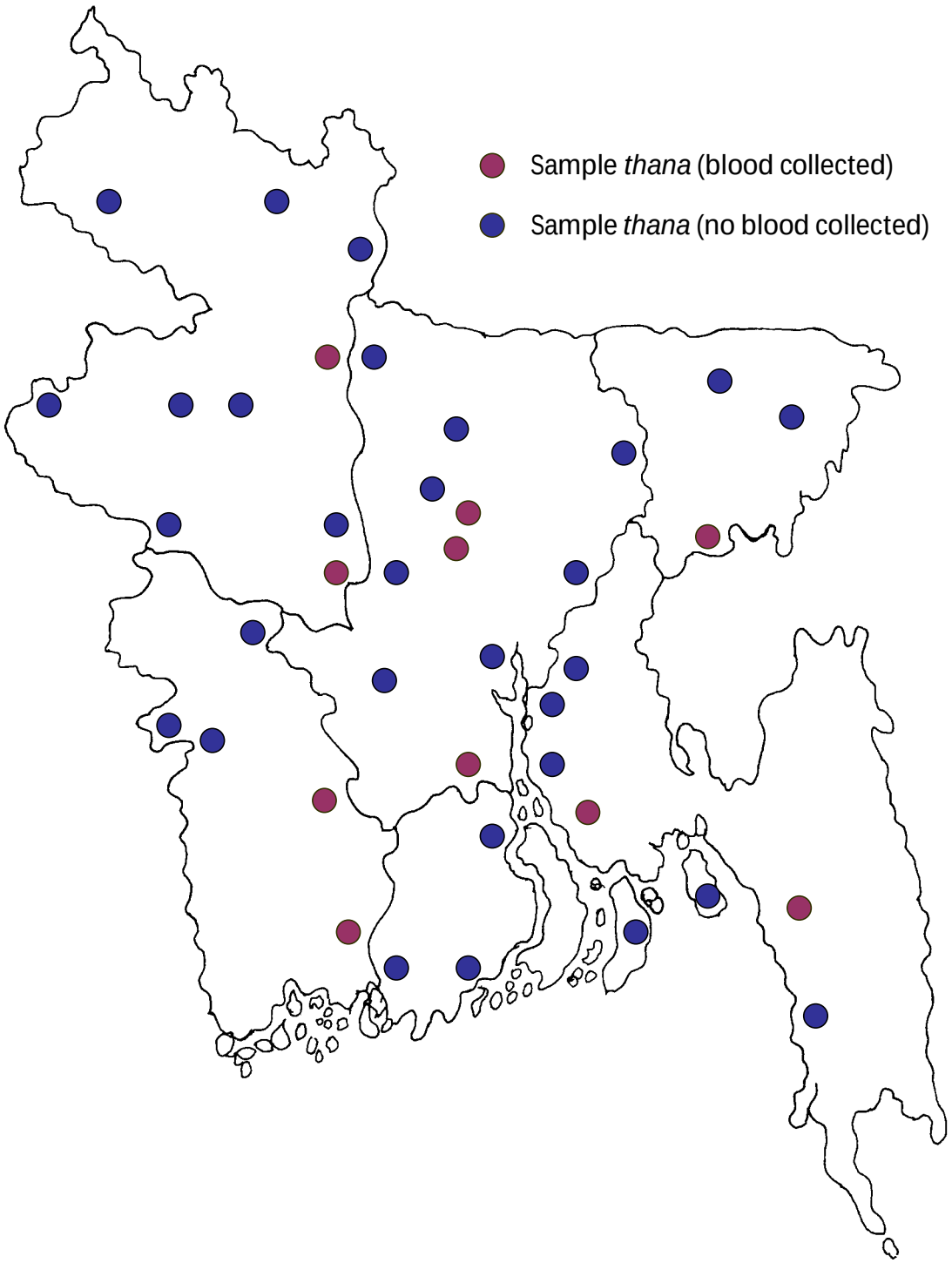
VA Survey Sites



Executive Summary

Iron deficiency and iron deficiency anemia (IDA) are major health and nutrition problems that affect more than 3.5 billion people (WHO, 1998). IDA is common among women, children and adolescent girls because they have higher iron requirements. Severe IDA among women of reproductive age is associated with increased risk of maternal mortality, while more moderate forms of IDA are associated with increased risk of infection and lower productivity (WHO, 1992; Hussain, 1991; DeMaeyer, 1985). IDA among children is associated with slow cognitive and psychomotor development and increased risk of infections (Lozoff, 1996; De Andraca, 1990; Walter, 1989).

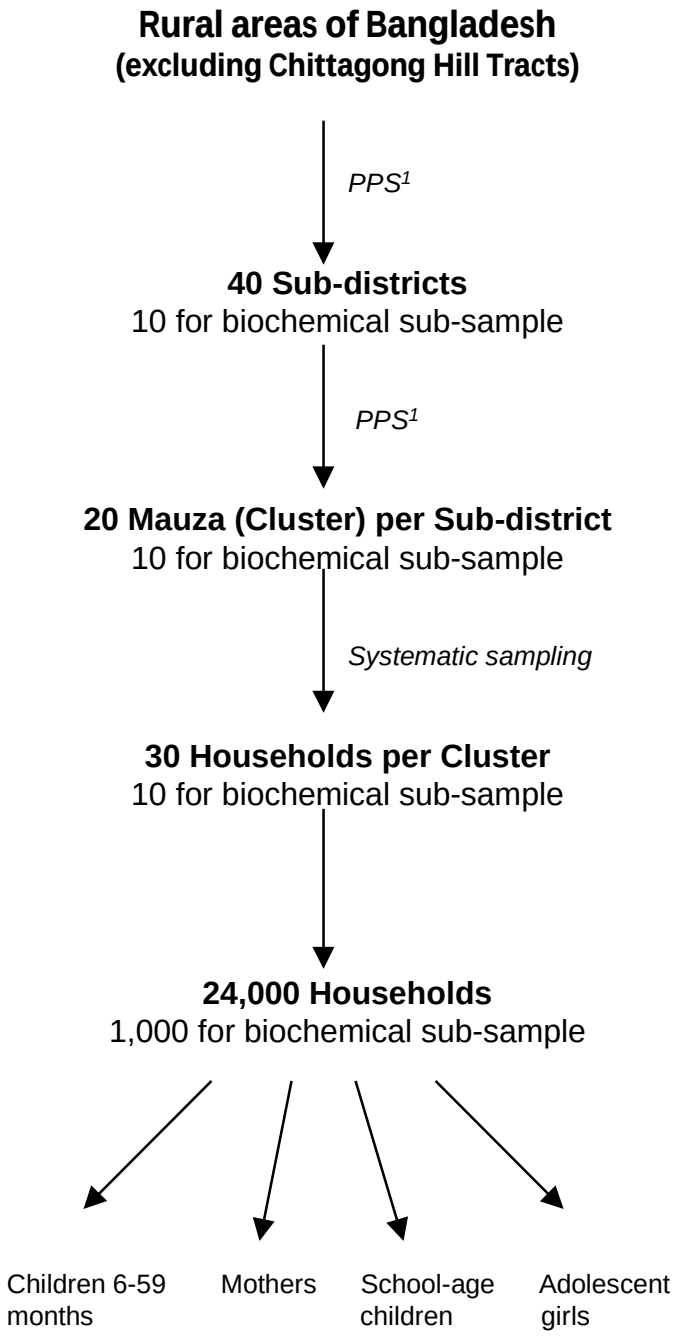
Although the causes for anemia are broad, IDA is the most common form of anemia in non-malaria endemic areas such as Bangladesh. One of the main causes of IDA is inadequate intake of iron -- due to either low intake of iron-rich foods, poor absorption of dietary iron because the main source is plant origin, high intake of foods that interfere with absorption of iron (tea, cassava), or low intake of iron absorption enhancers, such as vitamin C. IDA can also result from hookworm infection and other illness that cause high blood loss. There are several stages of iron deficiency, however, anemia, the final stage, is most commonly measured. Some experts suggest that the prevalence of iron deficiency is almost twice the prevalence of IDA.

Despite the enormous health and economic implications of iron deficiency, programs to address IDA are limited. In part, the lack of programs to prevent and control anemia is due to the lack of accurate, representative data on the prevalence of anemia among preschool children, women of reproductive age, and other sectors of the population. Policy makers, program managers, communities and families are not aware of the magnitude of the problem or the serious consequences that result from IDA. This report presents estimates of anemia among women, preschool children, school-age children and adolescent girls, and identifies key risk factors associated with anemia in these sub groups in rural Bangladesh. The data were collected from a nationally representative sub-sample of households as part of the national Vitamin A Survey in late 1997. The information will hopefully stimulate awareness about the serious magnitude of the problem of IDA in Bangladesh and stimulate the development and expansion of programs to tackle IDA to improve the health, productivity and cognitive development of Bangladeshi women and children.

Summary of Findings

- The findings from the survey suggest that approximately 52.7 percent of Bangladeshi children between 6-59 months are anemic (hemoglobin levels below 11.0 g/dl).
- This overall rate of anemia among this age group masks the high rates that were found among younger children. The prevalence of anemia (Hb <11.0 g/dl) was 78 percent among children 6-11 months of age and 64 percent among children 12-23 months of age.
- IDA in preschool children was more common among children with other forms of malnutrition (stunting and low serum retinol concentration) and among children living in households with poor sanitation practices. Children were more likely to be anemic if their mother was also suffering from anemia. Childhood anemia was also related to the diet and to the mother's propensity to purchase special foods for the household. We observed no difference in the prevalence of anemia between girls and boys in the survey sub-sample.
- Anemia among pregnant and non pregnant women of reproductive age is also common. Approximately 50 percent of pregnant women and 45 percent of non pregnant women suffer from anemia (using cutoff values for hemoglobin concentration of < 11.0 and 12.0 g/dl, respectively).
- The key factors associated with maternal anemia in rural Bangladesh included malnutrition (low body mass index and vitamin A deficiency), lactation demands, no use of family planning and extreme poverty. Total fertility, age, own education, or sanitation practices during the most recent pregnancy were not associated with anemia among non pregnant women.
- Approximately 28.6 percent of adolescent girls age 11-16 years of age had hemoglobin levels below 11.5 g/dl and 43.0 percent below 12.0 g/dl.
- Among school age children 6-11 years of age, 38.4 percent of the sample had hemoglobin levels below 11.5 g/dl and 55.5 percent had hemoglobin below 12.0g/dl.

Sampling Strategy for Vitamin A Survey



[1]Population proportonational to size

Programmatic Recommendations

The survey findings confirm that anemia is a major problem among pregnant and non-pregnant women and preschool children, adolescent girls and school children in rural Bangladesh. Pregnant women have been the primary targets of programs to improve iron status, through iron supplementation, but have been only moderately successful in Bangladesh and other countries (Yip 1996, Yip 1994). The findings suggest that more efforts are needed to expand and refine programs for pregnant if we are to reach the goals for 2000 and 2010 set by the National Plan of Action for Nutrition to reduce anemia (MOHW, 1997). Supplementation during pregnancy has been shown to improve iron status of women and their newborn children. Only a very small percentage of women received iron tablets at any point during pregnancy and almost no women were supplemented for the full period. Even fewer received iron tablets during post partum as recommended. The delivery of iron or multi-micronutrient supplements as part of antenatal care services needs to be improved. Improving iron tablet supplementation requires earlier, more frequent antenatal visits. Adequate supplies of iron tablets should be available at all levels of the health care system. Health care professionals should benefit from training to ensure they have sufficient knowledge of anemia and iron deficiency and are well-informed to counsel women and other household members. Community-based programs to create demand and awareness among women and communities about the benefits of iron and the risks of anemia will encourage women to seek supplementation during the antenatal and postnatal periods. Community awareness, efficient supply systems and training will improve program effectiveness. Programs to increase iron intake among lactating women should also be supported – either through fortification of common foods, increased consumption of iron-rich foods, or supplementation. The dietary patterns of rural Bangladeshi women suggest that women also consume inadequate amounts of VA, zinc and other important nutrients. Supplementation with multi vitamin and mineral tablets might be considered.

Because IDA during childhood can lead to slowed cognitive development and poor health, programs to improve iron status of infants are desperately needed, as are programs for preschool, school-age and adolescent girls. Large scale programs to improve iron status of children are less common, but EPI and growth monitoring contact points might be used to deliver iron or multi micronutrient supplements.

The findings suggest that there are clear synergies between iron deficiency and overall nutritional status, therefore programs should be done to address macro and micro nutrient deficiencies simultaneously. Recent work suggests that prevention and treatment of anemia has a very high cost-benefit ratio (Murray,1996). While the technical know-how exists, implementing effective programs to control and prevent anemia is still a major challenge. A multi-faceted approach, including health, agriculture and commercial food sectors is likely to have the greatest success in accomplishing a reduction in IDA. Innovative ways to increase the coverage and compliance of iron supplementation programs without intensive supervision (which is often not sustainable) are needed. Supplementation programs should be implemented in tandem with food fortification and IEC activities to increase consumption of animal foods and to improve the demand for and compliance with iron supplementation (tablets, syrup or multi-vitamins). Recognizing that iron deficiency affects individuals throughout the life cycle suggests that future programs will need to reach different sub-segments of the population.

Table 1*. Hemoglobin (Hb) levels below which anemia is judged to be present*[1]

Group/age/physiologic status	Hemoglobin (g/dl)
Children	
6 months to 5 years	11.0
5-11 years	11.5
12-13 years	12.0
Men	13.0
Women	
Nonpregnant	12.0
Pregnant	11.0
Severe anemia	7.0
Very severe (life threatening	4.0

[1]Source: WHO/UNICEF/UNU (1997), adapted from WHO (1968).

Introduction

Iron deficiency anemia (IDA) is a major health problem that affects more than 3.5 billion people or one-third of the entire world (WHO, 1998). Pregnant and lactating women and young children are more likely to suffer from anemia and face severe consequences from being anemic because they have very high requirements for iron. Severe anemia among women of reproductive age is associated with increased risk of maternal mortality. Mild to moderate anemia in adults also increases the risk of infection, and lowers productivity ((WHO, 1992; Hussain, 1991; DeMaeyer, 1985). Anemia among preschool children may irreversibly delay cognitive and psychomotor development and lowers resistance to infection (Lozoff, 1996, De Andraca, 1990; Walter, 1989, Dallman, 1987).

One of the main causes of IDA is inadequate intake of iron -- due to either low intake of iron-rich foods, poor absorption of dietary iron because the main source is plant origin, or high intake of foods that interfere with absorption of iron (tea, cassava). Iron deficiency anemia can also result from hookworm infection, and other illnesses that cause high blood loss. Although the causes of anemia are broader, including malaria, inherited diseases such as hemoglobinopathies, and deficiencies of other nutrients such as B12, B6 or folate, iron deficiency is the most common form of anemia in non-malaria endemic areas such as Bangladesh.

Nationally representative data of anemia, using reliable methods, among children, women of reproductive age, and other risk-groups in Bangladesh is limited. Several important studies have been conducted looking at anemia and iron status among garments workers, urban children, adolescents, and pregnant women (Ahmed, 1992, 1996, Kolsteren, 1999). While these studies provide useful insight on possible risk factors for anemia in these sub-groups, information to assist the government and NGOs to advocate for and to design, plan and evaluate large-scale anemia prevention programs on a population level has been limited. The following study, conducted as part of the National Vitamin A survey in 1997/98, was undertaken to obtain national estimates of anemia among women and preschool children and to identify key risk factors associated with anemia in these sub groups in rural Bangladesh. The findings from this study can be used to advocate for greater resources to control anemia and to facilitate the development of programs to prevent anemia.

Methods

The data presented below were collected during the 1997/98 vitamin A survey of rural Bangladesh. A random sub-sample of households from the VA survey population (nationally representative) was selected to assess serum retinol and hemoglobin concentration. Blood samples were collected from households in 10 clusters each in 10 rural thanas. (Survey design diagram on page 2) A trained nurse drew venous blood samples (5 ml) from a mother-child pair in the randomly selected households. If an adolescent girl or school-age child was also residing in the household, the survey team attempted to obtain a blood sample from them as well. Hemoglobin concentration was measured using the Hemocue®. Hemoglobin concentrations were recorded on the questionnaire forms immediately after obtaining the reading and shared with the households. Household consent was taken prior to starting the interview and blood collection. Hemocue machines were calibrated daily with special calibration microcuvettes according to manufacturer recommendations. To limit exposure to humidity, open vials of microcuvettes were discarded after 7 days. Women or children with hemoglobin values below 7.0 g/dl were immediately referred to the thana health complex or union health center for further diagnosis and treatment.

In addition to collecting blood samples, the survey teams interviewed households to obtain information on child and maternal health, food consumption, family planning, and homestead food production activities. Children and women were weighed and heights were measured to construct common anthropometric indices of nutritional status. This information was used to identify factors that were associated with a higher risk of anemia and to examine the effectiveness on ongoing programs and interventions such as iron supplementation.

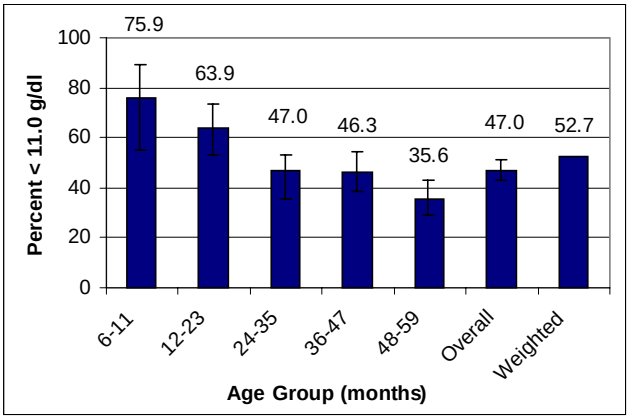
Findings

Pre-school Children

Using the INACG and WHO recommendations that hemoglobin levels below 11.0 g/dl among children signals anemia, the overall prevalence of anemia among preschool children (age 6-59 months) in the

survey sample was 47.2 percent (95% CI 42.9-51.0). The age of children in the sub-sample differed significantly from the sample, therefore an age-adjusted estimate of anemia among rural preschool-age children is 52.7% (95% CI). The mean hemoglobin concentration among preschool children was 10.9 g/dl (95% CI, 10.90-11.03). The prevalence of anemia by age groups is presented in Figure 1. As shown, 78 percent among children less than 11 months of age and 64 percent among children 12-23 months of age were anemic. Rates of anemia declined steadily with age and were lowest among children 48-59 months of age. High rates of anemia among the youngest children might be associated to low birth weight, a condition that affects 35-50 percent of all newborns in Bangladesh (World Bank, 1995). Maternal anemia, which is also high in Bangladesh, is also a likely contributing factor to the high levels of anemia among infants in Bangladesh. Low stores of iron at birth and dietary intakes of iron in the first two years of life are the likely causes of anemia in these children. Because the prevalence of anemia during childhood declines with increasing age, the cause is less likely to be with hookworm (which would be as or more common in older children who are highly mobile).

***Figure 1**. Prevalence of anemia by age group among preschool children, rural Bangladesh (n=1199)*



Although the prevalence of anemia among preschool children is high, severe anemia was not common. Only 5.2% of children less than 5 years of age in the survey sample had hemoglobin values <9.0 g/dl (Table 2).

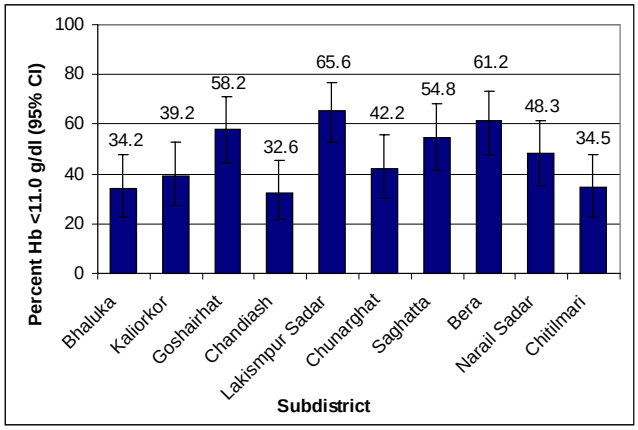
The prevalence of anemia among preschool children also varied significantly by geographic area

***Table 2**. Distribution of hemoglobin (g/dl) levels among children 6-59 months, rural Bangladesh (n=1199)*

Hemoglobin range	%
<8.0	1.7
8.0-8.9	3.5
9.0-9.9	12.2
10.0-10.9	29.6
11.0-11.9	34.6
≥ 12.0	18.4

(Figure 2). More than 60 percent of children in Bera *thana* (Rajshahi Division) and Laksmipur Sadar *thana* (Chittagong Division) were anemic. Anemia prevalence was also greater than 50 percent in Goshairhat *thana* (Dhaka Division) and in Saghatta *thana* (Rajshahi Division). Less than 40 percent of children in Chandanaish *thana* (Chittagong Division), Chitalmari *thana* (Khulna Division), Bhaluka *thana* and Kaliorkor *thana* (Dhaka Division) were anemic.

***Figure 2**. Anemia (Hb < 11.0 g/dl) among children 6-59 months by subdistrict, rural Bangladesh (n=1199)*



To identify the factors that put children at greater risk of being anemic, we examined the association between anemia and various household, maternal and child characteristics. Anemia among preschool children in the sub sample was found to be associated with poor nutritional status and child illness. Stunted children (height for age < -2 SD) were 1.8 times more likely to be anemic than children who were not stunted (height for age ≥ -2 SD). Children with diarrhea in the past 24 hours were also 1.6 times more likely to be anemic than were children who were not suffering from diarrhea. The risk of anemia was similar for boys and girls.

Anemia among preschool children in rural Bangladesh was also associated with low maternal education, maternal anemia and poor maternal nutritional status. Children whose mother had no formal education were approximately 1.4 times more likely to be anemic than children whose mother had at least one year of formal education. Children whose mothers were anemic were 2.0 times more likely to be anemic than children whose mothers were not anemic. Children whose mothers reported not being able to buy special foods for the household were 1.7 times more likely to be anemic.

Similarly, the risk of being anemic was associated to several household socioeconomic characteristics. Children residing in 'severely vulnerable households'[1] were 1.8 times more likely to be anemic compared to children of less vulnerable households. Children whose father had no formal education were 1.4 times more likely to be anemic than children whose fathers had at least one year of formal education. The risk of childhood anemia was also significantly greater among households who had improper household sanitation.

Multivariate analysis was conducted to identify the factors that were most strongly associated with anemia among preschool children. Controlling for other factors including breast feeding status and number of siblings, children less than 24 months of age were more likely to be anemic than children greater than 24 months of age. Children who were stunted were more likely to be anemic than children who were not stunted. Maternal anemia was associated with childhood anemia, suggesting that households are at increased risk of anemia. Maternal education and household poverty were not associated with anemia when other variables were included in the model; however, children in households where the mother did not buy special foods were more likely to be anemic than were children whose mothers reported buying special foods. Women's propensity to buy special food was most strongly associated with level of education. This suggests that mothers with formal education may have more purchasing power and may be more likely to purchase or influence purchasing decisions to obtain micronutrient-rich foods for their family with available resources. As a result, their children are consuming a better diet. When other factors are taken into account, neither household oil intake or homestead food production schemes such as poultry raising or homestead gardening were associated with an increased risk of anemia in pre-school children.

Mothers

Descriptive statistics for hemoglobin levels among women in the sub-sample are presented in Table 3. Overall, 50.0 percent of pregnant women and 48.7 percent of lactating women and 38.4 percent of non-lactating women were found to be anemic according to the respective cut-off points established by INACG/WHO cut-off points (WHO, 1997). The mean and median values within each of these subgroups are comparable.

Table 3*. Hemoglobin (g/dl) concentration and anemia among sample women by reproductive status*

Reproductive status (n)	Anemia Prevalence (95% CI)	Mean (SD)
Pregnant women[1] (120)	49.2 (36.2, 62.3)	10.9 (14.7)
Non pregnant[2] (1082)	45.0 (40.9, 49.5)	12.0 (15.2)
Lactating (694)	48.7 (43.3, 54.0)	11.9 (14.6)
Non lactating (388)	38.9 (32.1, 46.2)	12.2 (13.9)

[1] < 11.0 g/dl

[2] < 12.0 g/dl

For comparison of the Bangladesh data to other countries, data presented by Stoltzfus was appended in Table 4 (Stoltzfus, 1997). The table below suggests that overall anemia prevalence among pregnant women in rural Bangladesh is slightly higher than in China, but considerably lower than anemia/hemoglobin levels in Nepal. The prevalence of moderate and severe are particularly low among non-pregnant women. The sample size for pregnant women is small and cautious interpretation of the Bangladesh data on pregnant women should be taken.

[1]Household vulnerability is a composite index of land ownership and stability of employment. 'Less vulnerable households' own land and have permanent employment. 'Moderately vulnerable households' either own land or have permanent employment. 'Severely vulnerable households' do not own land and rely on casual labor.

***Table 4**. Hemoglobin distributions (g/dl) across countries*[1]

Country	n	% below cut-off[2]	<10.0	<9.0	<8.0	<7.0
Bangladesh, pregnant	***120***	***50.0***	***23.4***	***9.2***	***2.5***	***0.0***
Nepal, pregnant	1052	69.8	40.5	20.8	9.5	4.9
Shanghai, pregnant	829	66.2	25.3	5.5	0.8	0.2
Peru, pregnant	670	44.3	14.5	4.3	<0.1	<0.1
Bangladesh, not pregnant	***1089***	***45.0***	***6.9***	***3.1***	***1.7***	***0.9***
Zanzibar, not pregnant	583	71.7	26.2	13.0	8.9	5.3
Indonesia, rural[3]	3507	21.5	1.2	0.2	0.1	0
Indonesia, Jakarta slums[3]	1284	46.7	9.8	5.3	0.9	0.2

[1]Adapted from Stoltzfus, et. Al., 1997

[2]<11.0 g/dl for pregnant women, <12.0 g/dl for non pregnant

[3]Nutrition Surveillance System, HKI/Indonesia, 1999

Factors Associated with Maternal Anemia

Analyses were conducted to identify factors associated with anemia among non pregnant women in rural Bangladesh. Similar analyses were not conducted for pregnant women because of the small sample size. The findings suggest that a number of household and maternal characteristics are associated with an increased risk of anemia among women in rural Bangladesh. The prevalence of anemia among women of reproductive age was associated with household vulnerability status and land ownership, paternal education, household crisis, oil intake and type of sanitation facilities. Women in extremely vulnerable households were 1.8 times more likely to be anemic than women from less vulnerable households. Interestingly, women from households with no, marginal or even ownership of a small parcel of land were at similar risk of anemia compared to medium to large landholding households. Women in households who are affected by crisis – measured by whether a household had to take a loan for food in the month preceding the interview -- were 1.6 times more likely to be anemic than were women in households who did not take a food loan. Women who resided in households with an open latrine or whose households had caloric intake from oil below the population median intake (6.9 gms/person/day) were also at greater risk of anemia. Anemia was also associated with husband's level of formal education. Based on these analyses, anemia among rural women is clearly associated with household socioeconomic status.

Anemia prevalence was also associated with a number of demographic and health characteristics of the women themselves. The risk of anemia increased with increasing fertility rates. Women who had 3-6 pregnancies were 1.6 times more likely to be anemic than women with only 1-2 pregnancies. Women with 7 or more pregnancies were 2.1 times more likely to be anemic than were women with only 1-2 pregnancies. A similar pattern was observed for the number of children less than 5 years of age. Anemia was also associated with chronic energy deficiency (body mass index < 18.5). Women with CED were 1.8 times more likely to be anemic than were women with normal BMI. Non pregnant women who were breastfeeding were at 1.5 times greater risk of anemia than were women who were not breastfeeding. The woman's level of education and diarrhea were also associated with greater risk of anemia. The risk of anemia was also lower among women using oral contraceptives and among women who took iron tablets at some point during their most recent pregnancy.

Using the information from the bivariate analyses, multivariate analysis was conducted to identify the key factors associated with anemia among non pregnant women in the study population. Anemia was most strongly associated with body mass index, use of family planning, age of the youngest child, vitamin A status, diarrhea, intake of animal foods and extreme poverty.

Adolescent Girls

Among adolescent girls (age 11-16 years), 28.5 percent of the sample had hemoglobin levels below 11.5 g/dl and 43.0 percent had hemoglobin below 12.0 g/dl. The distribution of hemoglobin is presented in Table 5. The prevalence of anemia was similar to the prevalence of anemia among adolescent girls in rural Indonesia just prior to the economic crisis there.

School-Age Children

Among school age children 6-11 years of age, 38.4 percent of the sample had hemoglobin levels below 11.5 g/dl and 55.5 percent had hemoglobin below 12.0 g/dl. The distribution of hemoglobin is presented in Table 6. Only a small percentage of children in the sub-sample had severe anemia (hemoglobin <9.0 g/dl).

***Table 6**. Hemoglobin distribution (g/dl) for school-age children in the survey sample (n=328)*

Hemoglobin range	%
<9.0	2.1
9.0-9.9	5.8
10.0-10.9	13.7
11.0-11.9	33.9
12.0-12.9	33.5
>13.0	11.0

***Table 5**. Hemoglobin distribution (g/dl) for adolescent girls, rural Bangladesh (n=196)*

Cutoff	N	< 9.0	< 10.0	< 11.0	<11.5	< 12.0	< 13.0
Bangladesh	200	1.0	4.6	15.3	28.6	43.0	79.6
Indonesia[1]	818	1.1	5.0	10.7	30.9	42.5	76.0

[1]HKI/Indonesia GIRLS Project, March, 1998 (12-16 years of age)

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NSP Partner Organizations (For VA Survey)

ACTIONAID, Bangladesh
Association for Social Advancement (ASA)
Bangladesh Rural Advancement Committee (BRAC)
Comilla PROSHIKA
Dhaka Ahsania Mission (DAM)
Family Planning Association of Bangladesh (FPAB)
Gono Kallyan Sangstha (GKS)
Gono Unnayan Prochesta (GUP)
Grameen Jano Kallyan Sangsad (GJKS)
Institute of Public Health Nutrition (IPHN)
International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR,B)
Palli Bikash Kendra (PBK)
Plan International
Rangpur Dinajpur Rural Services (RDRS)
Society for Health Extension and Development (SHED)
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Village Education Resource Centre (VERC)

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