

***Final Report of the 1995 Viet Nam National Nutrition Anemia  
and Intestinal Helminth Survey***

**A Recommended Plan of Action for the  
Control of Iron Deficiency for Viet Nam**

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## Summary

The 1995 Viet Nam National Nutrition Anemia and Intestinal Helminth survey confirms that iron deficiency affects in majority younger children, women of child-bearing age, and some men. The age-specific pattern of anemia indicates that poor iron nutrition during infancy is the major determinant for iron deficiency during early childhood. The focus of intervention for children is to increase iron intake during late infancy by improved complementary feeding or by iron supplementation. Because of the high prevalence of iron deficiency anemia among non-pregnant women, strategy to improve maternal anemia requires provisions to improve iron status prior to pregnancy. Supervised iron supplementation to adolescent girls in school or young women in work sites can be considered an approach. The finding of high prevalence of hookworm infections among women in some areas of the country, and the strong association of the intensity of infection with iron deficiency anemia indicate that control of intestinal helminth should be a major component of the iron deficiency control program. Such activity can include deworming for both pregnant and non-pregnant women, and improvement of environmental sanitation among the more affected areas. Targeting of the intestinal helminth control program can be based on the low socioeconomic status of the communities in the more affected provinces identified by the survey. Other specific activities that can lead to the improvement of iron nutrition for women include the feasibility evaluation of iron fortification of sugar and imported flour, and strengthening the iron supplementation program for pregnant women through the MCH system. Development of epidemiologic and laboratory capacity of NIN for the long-term monitoring of iron deficiency anemia and intestinal helminth is also recommended as part of the program development to improve iron nutrition.

## The survey

This national survey was designed to provide estimates of specific health and nutrition conditions down to the level of seven major ecological zones for the country. The survey was carried out in August 1995 with 20 communities (clusters) selected, based on population proportion for each zone, and every province contributing one or more clusters. For each cluster, 40-50 families were surveyed, and one child under five, mother and father were surveyed for each family. Approximately ten thousand households and thirty thousand individuals were surveyed.

This survey was not designed to provide an adequate estimation down to the provincial level. However, the utilization of provincial-based information in this report is useful in demonstrating the relationship of major risk factors affecting nutritional status at the community level. Such demonstration of consistency as well as variation of nutritional status and factors affecting them allow for the determination of program action that is either better suited for a generalized action or for local specific action.

*Detail of the nutrition anemia and intestinal helminth survey.* see the report on survey design and plan (NIN/CDC, April 1995)

*Descriptive findings of the survey.* see report of the national anemia and nutrition risk factor survey, Vietnam, 1995 (CDC, August 1996)

### **Defining anemia and Iron deficiency anemia**

For this survey, hemoglobin level and prevalence of anemia are the primary indicators for iron deficiency. A small subset of the samples near Hanoi also had serum ferritin determination which is more specific in defining iron status. In general, when the prevalence of anemia is high, i.e., >20-30%, the majority of the anemic cases can be attributed to iron deficiency.

For this report, the prevalence of anemia is defined with the WHO criteria (Children, Hb<11.0; women, Hb<12.0, Pregnant women, Hb<11.0, and men, Hb<13.0). To estimate the prevalence of iron deficiency anemia, newly developed Viet Nam-specific anemia criteria were used based on a sub-sample of men in this survey who were unlikely to have iron deficiency. Detailed rationale and description of the procedure for the formulation of the Viet Nam-specific or "NIN anemia criteria" for the estimation of iron deficiency anemia are presented in **Appendix A**. The NIN criteria are set at 1.0 g/dl lower than the more up-to-date anemia criteria developed by ( Hb<10.0; women, Hb<11.0, Pregnant women, Hb<10.0, and men, Hb<12.5).

#### **Important note:**

*The WHO anemia criteria.* For the purpose of international comparison, and long term monitoring of population iron status, the continual utilization of the commonly used WHO criteria of anemia are indicated. Anemia based on these criteria reflects both iron deficiency anemia and anemia due to other causes.

*The Viet Nam-specific or NIN anemia criteria.* To estimate the prevalence of anemia which can be attributed to iron deficiency, and for the in-depth understanding of the relationship of iron status and anemia prevalence, the Viet Nam-specific anemia cutoff has the advantage of giving a more accurate characterization. It is important that when the Viet Nam-specific criteria are used in future reports, the specific cutoff values and the background of these criteria are provided as part of the study methods.

### **Key findings related to anemia and iron status**

*Overall Prevalence of anemia.* The prevalence of anemia for children, women,

and men for the entire survey based on both the WHO and Viet Nam-specific or NIN criteria and the 90% range of prevalence for the 53 provinces surveyed are shown in table 1.

**Table 1.** Prevalence of anemia and iron deficiency anemia plus range of prevalence across the communities surveyed. The WHO criteria-based prevalence reflects overall prevalence of anemia (iron deficiency and others), and the NIN criteria provide an estimate of prevalence for anemia related to iron deficiency. Detail of the NIN criteria see Appendix A.

	Prevalence of <b>anemia</b> based on WHO Criteria for anemia (90% range across the province)	Prevalence of <b>iron deficiency anemia</b> based on the NIN Criteria for anemia (90% range across the province)
Children 0.5 - 5 years	46.6% (27.8 - 63.7)	21.4% ( 9.2 - 40.3)
Children 0.5 -1.9 years		31.4% (13.8 - 51.6)
Children 2 - 5 years		10.3% ( 0 - 27.8)
Non-pregnant women	42.8% (18.8 - 60.0)	19.0% ( 3.8 - 36.4)
Pregnant women	52.5% (39.2 - 75.2)	24.2% (24.1 - 45.5)
Men	28.3% (5.0 - 52.9)	10.1% ( 0 - 23.5)

The difference of prevalence of anemia between the two criteria resulted in a discrepancy of 20% in the prevalence of anemia. This 20% can be regarded as "anemia due to reasons other than iron deficiency". The estimates of iron deficiency anemia using the NIN criteria are based on a reference without iron deficiency but not excluding other reasons for lower hemoglobin values. The prevalence based on the WHO criteria represents anemia caused by iron deficiency and other causes combined.

There are great deals of variations of prevalence of anemia across the communities in all provinces surveyed indicating there are rather diverse ecological and socioeconomic conditions across the country.

*Estimation of the prevalence of iron deficiency based on the prevalence of iron deficiency anemia.* Iron deficiency anemia represents the more severe end of the

iron deficiency spectrum, and from previous studies it is clear that a population is affected by iron deficiency about 2-3 times more than by iron deficiency anemia. Based on this assumption, the estimated proportion of population affected by iron deficiency would be about 2 to 3 times greater than the one suffering from iron deficiency anemia based on the more strict NIN criteria. **Table 2** below provides the estimated prevalence of iron deficiency for Viet Nam.

**Note** - iron deficiency defined as having biochemical evidence of iron deficiency which includes both iron deficiency anemia and iron deficiency without anemia.

**Table 2.** Estimated prevalence of iron deficiency based on the prevalence of iron deficiency anemia using the conservative NIN criteria for anemia.

	Estimated prevalence of Iron Deficiency
Children 0.5 - 5 years	40 - 60%
Children 0.5 -1.9 years	60 - 90%
Children 2 - 5 years	30 - 60%
Non-pregnant women	40 - 60 %
Pregnant women	50 - 75 %
Men	20 - 30%

***Program implications of the findings related to anemia.*** The much higher prevalence of iron deficiency anemia for children under two than children over two suggests that iron deficiency is mainly a problem of not being able to meet iron requirement in infancy and early childhood. **Prevention of iron deficiency in childhood needs to focus on improving iron nutrition during infancy.**

The high rates of anemia or estimated prevalence of iron deficiency for non-pregnant women indicates that most women would start pregnancy with a negative iron balance which makes it even harder to acquire the necessary amount of iron through supplementation during pregnancy. **Strategy to improve baseline iron status before pregnancy must be considered.**

Men have the lowest prevalence of iron deficiency anemia, about 10% based on

the conservative Viet Nam-specific criteria. This is a very significant prevalence because in many developing countries where dietary iron intake is poor, men do not develop iron deficiency anemia. This suggests that factors other than poor dietary iron intake play a significant role in the cause of anemia. In tropical countries, hookworm infection is a likely explanation.

The high prevalence of iron deficiency affecting the majority of the children and women indicates that any intervention approach should be population based, not individual based screening and treatment.

*Relationship between anemia and iron status as assessed by serum ferritin.* For the sub-sample having also serum ferritin determination from communities near Hanoi, there were no men having a low serum ferritin (<20 ug/l) or borderline depleted iron stores (20-35 ug/l). For under five children and non-pregnant women, about half of them had low or borderline depleted iron stores. The relationship between anemia and serum ferritin value is shown in the table below.

Serum Ferritin (ug/l)	Children - Prevalence of anemia *	Non-pregnant Women Prevalence of anemia *
< 20	25.7 %	40.0 %
20 - 39	6.3%	28.9 %
40 - 59	8.5%	6.9 %
60 - 79	0%	5.4%
80 - 99	4.3 %	8.3 %
>100	-	0%

\* NIN anemia criteria

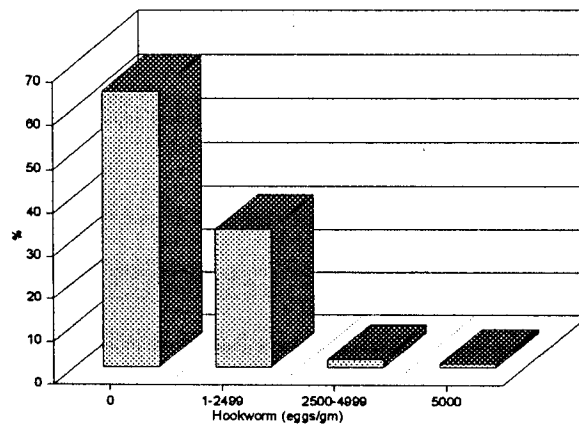
From the relationship of low serum ferritin and anemia, it is evident that only about 30-40% of the iron depleted children and women also are anemic. Therefore, an estimation that one case of iron deficiency anemia represents two to three cases of iron deficiency or iron depletion in a population appears to hold true for Viet Nam.

### Key findings related to hookworms

Detailed descriptive finding on intestinal helminth other than hookworm - ascaris, and trichuris - please see the analytical report of the NIN survey (August 1996).

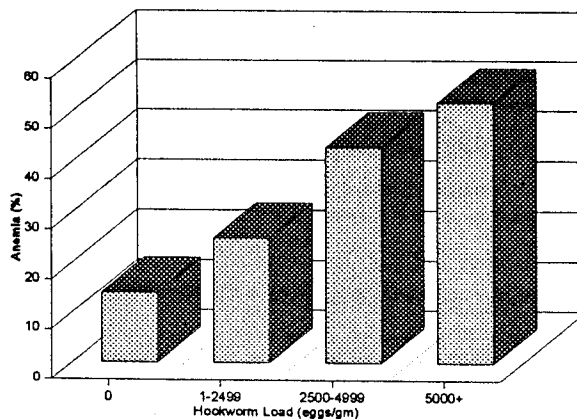
**Prevalence of hookworm infection.** A total of 5063 non-pregnant women had stool examination done as part of the Nutrition Anemia Survey from communities in all 53 provinces. The median prevalence of hookworm infection for the 53 provinces is 37% with five sample locations in the Mekong Delta Area with no hookworm found, and five locations with prevalence exceeded 80% (**Appendix B**). This diversity in prevalence indicates that the intervention program needs to be targeted for the highly endemic areas, not necessarily as a generalized national program. The distribution of hookworm intensity based on stool egg count for the entire sample is shown in **Figure 1**.

**Figure 1.** Proportion of women with hookworm infection and intensity of infections.



**Impact of hookworm infections on anemia.** The relationship between anemia and intensity of hookworm infection for women surveyed is shown in the figure below.

**Figure 2.** Prevalence of anemia at different intensity of hookworm infection



The impressive relationship between hookworm infection intensity, and the prevalence of anemia affirms the known fact that hookworm causes GI bleeding and this iron loss is a major contributor to iron deficiency anemia. It is important to point out that, only a small proportion of the affected population has high intensity of hookworm infection (Figure 1). Therefore the impact on iron status of hookworm for a population must be taken into account in both the biological impact as reflected by elevated prevalence of anemia, and the prevalence and/or intensity of the infection. In general, the intensity of hookworm infection for a population correlates with the prevalence. When the prevalence exceeds 50%, the intensity warrants mass treatment. If there are many areas within a country with low intensity or low impact of hookworm infection, a generalized deworming program may not be justified.

Using the seven ecological zones, the impact of hookworm infections on anemia expressed as "attributable fraction" or "preventable fraction" is shown in the table below. In essence, the attributable fraction can tell us, in a given population, what proportion of the observed anemia is related to hookworms. Or, if hookworm infection is eliminated, how much reduction in iron deficiency anemia can be expected. This is a useful tool for targeting beyond using the prevalence of infection itself, because it is based on impact assessment. Also, in doing so, control of intestinal helminth can be regarded as an important strategy for the control of iron deficiency.

**Table 3.** The impact of hookworm infections on iron deficiency anemia of women as expressed in attributable fractions for the seven ecological zones of Viet Nam.

Eco Zone	Iron Def Anemia without Hook - worm(%)	Iron Def Anemia with Hook-worm(%)	Relative Risk for Iron Def Anemia	Overall Prevl of Iron Def anemia (%)	Prev (%) can be attribut-ed to hook w	Attributab le Fraction (%)
1	13.8	31.7	2.30	19.2	5.4	28.1
2	12.5	13.1	1.05	12.6	0.1	1.0
3	19.8	24.8	1.25	23.1	3.3	14.2
4	18.6	28.2	1.52	22.1	3.5	15.8
5	12.7	25.6	2.02	21.9	9.2	42.0

6	10.4	27.3	2.63	17.5	7.1	40.6
7	13.0	43.2	3.21	17.6	4.6	26.1
All	14.3	26.2	1.83	19.3	5.0	25.9

From the table, it is clear that there are significant variations across the country in terms of the impact of hookworm on iron status. It would be advisable that priority be given to zones 5 (Central Highland) and 6 (South East - Surrounds of Ho Chi Minh city) for population based control of intestinal helminths as part of the effort for reduction of iron deficiency.

### Socioeconomic factors affecting anemia and hookworm infection

Almost all major factors related to socioeconomic status - education level, ownership of TV, frequency of meat consumption, lack of latrine - have a strong correlation with the prevalence of hookworm as well as iron deficiency anemia at the community level. This type of information can be helpful in the selection of communities for deworming and sanitation program in a large area, if resource does not permit a generalized program for the entire area.

One example given here is mother's education, based on percent of mother in a given community who completed more than 7 years of education. This same relationship holds true for other key variable collected, and their relationship with mother's education also shown in this table.

**Table 4:** Relationship of socioeconomic factors with anemia and hookworms in a community level based on 53 provinces.

Percent of mother >7 yr Education	Proportion of anemia >20% (%)	Proportion of hookworm > 50% (%)	Proportion eat meat < once a week (%)	Proportion with latrine (%)
<10%	50.0	50.0	100	87.5
10-19%	66.7	41.7	67	41.7
20-29%	58.3	33.3	75	41.7
30-39%	35.7	21.4	50	42.9
40+ %	28.6	28.6	14	28.6

It is well known that poor environmental sanitation hygiene is the main reason for hookworm transmission, and for the reinfection after deworming with chemotherapy. For this reason, any effort to reduce hookworm infection should include the improvement of sanitation practice and capacity of a community in conjunction with de-worming, since there is a strong correlation between hookworm infections with low socioeconomic status including lack of sanitation facilities as shown in this survey. The targeting of both deworming, and sanitation improvement programs can be based on the socioeconomic status of the small communities.

## **Recommended plan of action**

### **I. Strategic considerations for the control of iron deficiency anemia women of childbearing age women (applies to older children also)**

Based on the key findings of the 1995 NIN Survey, following approaches can be considered as intervention activities or required further development to turn into specific plan of action.

#### **I.A. Control of hookworm infections**

The survey discovered many areas which were significantly affected by hookworms and other helminth which makes it imperative to regard program for the control of intestinal helminth as an integral part of the program in reducing iron deficiency anemia. This can be done based on selecting areas with high hookworm prevalence ( $> 50\%$ ), or areas with evidence of high impact of a potential program (high attributable risk - Central Highland, and Surrounds of Ho Chi Minh city). If further targeting within an ecological zone or a province is indicated, selection of rural and improvised communities can be justified. **Appendix B** lists the prevalence of hookworm for each province based on one or more communities surveyed. Even though the provincial prevalence estimates are not based on adequate sampling, it provides a clue on the variation within each ecological zone.

*Deworming program for highly endemic area.* This is an activity that can be carried out for pregnant women through the MCH system. For the non-pregnant women, deworming should be part of the activities through new mechanism for iron supplementation. In 1994, a WHO working group on maternal anemia concluded that it is safe to provide albedazole or merbedazole to pregnant women during the second and third trimester of pregnancy. For older children or adolescent girls, administration of deworming medication through school can be considered.

*Improving environmental sanitation.* For the areas where deworming program is indicated, investment in programs to improve the basic infrastructure of the

community water and sanitation facilities, and health education to promote sanitation behavior such as the proper handling of night soil for fertilizer, and wearing shoes in the field should be considered as an integral part of the helminth control program.

## **I. Improving the base line iron status of women before pregnancy**

The significant prevalence of iron deficiency anemia even among non-pregnant women who are free from hookworm infection indicates that iron intake or bio-availability of the general diet is inadequate. The improvement of iron nutrition of the general population especially women can be justified. Even though men do suffer less from iron deficiency related to hookworm infections, a modest increase of iron content in the general diet will not pose any harm. Two major approaches to improve the base line status are:

*Iron fortification.* Explore the feasibility of iron fortification of commonly consumed food items by working with the industry sector. Potential food items include wheat flour and sugar. An assessment of the process, distribution, and level of consumption of potential commodities by consultants who are familiar with specific industry can be a helpful first step.

*Iron supplementation of non-pregnant women.* A more specific but far more effort intensive approach is to develop mechanisms to provide intermittent iron supplementation to young women under supervised conditions. For example, weekly administration of 30 mg of iron at school or factory. Or, twice monthly administration by community health workers during special gathering. The intermittent approach is to make the process feasible under supervised condition. Intermittent supplementation is a feasible approach in improving iron status for non-pregnant women because of the long period of time can be applied for iron supplementation, e.g. several years. Currently, there are several studies which have shown that such approach is feasible and can improve iron status.

## **IC Improve iron status for pregnant women through supplementation**

The widely accepted practice in providing iron supplementation during pregnancy is still an important strategy to prevent severe iron deficiency anemia, even though it has been a difficult approach to demonstrate effectiveness in many countries. The high requirement of iron during pregnancy - three times higher than in non-pregnant state - is not possible to meet by diet alone when the high rates of anemia for non-pregnant women indicate that many Viet Nam women are not able to meet their requirement even when they are not pregnant.

*Revitalize and enhance the iron supplementation program for pregnant women.*

Currently, Viet Nam does not have an active program in providing iron supplementation to pregnant women and it is occurring in limited areas. The first step is to redefine this policy and specify the role and responsibility of the MCH system for this program. In the process of reformulation of an iron supplementation program, provisions for key components of a successful program should be considered - 1) system for the procurement and distribution of iron tablets; 2) adequate maternal care delivery system; 3) adequate communication of the importance of supplementation and potential side effects to pregnant women.

### **Specific considerations for iron supplementation programs during pregnancy**

1. There are few small scale studies which suggested that weekly iron supplementation during pregnancy may achieve comparable result as the daily supplementation. The overall evidence at this point is not sufficient to recommend pragmatic adoption of the weekly approach during pregnancy. Based on the known iron requirement during pregnancy and the many women with negative iron balance at the start of the pregnancy, the calculated amount of iron that could be acquired from the weekly supplement during a relatively short period of time appears to be inadequate. For these reasons, supplementation should be based on daily administration of iron.
2. Gastrointestinal side effects are in proportion to the dosage of iron, and dosage above 60 mg carried a significant level of risk of side effects. Also, iron absorption efficiency inversely proportion to the dosage hence higher dosage only provides limited gain in additional iron absorbed. Given the relatively poor iron status of many women at the start of pregnancy, a daily dosage of 60 mg appears to be optimal.
3. It is a common practice in other countries to provide iron tablets for 90 or 100 days during pregnancy. Given the high iron requirement, the length of administration should be from the earliest time when pre-natal care starts, and until the post-partum period. Or, minimally until the end of pregnancy.
4. Provide iron supplementation to post-partum women for 2-3 months can be justified on the basis that many women will end up with a negative iron balance by the time her child is born even with iron supplementation during pregnancy. This survey found that higher parity women having greater prevalence of anemia supports such consideration.
5. The oral iron supplementation should preferably be taken with an empty stomach to enhance absorption. A good time to take the supplement is bed

time when side effects are least likely to be noticed.

6. Consider the development of simple pictorial hand-out material about anemia (signs of weakness and poor health), and the need for iron tablets (signs of healthy baby and mother) to be given at the initial iron tablet distribution. This is to overcome the common problem that health workers do not provide adequate explanation why it is important to take iron tablets. Studies have shown compliance improves when information given about the health benefits and potential side effects.

## **II. Strategy considerations for infants and young children**

It is evident from the NIN survey that children under 2 years of age are at much greater risk of iron deficiency anemia than those over 2 years of age. This suggests that most of the iron deficiency occurs early and as a child gets older the iron status will improve. This observation fits with the world wide patterns that infants are not able to meet their iron requirement because of rapid growth, and poor iron content of complementary food. In fact, based on the common diet for infants in Asia, it would be exceptional not to develop some degree of iron deficiency by one year of age. As a child gets older, the growth rate slows down, and family diet often has better iron content than infant diet resulting in some improvements of iron status. Based on the finding and current knowledge of childhood iron nutrition, the focus for improvement of children should be aimed at infancy - to prevent the onset of severe iron deficiency. Another reason for the need to start early in this process is the strong evidence that iron deficiency anemia occurs in late infancy and early childhood results in developmental delay and deficit. A consequence similar to mild and moderate iodine deficiency, and moderate childhood lead poisoning. It is imperative to prevent such developmental damage. Specific approaches are:

### **II.A. Encourage exclusive breast feeding**

Even though breast milk is not high in iron content, the limited iron is well absorbed. This high bio-availability is reduced by other food stuff, especially grain-based products such as rice. For this reason, exclusive breast feeding up to 4 to 6 months of a ge will assure optimal absorption of iron and other minerals such as zinc.

### **II.B. Develop a strategy to improve complementary feeding**

The reason that iron deficiency is common in early childhood is related to the general poor quality of complementary feeding. A predominately rice-based infant diet not only is inadequate in nutrient density - low in iron, zinc, and vitamin A etc., also often does not have sufficient energy density. Therefore, any attempt to improve the iron content of

the infant diet should be based on the improvement of the entire nutrition packages of infant diet, not just limited to iron. From an education point of view, the earlier introduction and greater use of animal-based food items as part of the infant diet can be considered in areas where such items are affordable.

### **II.C. Provide iron supplementation through the MCH system.**

Given the lack of clear prospect of improving infant diet in the short term, there is a general consensus among major agencies (UNICEF, WHO, and USAID) to make it possible to provide iron supplementation during late infancy (after 6 months of age). The potential supplement can be administered orally as drops or syrups on a daily basis, or as additive to the complementary food. Given this is a recent development, without a large scale based experience, the proper step is to conduct a smaller scale operational research of iron supplementation to define the acceptability or compliance, feasibility, and impact on iron status. Within such frame work, zinc should be considered because it is likely that zinc deficiency is just as common as iron deficiency, and iron alone may affect zinc absorption from the diet which can further worsen the zinc status.

### **III. The need for an on-going nutrition surveillance system**

Given all the consideration for deworming, iron supplementation for adult women, and the need to evaluate the feasibility for supplementation or nutrition education to improve iron status during infancy, it would be very helpful to develop a limited nutrition surveillance system. A limited system based on selected sentinel sites that can collect feeding, height, weight, and hemoglobin data from children and women attending health centers can meet such purpose. Such system, once developed is easy to maintain, and save the long term cost to organize special surveys for each specific activity. Experience from few countries can be used for such development.

### **VI. Development of the laboratory capacity for rapid nutrition assessment and surveillance**

On-going capacity with quality operation is essential for the on-going development of various intervention activities. Currently, NIN has a basic laboratory ability for hemoglobin, and parasite examination. Upgrade of this capacity is indicated. This would include: 1) hemoglobin measurement beyond HemoCue method - an adequate spectrophotometer for the cyanmethemoglobin method; 2) serum ferritin determination based on ELISA method - including the development of a quality assurance program for the ELISA methods, basic ELISA system if NIN do not have it already; and 3) microscopes for field operations .

## **Acknowledgment:**

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**Appendix A:** The development of the NIN criteria for iron deficiency anemia based on hemoglobin distributions of non-iron deficient sub-sample of the survey

### *Issues related to hemoglobin criteria for anemia*

One outstanding issue is the appropriate hemoglobin cutoff values for anemia for population in SE Asia. In recent years, there is mounting evidence that in defining iron status of the population or in using anemia as a screen for iron deficiency, the Hb cutoff value is not a universal one. The best example is that for the white population in Europe and North America, the hemoglobin distribution (after exclusion of iron deficiency cases) is almost one gm/dl higher than that for population of African extraction. For this reason, a lower Hb cutoff for the blacks provides a comparable predictive value for iron deficiency as a higher value for whites. The most likely reason that blacks have a lower "normal" or non-iron deficiency hemoglobin distribution is the high rates of mild hereditary red cell production defects such as thalassemia traits and hemoglobinopathies.

Existing evidence indicating that this is also likely the case for populations in SE Asia. For this reason, part of the survey objectives is to determine if a different cutoff value for Viet Nam is indicated.

***Defining the non-iron deficiency hemoglobin distribution and cutoff values for Viet Nam.***

In general, men are least or not affected by iron deficiency when a dietary iron intake is low. For this reason, hemoglobin values for adult men who are from community of low hookworm infections - <5% prevalence based on stool examination of women - was used to define the normal range. In addition, the Hb distribution for both men and women who had serum ferritin determination also used for such purpose after excluding those with a low or borderline value of serum ferritin (<30 ug/dl). The mean hemoglobin values for the selected or non-iron deficient sub-sample are:

	Mean Hgb (g/dl)	S.D.
men	14.7	1.1
non-preg women	12.8	1.0
children 5-60 mo.	11.9	1.3

Given the mean Hb values are 1 g/dl lower than the mean hemoglobin of criteria based on U.S. or European populations, a reduction of 1 g/dl from the common criteria of 13.5 g/l for men, 12.0 g/l for women, and 11.0 g/l for under five children is indicated. The proposed working criteria for anemia based on the data of NIN survey are:

Men -	12.5 g/dl
Non-pregnant women -	11.0 g/dl
Pregnant women -	10.0 g/dl or
First trimester -	10.5 g/dl
Second trimester -	10.0 g/dl
Third trimester -	10.5 g/dl
Children <5 -	10.0 g/dl or
6-23 month -	10.0 g/dl
24-59 months -	10.2 g/dl

20	THAI BINH	50.40	11.1
21	THANH HOA	61.60	25.0
22	QUANG TRI	76.70	11.9
23	THUA THIEN HUE	48.80	26.2
24	HA TINH	88.90	30.1
25	NGHE AN	64.80	16.7
26	QUANG BINH	89.50	24.5
27	QUANG NAM DA NA	45.30	22.0
28	QUANG NGAI	53.70	29.9
29	NINH THUAN	86.40	23.3
30	PHU YEN	20.50	15.1
31	BINH DINH	25.90	10.8
32	BINH THUAN	8.10	22.3
33	KHANH HOA	20.70	13.4
34	DAK LAK	84.50	24.7
35	KON TUM	77.10	37.9
36	GIA LAI	62.80	22.1
37	LAM DONG	58.30	16.9
38	TP HO CHI MINH	13.20	4.9
39	BA RIA-VUNG TAU	37.70	17.3
40	SONG BE	49.10	19.2
41	DONG NAI	68.30	36.4
42	TAY NINH	72.30	24.3
43	CAN THO	14.20	12.2
44	KIEN GIANG	15.40	17.0
45	MINH HAI	28.20	26.9

46	VINH LONG	0.0	14.7
47	SOC TRANG	18.20	18.4
48	AN GIANG	26.50	24.5
49	DONG THAP	0.0	25.6
50	BEN TRE	0.0	15.1
51	TRA VINH	70.40	32.5
52	LONG AN	0.0	18.6
53	TIEN GIANG	0.0	5.3