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Micronutrient Initiative Project, Pilot Project –1

**School-based Iron/Folate Supplementation for Girls
Manica Province**

**Report of Mid-Term Hemoglobin Study
May 2002**

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1 Introduction

In May/June 2001, the HKI/MI school-based adolescent girls iron/folate-supplementation pilot project was initiated in two districts in Manica Province beginning with a HemoCue™ blood draw and pre-supplementation survey questionnaire. (Refer to: *School-based Iron/folate Supplementation for Girls, Manica Province, 19 December 2001* for project background and details). Due to delays in the original study and the impending end of year school holidays, initiation of iron/folate supplementation to participating girls began when the new school year commenced in February 2002. At that time, a second HemoCue™ measurement was taken which would become baseline data for the project (Refer to: *School-based Iron/Folate Supplementation for Girls, Manica Province, February 2002*).

Iron/folate supplementation began mid-February with girls in the first group of six schools (Table 1, below). Mebendazol was given to all girls in January, and again to *all* students in August¹. An in-depth refresher, teacher-training seminar was carried out in March as planned. Printed nutrition education materials (including in-depth sections on micronutrients) were produced for both teachers and students. The teacher booklet is intended to assist with inclusion of proper nutrition education in the curriculum.

Group 1¹	School Name	District	Level
	Guro Sede	Guro	EPC ³
	Tseretze Khama	Guro	grades 1-4
	Nhamassunge	Guro	EP1 ⁴
	Catique Nzaia	Macossa	EP1
	Mussungadze	Macossa	EP1
	Nhamagua	Macossa	EP1
Group 2²	Mungari	Guro	EPC
	Mandie	Guro	EPC
	Chivuli	Guro	EP1
	Dunde	Macossa	EP1
	Malimanao	Macossa	grades 1-3
	Macossa Sede	Macossa	EPC

¹ Schools receiving iron supplements for 9 months.
² Schools receiving iron supplements for 6 months.
³ EPC = Complete Primary School and includes grades 1 - 7
⁴ EP1 = 1st level primary school, grades 1-5

In May, before initiation of supplementation in the second group of schools (control), a mid-line hemoglobin (Hb) test was performed on participant girls in all 12 schools (n=706), providing a three-month measurement for comparison purposes.

¹ At the suggestion of health officials, both boys and girls were given Mebendazol in August as the risk of re-infection is high in populations with high endemic rates of parasitic infection.

Supplementation was initiated in group 2 schools one week later. Field supervision visits were done shortly after beginning supplementation in the second 6 schools to ensure proper implementation. Thereafter, monthly supervisory visits are used to encourage school officials, assure proper supplementation and generally to address problems as they arise.

Unexpectedly, 285 girls were lost between the January and May 2002 hemoglobin measurements and 152 new girls were added (n=991 in January; n=858 in May). School officials explained this flux as normal, citing the main reasons (in order) as: school dropouts, transfers to other schools (not included in our 12 pilot schools), and lastly, refusal to participate in the program. Also some girls were absent on the day of the survey. Because of the changes, comparison analysis is only done for the 706 girls which presented for both January and May HemoCue™. However, all new girls are allowed to participate in the supplementation program.

Methodology Limitations:

Although every effort is made to eliminate error from survey results, methodology limitations related to this project include those discussed previously (page 2, Supplementary Report, Feb 2002). The following also deserve mention:

- Supplement distribution and or data-recording problems were seen in a few of the group 1 schools. Strong efforts were made to assist school officials in proper management of the program by way of regular visits and support. Nonetheless, in most schools at least some data is missing/obscured due to recording problems or missed distribution attributed to school holidays or confusion at start-up.
- Although this project intended to track the same girls for the 9-month period, changes in school structure and/or fluctuation in student populations limit this task. In principle, all girls between ages 10-18 attending schools were scheduled to participate in the program. However, official enrollment registries do not exist, therefore actual numbers of girls in each school are not known. Additionally, HemoCue™ measurements are not compulsory and some girls were absent for one or the other test. Absenteeism in some schools also hindered regular and consistent supplementation. Lost or new girls changed the overall number and structure of the sample and limit comparison, especially in smaller schools. For this reason only girls present for both hemoglobin tests were used in this analysis.

2. Results

I. Comparison of girls lost and remaining

Table 1 (Annex) compares age, mean hemoglobin, and anemia prevalence of the 285 girls lost to the study with the 706 remaining girls. Differences between those lost and those remaining were not statistically significant for all variables. It is therefore concluded that the girls lost to the study were not statistically different than the girls remaining in the study.

II. Age and Anemia Prevalence²

Given mentioned fluctuations in school structure and enrollment, the number of girls per school reflect the 706 girls who were also measured during the January HemoCue™. Thus for the purposes of this report, numbers and ages of girls present for both the baseline, January 02, and May 02 studies are the same (Table 2, Annex). Due to the fact that only data of 706 of the original 991 girls included in the January 02 survey are used in this report, figures for January 02 will slightly differ from the results presented in the previous report on that same survey.

Mean reported ages of participant girls is 11.9 years (the same as January)³. Overall mean hemoglobin level was 12.40 g/dl and anemia prevalence measured 36%, a decline from the January study⁴ (Table 2, Annex).

As in the January study, in the May study younger girls are generally worse off than older girls, with anemia prevalence falling consistently by age category, from 40% in girls 10 years of age to 29% in girls 14 years or older (Table 3, Annex).

Age frequency percentages changed slightly when the 285 lost girls are removed from analysis, the largest being an increase in number of 12 year olds by 3 percent. The girls remain mostly young, 68% are 12 or younger.

III. Comparison of Girls by Study Group

Before supplementation began no significant differences existed between supplemented (group 1) and non-supplemented (group 2) girls for either anemia prevalence nor age. Mean hemoglobin was significantly different between study groups before supplementation (95% significance). However, when the lowest one girl's hemoglobin value is removed from analysis (6.9 g/dl), the difference in mean hemoglobin between study groups becomes insignificant (Table 4, Annex).

At the end of the first 3 months of supplementation of iron/folate tablets to group 1 girl (10 supplementation weeks), hemoglobin levels of supplemented girls were significantly higher than those of non-supplemented girls (Table 5, Annex).

Little or no change occurred *within* each group (1 and 2) between January and May surveys. A .04 g/dl increase in mean hemoglobin was measured among supplemented girls, and .19 g/dl decrease among non-supplemented girls (both not significantly different). No change in anemia prevalence occurred among supplemented girls between January and May (30%), while prevalence increased 6 percentage points among non-supplemented girls (both not significantly different). While not significantly different, these within-group changes occur in opposite directions where supplemented girls improve and non-supplemented girls worsen. The result is a statistically significant *between*-group difference for both mean hemoglobin and

² Anemia prevalence defined as: Hemoglobin <12.0 g/dl.

³ Ages for seven girls of 706 were reported 'unknown', and are excluded from age-related analysis

⁴ Refer to: *School-based Iron/Folate Supplementation for Girls, Manica Province, February 2002* relating to comparison between the Jan 02 and May 02 surveys.

anemia prevalence both significantly favorable in the supplemented group. (Table 5, Annex).

IV. Illness Experience by Study Group

Girls were asked if they missed school days due to illness during the past two weeks and if so, what were the symptoms or illness experienced.⁵ The majority of girls (71% overall) report no illness or symptoms during the past two weeks (Table 6, Annex). Of those who complained of illness, the majority (18%) reported headache, 6% stomach illness and 2% malaria, and 1% each diarrhea, more than one symptom, or 'other'. Overall, slightly more supplemented girls complained of illness symptoms than did non-supplemented girls, 31% versus 27%. Type of illness is not associated significantly with anemia prevalence overall nor within study groups.

V. Distribution

After three months, each of the group 1 schools had supplemented for 10 weeks, with average of 8.7 supplements per girl (Table 7, Annex)⁶.

Survey outcome goals require that 85% of girls in participating schools receive supplements, and that 80% of these take at least 75% of supplements. As discussed, since no official enrollment registry is kept, tracking number of girls and participating girls per school is difficult. However, all girls who said they were at least 10 years of age were included in the program, and school officials have not reported any girl formally refusing to participate. Supplementation is strictly controlled and recorded by the teacher in charge, who gives girls one tablet and they take it at that time. Therefore for the purposes of this report, a girl who received the tablet is counted as also having ingested it.

Per program reporting, 100% of the 359 girls in group 1 received tablets and 87% of possible tablets were taken (3108/3590 for the 10 week period, corresponding with 8.66 tablets per girl). Of those receiving tablets, 77% of girls took at least 75% of tablets (out of 10 possible).

3. Discussion

This report is concerned with hemoglobin measurements relating to the January and May 02 surveys, and the two supplementation groups. The first three months of the program in which group 1 received tablets but group 2 has not yet started are a key

⁵ This contrasts with the January 02 survey where girls were asked if they were experiencing illness symptoms "at the time of the HemoCue™". The end-line survey in October will again ask about school days lost and symptoms for the last two weeks. Inconsistencies are due in part to personnel changes across surveys.

⁶ Although officially supplementation had been in place 13 weeks as of May HemoCue™, each of the 6 schools had supplemented no more than 10 times/weeks due to holiday or program-related confusion. Therefore, 10 weeks is used as the denominator for number of tablets each girl could have possibly taken.

period for comparison between recipients/non-recipients. It is an additional advantage that three HemoCue™ measurements have been taken. Although May 01 data is not used for official comparison, it provides an interesting and useful trend picture.

A factor affecting this project, not fully realized beforehand, is that of fluctuation of student populations whereby the sample of girls has changed with each hemoglobin measurement. Although only the 706 girls present for both January and May surveys are included in this analysis, roving students and a dearth of accurate enrollment information highlight a serious challenge to program delivery at the school level. This ‘challenge’ affects potential program impact, but also emphasizes the greater, more serious problems inherent in delivery of anything (including education) at the school level. It is hoped that fluctuations among girls will be minimum between May and October and that a majority of the 706 girls will continue participating until the final HemoCue™.

It was shown that there were no significant differences with regard to study variables among the 285 girls who left and the 706 who stayed. The exception was a significant difference in mean hemoglobin between supplemented and non-supplemented girls before the start of supplementation. As discussed, once a very low measurement for one girl is removed from analysis the difference becomes insignificant. Therefore, although randomization into study groups was not done at the individual level, it can be said that neither lost girls nor differences between study groups at the beginning of the study affect the sample and with respect to the main study variables⁷.

Nonetheless, in fact girls in schools chosen for supplementation were already better off (before supplementation) than were non-supplemented girls. While differences weren’t great in size, this should be remembered when interpreting program results.

Although between district differences were not highlighted in this report the difference is worth mentioning since Macossa bore the entirety of the decline in hemoglobin levels. The month of May falls during the ‘lean’ season and because Macossa is generally drier, more rural and more impoverished than Guro it may be affected more by seasonality. Indeed, 2002 has been a drought year, and students/school officials in Macossa district complained to survey staff of food shortages starting as early as the January 02 survey. Recent food security work in the area has highlighted the fact that nearly 90% of Macossa district is reserve land and lies uncultivated⁸. It is perhaps important too that Macossa district has historically been targeted by aid/relief organizations and may have a dependence culture, and subsequent lower productivity than is actually possible.

It was unexpected that blood hemoglobin levels would worsen by such an extent between January and May 02. In January the trend had been opposite and unexpected improvement seen, leading one to consider measurement error in explanation, as

⁷ Reasons for randomizing at the school-level were practical/logistical. These include a lack of accurate enrollment information, as well as the desire to include entire schools with three schools from each district in each study/control group, each with groups of similar size – a challenge when school sizes vary greatly. Schools were ordered by anemia prevalence as of January, with every 2nd school allocated to the intervention group.

⁸ Unofficial data based on discussions during HKI/partner nutrition seminar in Maputo, June 02.

discussed previously⁹. It appears now that apart from measurement errors, a combination of factors including ecological trends, local culture and seasonality are probably responsible for this change, perhaps especially in Macossa district, where larger hemoglobin fluctuations were observed.

Significant differences between groups of supplemented and un-supplemented girls after three months imply program efficacy, if somewhat differently than expected. It was expected that hemoglobin levels among supplemented girls would improve. Instead, they remained almost constant, while hemoglobin levels among un-supplemented girls fell. The resulting significant difference between supplementation groups in May show that the program may have exerted a protective effect on those taking supplements versus those not. Given local food insecurity, multiple etiologies of anemia and other ecological factors it is certainly desirable that iron supplements exert a protective effect among vulnerable girls. Further, in the absence of more integrative programming during this pilot project, it may also be the best outcome possible.

Earlier reports identified a weakness of this study to acquire more morbidity information consistently, especially that of malaria and intestinal parasites that are highly associated with anemia status. At the suggestion of MOH/DPS officials, discussion of the feasibility of parasite-load testing (both malaria and intestinal in a sub-sample of girls) is underway, dependent upon cost and field-related constraints.

Although anemia levels were not associated with illness symptoms in either study, headache –mentioned by nearly one-fifth of girls, is a well-known symptom of malaria and though unreported, malaria experience may be higher even though a girl has not sought medical treatment. This is important since malaria is endemic in Manica province and has implications for program effectiveness. However, malaria management is historically problematic and will continue to be so. Where this study and anemia risk groups are concerned, program activities should include *at least* a malaria awareness component focusing on increased vigilance and education regarding risk, symptom recognition and prompt treatment.

Further, given the multiple etiologies of anemia, anemia prevention programming must consider an array of risk factors in an integrated manner to achieve effectiveness. This is true of Manica Province where high levels of malnutrition exist concurrently with high prevalences of malaria, parasites and early and multiple parity. This integrated approach should take a priority in future school-based supplementation programming.

Supplementation appears overall to be going well but has not been problem free. Guro Sede and Tseretze Khama especially encountered problems in the first weeks, a concern because the majority of group 1 girls are in these two schools combined. With additional visits, problems appear to have been worked out. Nonetheless, none of the 6 schools supplemented more than 10 weeks out of 13 possible, underscoring

⁹ With results from a second May survey, the elevated levels of anemia seen in Guro in May 01 are indeed likely to be result of measurement error.

the dependency of programs on cooperation and partnership (among school officials in this case)¹⁰.

Officials in several schools said that in the early weeks, acceptance was problematic even after explanation to students, and preconceived ideas about iron/folate remained (that they are contraceptives). Additionally, in-classroom education had not formally begun by this report due to delays in printing/delivery of student manuals. Guro Sede and Tseretze Khama held informational meetings in the evenings to explain the program to parents, especially why only girls receive tablets. It has been suggested by school and DPS officials that boys be included in supplementation in the future. This has currently been proposed for the next funding phase as a way to improve program acceptance. It is also likely that anemia is prevalent among boys given the poverty level in the region.

According to reporting professors, coverage of participating girls is very good with all group 1 girls taking supplements. However, only 77% of girls are taking at least 75% of tablets, falling short of the 80% required by program objectives. This will be addressed with professors/school officials in future supervisory visits.

At the moment of the final drafting of this report, group 2 schools had been supplementing for approximately 15 weeks and in general, supervisory reports from new schools seem positive. It does occur that supplementation supervisors are absent at the time of a supervisory visit making details and program monitoring difficult. Efforts are being made to correct this, but lack of a means of communication (no telephones) and long distances complicate matters.

Due to delays in printing of materials, the education component was introduced some weeks after supplementation commenced. Additionally, in terms of program management, nutrition education is a weak point since integration into curriculum is self-reported by teachers. The endline survey should reflect improved knowledge scores if indeed it is being implemented into curriculum. A more consistent and verifiable method of tracking curriculum inclusion should be explored for future programming. This could include local supervisors to visit schools more regularly than is possible from the provincial office. Inclusion of Peace Corps volunteers for this role and to assist in teaching nutrition has also been discussed.

Program sustainability is currently being addressed with DPS/DPE (provincial health and education authorities). Sustainability is integral to HKI's mission and goals in Africa, and the question of the future role of local authorities in maintaining school-based supplementation program in the province must be considered as input in our own programming considerations for the coming year(s). Initially authorities have stated interest in continuing the program using a model developed with this pilot study and taking advantage of lessons learned. It remains to be seen whether funding will follow stated interest.

¹⁰ During the process of this mid-way evaluation, MI advisors related that minimum 20 tablets must be ingested before effects are expected. The May HemoCue™ measured girls who had taken on average only 8.7 tablets. Therefore, more time is required before real program evaluation can be made.

Summary

Three months into the pilot school-based supplementation program shows improved program support and management on behalf of school officials and prevention of worsened hemoglobin levels by girls taking iron/folate supplements.

In addition to improving hemoglobin levels among study girls, a main objective of this pilot project is to assess the feasibility (process) of delivery of supplements to vulnerable girls in this locale via the school system. Inherent in this objective is the documentation of lessons learned in the pilot process, with the underlying goal of scaling-up to more schools (inclusive of girls and boys) and a sustainable takeover by provincial health and education officials in the future. In general, good progress has been made as to these objectives given the difficulties inherent in introduction of new programs.

It remains to be seen exactly what effect 6 versus 9 months supplementation will have on hemoglobin levels, or how much nutrition knowledge improves among students. However, it is reasonably concluded at this stage (after 3 months) that supplementation with iron/folate has at least had a positive, protective effect among schoolgirls who are taking supplements in comparison with those girls who are not. Given the complicated, food insecure environment which characterizes Manica Province, this is perhaps the most that can be hoped for under the circumstances.

Annex of Tables

Table 1: Comparison of Study Girls and Those Who Dropped (Jan 02)

	mean Hb (g/dl)	% Anemic	Age
Current Girls (n=706)	12,48	33	11,9
Lost girls (n=286)	12,43	32	11,8
Significance:	p>.05	p>.05	p>.05

Table 2: Characteristics of Girls by School & District

District	School Name	Number of			Mean Hb	% Anemic	sd
		Girls ¹	Mean Age ²	sd			
Guro	Guro Sede	142	12,9	1,6	13,03	20	1.4
	Mungari	82	11,8	1,4	12,32	37	1.2
	Mandie	73	12,4	1,6	12,27	38	1.3
	Nhamassunge	39	11,8	1,7	11,66	56	1.7
	Chivuli	47	10,8	1,2	12,11	36	1.0
	Tseretze Khama	111	11,0	1,4	12,85	24	1.3
	<i>Guro Total</i>		494	12,0	1,7	12,56	31
Macossa	Nhamagua	23	11,3	1,1	11,11	74	1.2
	Dunde	44	11,3	1,2	11,85	50	1.0
	Catique Nzaia	15	10,9	1,1	12,09	47	1.0
	Malimanao	14	10,5	0,8	11,91	43	0.8
	Mussungadze	29	11,9	1,8	12,43	28	0.9
	Macossa Sede	87	12,3	1,7	12,20	46	1.3
	<i>Macossa Total</i>		212	11,7	1,6	12,01	47
Total		706	11,9 ²	1,7	12,40	36	1.3

¹ Because 285 girls were lost between the January 02 and May 02 studies, 'n' of 706 represents the same girls presenting for both studies. The 152 new girls are not included in this analysis.

² "Mean age" reflects unknown ages for 7 girls.

Table 3: Characteristics of Girls by Age Group

Age	Number of Girls	Percent	Mean Hb	% Anemic
10 ¹	196	27,8	12,24	40
11	108	15,3	12,33	39
12	172	24,4	12,36	35
13	102	14,4	12,63	32
>=14	121	17,1	12,62	29
Unknown	7	1,0	11,79	43
Total	706	100%	12,40	36

¹ Includes two 9 year old girls.

**Table 4:
Characteristics of Girls by Comparison Group
(Jan 02)**

	Number of			Mean Hb	sd	% Anemic
	Girls	Mean Age ¹	sd			
Supplemented (group 1)	359	12,0	1,8	12,58	1.2	30
Non-supplemented (group 2)	347	11,8	1,6	12,38	1.3	35
Total	706	11,9	1,7	12,48	1.3	33
<i>Signif:</i>		p>.05		p<.05 *		p>.05

¹ "Mean age" reflects unknown ages for 7 girls.

* Becomes insignificant when 1 girl with extremely low Hb, 6.9 g/dl is removed from analysis.

Table 5: Mean Hemoglobin and Percent Anemic by Study Group

	Jan 02 (n=706)	May 02 (n=706)	Sig
Mean Hb			
Supplemented (n=359)	12.58	12.62	p>.05
Not supplemented (n=347)	12.38	12.17	p>.05
<i>Signif:</i>	p<.05 *	p<.05	
Percent Anemic			
Supplemented (n=359)	30	30	p>.05
Not supplemented (n=347)	35	41	p>.05
<i>Signif:</i>	p>.05	p<.05	

* Becomes insignificant when 1 girl with extremely low Hb, 6.9 g/dl is removed from analysis.

Table 6: Reported Illness/symptoms During Previous Two weeks by Study Group¹

	Supp	Not Supp	Total %
Stomach Illness	7	6	6
Headache	20	17	18
Malaria	2	1	2
Diarrea	1	0	1
Various/other ²	1	2	1
More than 1 symptom	0	1	1
None	69	73	71

¹ This question was asked 'if the girl missed school due to illness during the previous two weeks, what were her symptoms'.

² "More than one" includes mention of more than one of the above symptoms during previous two weeks.

Table 7: Distribution of Iron/Folate to Study Girls

School	Girls	N° Tabs received	Mean N° Tabs	May 02 Anemia %
Nhamagua	23	215	9.9	74
Guro Sede	142	1232	8.68	20
Tseretse Khama	111	901	8.12	24
Nhamassonge	39	344	8.82	56
Catandica Sede	15	141	9.4	47
Mussungadze	29	275	9.48	46
<i>Total</i>	359	3108	8.66	30