

# Positive Impact of a Weekly Iron-Folic Acid Supplement Delivered with Social Marketing to Cambodian Women: Compliance, Participation, and Hemoglobin Levels Increase with Higher Socioeconomic Status

Byron L. Crape, Eric Kenefick, Tommaso Cavalli-Sforza, Jennifer Busch-Hallen, Silvano Milani, and Koum Kanal

*A social marketing program promoting weekly iron-folic acid supplementation improved hemoglobin levels in women of reproductive age in Cambodia. Supplementation was increasingly effective among women of higher socioeconomic status (SES). Among higher SES schoolgirls, 58% took the supplements, compared with 49% for lower SES ( $P = 0.07$ ). Garment factory workers with an 11th- or 12th-grade education had a mean improvement in hemoglobin of 0.72 g/dL over those with a 5th-grade education or less ( $P = 0.04$ ). The percentage of rural village women taking supplements increased with increasing SES (linear trend  $P = 0.046$ ). These results suggest that women with lower SES be given special attention for future programs.*

**Key words:** social marketing, iron-folic acid, socioeconomic status, Cambodia

© 2005 International Life Sciences Institute

doi: 10.1301/nr.2005.dec.S134-S138

---

Mr. Crape was formerly affiliated with the Johns Hopkins School of Public Health, Baltimore, Maryland, USA; Mr. Kenefick is with the UN World Food Programme, Vulnerability Analysis and Mapping Unit, Rome, Italy; Dr. Cavalli-Sforza is with the WHO Regional Office for the Western Pacific, Manila, Philippines; Ms. Busch-Hallen was formerly affiliated with WHO in Phnom Penh, Cambodia; Dr. Milani is with the Institute of Statistics, Faculty of Medicine, University of Milano, Italy; Professor Kanal is the director of the National Maternal Child Health Centre, Ministry of Health, Cambodia.

Please address all correspondence to: Byron Crape, PAHO/WHO, 8 Brickdam, Georgetown, Guyana, South America. Phone: 592-225-3000; Fax: 592-226-6654; E-mail: crapeb@guy.paho.org.

## INTRODUCTION

The weekly iron-folic acid supplementation program in Cambodia utilized social marketing and community mobilization approaches to educate women about iron-deficiency anemia and to promote taking the supplements.<sup>1</sup> The social marketing-mobilization program is described in detail in an accompanying paper.<sup>2</sup>

The objective of this paper is to evaluate the impact of weekly iron-folic acid supplementation on hemoglobin (Hb) levels for Cambodian women of reproductive age and to evaluate the impact of SES on program participation and compliance.

## METHODS

### Hemoglobin Measurement

Hb was measured at baseline and at follow-up 6 months later using the HemoCue analyzer (HemoCue AB, Angelholm, Sweden), which requires a finger prick and a few drops of blood drawn into a microcuvette. Hb levels are read immediately by a photometer in the analyzer, which provides a measure of circulating Hb concentrations but does not directly measure iron stores.

In an anemia survey in Kandal Steung/Kandal Province, Cambodia among 159 children ages 6 to 69 months, the HemoCue analyzer was compared with the gold standard, the ABX Micro-60 (Horiba ABX Co., Montpellier, France). Using a cutoff for anemia of  $\leq 110$  g/L, Pasteur Laboratories in Cambodia reported an anemia prevalence of 30% using the ABX test, while the HemoCue test identified an anemia prevalence rate of 42% in the same population (Institut Pasteur du Cambodge, Ministry of Health, Kingdom of Cambodia,

World Health Organization, National Institute of Public Health of Cambodia, World Vision, Cambodia. Anaemia survey in Kandal Steung/Kandal, preliminary unpublished results 2002). Based on these numbers, the HemoCue test has a sensitivity of 89% and a specificity of 82% to detect anemia.

Because the HemoCue test set-point for the measurement of Hb level was somewhat higher than that of the ABX test, the unit for the analyses used in this paper is the change in Hb, which requires only that the Hb be reliable between repeat measures.

## Measurement of Socioeconomic Status

SES status among both the secondary school students and rural village women was measured as the sum of items owned by their households based on a pre-defined list. This list included household ownership of a bicycle, cart, motorcycle, water pump, boat, machine, radio, or television. Household automobile ownership was also included on the list for the secondary students.

SES for garment factory workers was measured by educational grade level attained. The number of listed items of household ownership was not available for garment factory workers, since most live in temporary accommodations such as hostels.

Both the listing of household items and information on attained educational grade level was acquired from participant reporting. The variability in the socioeconomic measures for secondary school students was considerably less than that found among the rural village women. Thus, secondary students were grouped into two SES categories, while rural village women were grouped into three SES categories.

## Subjects

The subjects of this study were described in detail in an accompanying paper.<sup>2</sup>

## Statistical Analysis

The Wilcoxon rank sum test was applied to data concerning changes in Hb levels in secondary school students and garment workers in lieu of the Student's *t*-test because changes in Hb level are not normally distributed. Due to multiple comparisons, the Bonferroni correction was applied to the statistics for changes in Hb levels.

Comparisons were made between women of different SES (based on number of listed household items) and

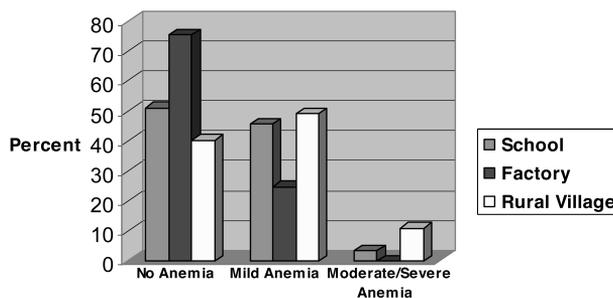
participant-reported compliance rates for taking the weekly iron-folic acid supplements 6 months after baseline. A chi-squared test was used for statistical testing of the differences for the secondary school students, and a chi-squared test for linear trend was applied to the differences in rural village participants. The association between the educational grade attained and the change in Hb level over 1 year of the weekly iron-folic acid supplementation among garment factory workers was assessed by a multivariable linear regression model. To remove the potential confounding effects of other factors (which can cover up the true association between education and change in Hb), the variables initial Hb level, age, salary, body mass index (all in quartiles), having a fever during the 2 weeks prior to baseline, and having diarrhea 24 hours prior to baseline (both dichotomous) are also included in the model.

The statistical package SAS 8.2 (SAS, Inc., Cary, NC) was used for statistical analyses. SPSS software (version 10.0, SPSS, Inc., Chicago, IL) was used for conversion of the original databases to a SAS database.

## RESULTS

Baseline characteristics of the subjects were described in detail in the accompanying paper.<sup>2</sup> Figure 1 shows that rural women at baseline had the highest proportion of moderate to severe anemia and mild anemia. The factory workers had the lowest proportion of mild and moderate to severe anemia. Prevalence of anemia among secondary school students fell between that of the rural village women and the factory workers.

The median age for rural village women was 16 years greater than the median age for secondary school students. The median age of garment factory workers was 5 years greater than that of the students. Rural village women reported the highest prevalence of diarrhea and fever, whereas the secondary school students reported the lowest rates.



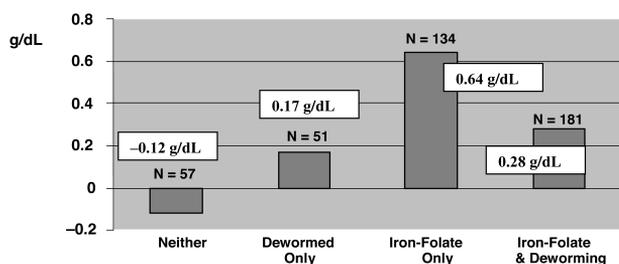
**Figure 1.** Percentage of Cambodian women not anemic (Hb  $\geq$  12 g/dL), mildly anemic (Hb 9–12 g/dL), or moderately to severely anemic (Hb  $<$  9 g/dL).

The impact of the weekly iron-folic acid supplementation and deworming treatments on changes in Hb level after 6 months for secondary school students are shown in Figure 2. Four groups were compared. Group 1 neither received the mebendazole treatment nor took the weekly iron-folic acid supplements (N = 57); group 2 received mebendazole but did not take iron-folic acid supplements (N = 51); group 3 took the weekly iron-folic acid supplements but received no mebendazole treatment (N = 134); and group 4 received the mebendazole and took the weekly iron-folic acid supplements (N = 181). Hb declined in group 1 by 1.2 g/L, but increased in groups 2, 3, and 4 by 1.7, 6.4, and 2.8 g/L, respectively. Comparison of group 1 with groups 2, 3, and 4 yielded *P* values for differences (Wilcoxon rank sum test) of 0.220, 0.006, and 0.089, respectively. The only statistically significant difference (Bonferroni correction, alpha = 0.05/6 = 0.008) in Hb change occurred between group 1 and group 3 (*P* = 0.006).

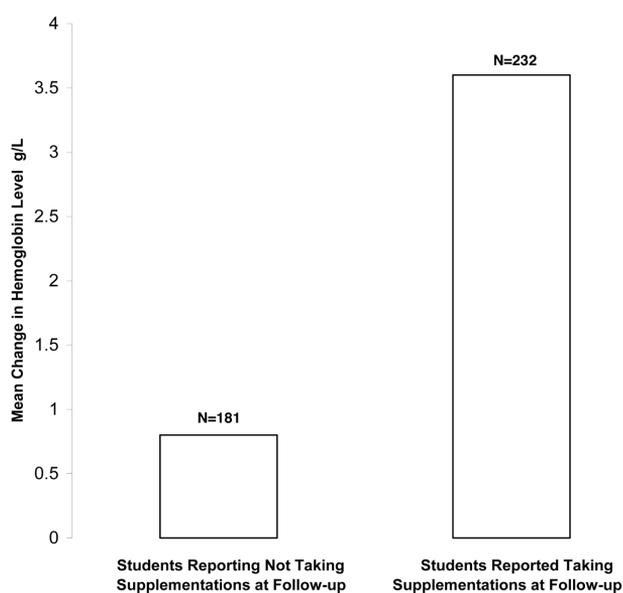
Figure 3 shows the change in Hb among the secondary school students who reported taking the iron-folic acid supplements at follow-up (N = 232) and those who reported not taking the supplements (N = 191). The improvement in mean Hb was significantly greater for those students who took the weekly iron-folic acid supplements (3.6 g/L) than for those who did not (0.8 g/L) (Wilcoxon rank sum *P* value slightly less than 0.05).

Table 1 shows the association in secondary school students between SES differences and the use of weekly iron-folic acid supplementation 6 months after the program started. A borderline significant improvement in use of weekly iron-folic acid supplements was found for the highest SES group compared with the lowest SES group. The initial median Hb levels, based on measurements using the HemoCue analyzer, were 119 g/L and 120 g/L for the low and high SES groups, respectively.

All garment factory women answering the evaluation questionnaires reported taking the supplement at the time of follow-up. Table 2 summarizes results of the multivariable linear regression that models the change in



**Figure 2.** Mean change in hemoglobin level (g/L) from baseline to follow-up after 6 months among Cambodian secondary school girls, by deworming/iron-folic acid treatment.



**Figure 3.** Mean change in hemoglobin level over 6 months for Cambodian secondary school girls by iron-folic acid supplementation status (Wilcoxon *P* < 0.05).

Hb level from baseline to follow-up as the outcome, adjusting for potential confounding due to initial Hb level, age, salary, body mass index (BMI), and the existence of fever and diarrhea. After adjustment for potential confounders, the most highly educated group (11th- and 12th-grade education), showed a mean elevation in Hb of 0.74 g/dL over that of the lowest educated group (no education to 4th-grade education). This difference was statistically significant.

Table 3 assesses the association between the SES (count of listed household items) of rural women and the use of the weekly iron-folic acid supplements at follow-up. Rural village women participants in the weekly iron-folic acid supplementation evaluation were increasingly more likely to report taking iron-folic acid supplements with increasing SES. The initial median Hb

**Table 1.** Socioeconomic Status (SES)\* Groups Stratified by Participant-Reported Use of Weekly Iron-Folic Acid Supplements (WIFS) at Follow-up for Secondary School Girls in Cambodia (N = 423)

SES	Taking WIFS	Not Taking WIFS
High SES (N = 259)	58.3%	41.7%
Low SES (N = 164)	49.4%	50.6%

\*SES was computed as the sum of household ownership of the following items as reported by the participants: bicycle, cart, motorcycle, water pump, boat, machine, radio, television and car. High SES was considered to be the possession of 4 to 7 of these items; low SES was 0 to 3 items.

levels, based on measurements using the HemoCue analyzer, were 116, 115, and 120 g/L for the lowest, middle, and highest SES groups, respectively (not shown in table).

## DISCUSSION

The results from the secondary schools indicate that in the Cambodian context, a social marketing and community mobilization strategy promoting weekly iron-folic acid supplementation is effective in improving Hb levels; however, the magnitude of the impact depended on SES. Based on number of listed household items or on education, with increasingly higher SES, participants were more likely to take the weekly iron-folic acid supplements and were more likely to take them consistently over time. For all three weekly iron-folic acid supplementation participant groups in Cambodia, the secondary school girls, the garment factory workers, and the rural village women, this pattern was consistent across settings, populations, and weekly iron-folic acid supplementation program differences. Poorer participation and compliance among lower SES women reduced the hematological impact of the weekly iron-folic acid supplementation for these women.

The secondary school students and the rural village women paid a nominal fee for the iron-folic acid supplements. For the poorest rural village women, this fee was waived. Regardless, lower SES women were less likely to actually take the supplements. Though SES distribu-

**Table 2.** Multivariable Linear Regression Model\* for Women Working in Garment Factories in Cambodia Participating in a Weekly Iron-Folic Acid Supplementation Program

Highest School Grade Attained	Change in Hb Level†	P
11th–12th	0.74 g/dL	0.04
9th–10th	0.14 g/dL	0.48
7th–8th	0.11 g/dL	0.46
5th–6th	0.05 g/dL	0.72
4th or less (reference group)	n/a	n/a

\*The model adjusted for potential confounding by these variables: initial Hb levels, age, salary and body mass index (all in quartiles), having a fever during the 2 weeks prior to baseline (binary), and having diarrhea 24 hours prior to baseline (binary).

†Above that of the reference group. The difference in the means of Hb change between a category of school grade attainment and the reference group (4th grade or less). For example, the mean Hb change for those women who attained 11th or 12th grade was 0.74 gm/dL higher than that for those women who attained 4th grade or less.

**Table 3.** Socioeconomic Status (SES)\* Groups Stratified by Participant-Reported Usage of Weekly Iron-Folic Acid Supplements (WIFS) at Follow-up for Rural Village Women in Cambodia (N = 638)†

SES	Taking WIFS	Not Taking WIFS
High SES (N = 94)	57.4%	42.6%
Middle SES (N = 416)	49.3%	50.7%
Low SES (N = 128)	43.8%	56.3%

\*SES was computed as the sum of ownership of the following items as reported by the participants: bicycle, cart, motorcycle, water pump, boat, machine, radio and television. High SES was considered to be owning 4 to 7 of these items; middle SES as owning 1 to 3; and low as owning none of these items.

†Chi-squared P for linear trend = 0.046.

tions were different between students and rural village women, the pattern among those who chose to take the supplements was similar. This is of special concern because lower SES women tended to have lower average Hb levels and are at greater risk for anemia.

All participants in the garment factories were provided weekly iron-folic acid supplements free of charge, and everyone participated in the educational and motivational programs throughout the year. Among those factory workers who completed the final follow-up questionnaires, essentially all indicated that they were taking the weekly iron-folic acid supplements. However, those women with the highest educational status, another indicator of SES, showed the largest improvements in Hb levels. If women with the highest educational attainment took the weekly iron-folic acid supplements more consistently during the evaluation period of 1 year than women with less education, this would explain the differences in change in Hb levels.

## CONCLUSIONS AND RECOMMENDATIONS

These findings indicate that the weekly iron-folic acid supplementation positively impacted Hb levels. For all three participating groups, the supplementation program was more effective among those who were better off socioeconomically. This may be explained by greater participation and better compliance in taking the supplements weekly. This suggests that to improve program effectiveness, the program should be especially designed to target lower SES women.

## REFERENCES

1. National Maternal and Child Health Center, Ministry of Health, Kingdom of Cambodia. *The Weekly Iron/Folic Acid Pilot Program for Prevention of Anemia*

*in Women of Reproductive Age, Cambodia, 2001–2002*. Cambodia: Ministry of Health' 2002.

2. Kanal K, Busch-Hallen J, Cavalli-Sforza T, et al. Weekly iron-folic acid supplements to prevent ane-

mia among Cambodian women in three settings: process and outcomes of social marketing and community mobilization. *Nutr Rev.* 2005;63(12 part 2): S126–S133.