PROGRAM REPORT

GIZI: INTERVENSI PADA REMAJA LEWAT SEKOLAH

GIRLS PROJECT

IMPROVING REPRODUCTIVE HEALTH THROUGH
SCHOOL-BASED INTERVENTIONS AMONG ADOLESCENTS
IN EAST JAVA, INDONESIA
1996-1999

Implemented by:

Helen Keller International/Indonesia
in collaboration with the Government of Indonesia

With support from:

Opportunities for Micronutrient Interventions (OMNI) /
US Agency for International Development (USAID)
United Nations Children’s Fund (UNICEF)
ACKNOWLEDGEMENTS

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The work presented in this report would not have been possible without financial support from the Opportunities for Micronutrient Interventions (OMNI) project, funded by the United States Agency for International Development (USAID), whose continued support for the work of Helen Keller International (HKI) Indonesia deserves our tremendous appreciation. We also thank the United Nations Children’s Fund (UNICEF) for their funding of the project and their technical expertise.

We would like to extend our gratitude to our counterparts in all of the above-mentioned agencies.
Gizi: Intervensi pada Remaja Lewat Sekolah
GIRLS Project

Improvement Of Reproductive Health Through
Increasing Micronutrient Status Of Adolescent Women In Indonesia
1996 - 1999

EXECUTIVE SUMMARY

Micronutrient deficiencies are widespread across the globe, especially in developing countries. The most vulnerable groups are those who experience fast growth and development, such as pregnant women, small children and adolescents. Pregnant women and children below 5 years of age have been the focus of most studies and intervention programs. However, limited data are available concerning female adolescents. There is, however, growing awareness that this is an important group to consider, not only for their growth and development, but also for future pregnancies. Indeed, one of the primary factors leading to micronutrient deficits during pregnancy is that many girls or women of reproductive age have poor micronutrient status prior to conception. Thus, improving micronutrient status of women during adolescence is likely to have multiple and long-lasting benefits.

The GIRLS project was, therefore, designed to assess the impact of various strategies of improving iron and vitamin A status among female adolescents (aged 12-15 years) attending schools in rural and urban East Java, Indonesia. It also served the long-term goal of improving reproductive health by reducing micronutrient deficiencies. More specifically, the project focused on the following goals concerning female adolescents in rural and urban communities:

1. Test the effectiveness of iron-folate and vitamin A given alone or in combination on reducing anemia, vitamin A deficiency, and improving growth

2. Test the effectiveness of daily versus weekly multi-micronutrient supplements on reducing anemia, vitamin A deficiency, and improving growth

3. Test the effectiveness of a daily meal prepared to be either high or low in both iron and vitamin A on anemia, vitamin A deficiency, and growth

4. Determine the relative benefit of iron-folate or vitamin A supplementation in rural or urban settings

5. Determine the prevalence of anemia and vitamin A deficiencies among female adolescents in rural and urban communities

6. Assess the direct causes and underlying factors, as well as the processes, which lead to quantitative and qualitative micronutrient deficits in the habitual diets of female adolescents in rural and urban communities
7. Assess the appropriateness of the school as a channel to address the nutritional problems of female adolescents

The preparations for this project started in January 1996 and the field activities started in August of the same year. The project ended on 31 July 1999. During the three years of the GIRLS project, approximately 11,000 adolescents attending 34 schools received some form of supplementation or dietary intervention.

In 24 junior high schools, approximately 6,000 were enrolled in each of three years of randomized weekly supplementation trials. In the first year, 10,000 IU vitamin A and 60 mg iron with 250 μg folic acid was given either alone or in combination in 15 schools while the other 9 schools served as controls. In the second year, the trial used a placebo-controlled design and participants received either 20,000 IU vitamin A plus placebo, 60 mg iron with 250 μg folic acid plus placebo, 20,000 IU vitamin A plus 60 mg iron with 250 μg folic acid, or two placebos. In the third year, the impact of daily versus weekly multi-micronutrient supplementation was addressed. In addition, issues surrounding compliance and distribution of supplements were examined.

Along with supplement-based interventions, over 400 girls in Islamic boarding schools (pondok pesantren) were enrolled in a 6-month dietary intervention trial that assessed the impact on hemoglobin concentration of a daily meal containing iron-rich foods compared to a meal with a low iron content.

Although focusing on female adolescents, it was inherent to the school-based nature of the project that adolescent boys also participated. A health surveillance system was set up which allowed for data collection on all participants before and after each intervention round. Data collected in this surveillance system included socio-economic data, puberty, morbidity, anthropometry, hemoglobin concentration, dietary intake. In subsamples, other data were collected as well, such as physical fitness, parasitic infestations, serum concentrations of micronutrients, including retinol and zinc.

Preliminary analyses of data gathered from these interventions indicates that:

1. Supplementation with iron and vitamin A were effective in reducing deficiencies in these micronutrients in female and male adolescents.
2. Giving one daily meal with high iron content for six months was effective in improving iron status in female adolescents.
3. Iron deficiency anemia and vitamin A deficiency are very prevalent among both female and male adolescents, which makes it probable that they also suffer from other micronutrient deficits.

We therefore recommend that:

1. Attention is given to micronutrient supplementation of female, and male, adolescents
2. In the design of supplementation intervention, special care be taken to investigate factors that negatively influence compliance and that ways are found to overcome these
3. Schools are an appropriate channel for micronutrient supplementation to adolescents, where enrollment is sufficiently high
4. More research be devoted to gain insight in the health status of adolescents, including the prevalence of micronutrient deficiencies
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I. INTRODUCTION

Micronutrient deficiencies have severe consequences for health, well-being and productivity, including irreversible damage to the physical and mental development of young children (Kretchmer et al, 1996), impaired immune function (Herschko, 1993; West et al, 1991) and reduced work performance (Basta et al, 1979; Scholz et al. 1997), and increased peri-natal and maternal mortality (Scholl & Hediger, 1994).

The most widespread micronutrient deficiency is anemia, which is largely due to iron deficiency and affects millions worldwide. In non-industrialized countries, the prevalence of anemia during pregnancy ranges from 35 - 80%, with the highest prevalence found in South East Asia (ACC/SCN 1997). Vitamin A deficiency is another frequently occurring condition, with detrimental effects on morbidity and mortality (Scrimshaw & Sangiovanni 1997), partly through contribution to the development of anemia (Bloem 1995). In Indonesia, vitamin A deficiency has been found to be prevalent among women of reproductive age and, in particular, during lactation (Tanumiharjo et al 1994, Suharno et al 1992, de Pee et al 1997).

The main cause of iron and vitamin A deficiency is inadequate intake of bio-available iron and vitamin A. In addition, other factors play a significant role such as excessive blood loss, infections, and deficiencies of other complementary micronutrients that facilitate the physiologic functions of iron and vitamin A. Although iron and vitamin A are widely recognized as crucial micronutrients, individuals who are deficient in these nutrients are generally deficient in multiple micronutrients, including zinc, B vitamins, and anti-oxidants. Rapid growth, as it occurs in adolescence, pregnancy and early childhood, greatly increases physiological needs for multiple micronutrients (Brabin & Brabin, 1992; Antilla & Siimes, 1996). Therefore, the susceptibility to deficiencies of micronutrients in these phases of the lifecycle is increased if micronutrients are not consumed in sufficient quantities.

II. RATIONALE

Nutritional needs during pregnancy increase to such an extent, that they are often difficult to meet with typical diets. Even high dose iron supplements can be ineffective in the treatment of anemia during pregnancy. Considering the fact that the main cause of iron deficiency anemia in pregnancy is marginal iron status in women of reproductive age before conception, a logical alternative approach would be to improve iron status prior to pregnancy, and to continue supplementation during pregnancy. Less experience has accumulated with vitamin A supplementation during pregnancy, partly because of the teratogenic effects of high doses of vitamin A. It is, however, now considered safe to give low dose vitamin A supplementation to pregnant women. The potential benefit of improved pre-conceptual vitamin A status is underscored by the dramatic results of the Nepal study which showed that routine vitamin A supplementation of women of reproductive age was effective in reducing maternal mortality by 40% (West et al., 1999). As previously mentioned, selective micronutrient deficiencies rarely occur in isolation, indicating that multiple micronutrient supplementation may provide optimal benefit. Therefore, this project focused on improving intakes of iron, vitamin A, as well as multi-micronutrients among adolescent girls.
In Indonesia the mean age at first marriage is 21.6 (1990 data) and almost 25% marry before the age of 16. In addition, those marrying at a young age are most likely to curtail their education, which emphasizes the need to focus interventions and nutritional education prior to marriage. With 80% enrolment rates in junior high school education, the Indonesian majority of adolescent girls and boys are to be found in schools. In addition, given that adolescence spans several years, interventions during this period must be sustainable and logistically feasible. Although daily micronutrient supplementation could be problematic, weekly supplementation may be feasible and sufficient to improve iron and vitamin A status (Angeles-Agdeppa et al., 1997; Viteri & Cook, 1996). Changes in dietary habits may, however, represent the most promising sustainable approach, and introduction of such concepts during adolescence may be particularly effective for making changes in the future generations. For these reasons, the GIRLS project focused on adolescent girls attending junior high school.

In addition to the public health and programmatic reasons, focusing on adolescents contributes to closing the considerable gap in nutritional knowledge concerning this age group. In an extensive review of nutritional studies, DeMaeyer and Adiels-Tegman found that most studies focused on pregnant or lactating women and underfive children, with relatively few studies in adolescents, and none comprised of more than 5,000 subjects. This is partly due to the difficulties in studying adolescent populations in a state of rapid physiological change, psychological volatility, and greater mobility. However, these factors also make adolescents a potentially very informative group, particularly if the design of studies/projects spans multiple years of the adolescent transition.

Thus, results of the GIRLS project add to our knowledge on adolescents in general, and on adolescent reproductive health in particular. The experience built in three years of school-based interventions may be used in designing and implementing similar projects in other parts of Indonesia as well as in other countries.

III. OBJECTIVES

This project was carried out in an adolescent female population (age 12-16 years) and was designed to assess the impact of supplementation with iron-folate, vitamin A, or multiple micronutrients on anemia, vitamin A status, and growth. In addition, the underlying causes of poor nutritional status were investigated. More specifically, this project aimed to:

1. Test the effectiveness of iron-folate and vitamin A given alone or in combination on reducing anemia, vitamin A deficiency, and improving growth

2. Test the effectiveness of daily versus weekly multi-micronutrient supplements on reducing anemia, vitamin A deficiency, and improving growth

3. Test the effectiveness of a daily meal prepared to be either high or low in both iron and vitamin A on anemia, vitamin A deficiency, and growth

4. Determine the prevalence of anemia and vitamin A deficiencies among female adolescents in rural and urban communities
5. Determine the relative benefit of iron-folate or vitamin A supplementation in rural or urban settings.

6. Assess the direct causes and underlying factors, as well as the processes, which lead to quantitative and qualitative micronutrient deficits in the habitual diets of female adolescents in rural and urban communities.

7. Assess the appropriateness of the school as a channel to address the nutritional problems of female adolescents.

In addition to these aims, the GIRLS project evaluated the feasibility of micronutrient supplement distribution through the school system, and served the long-term goal of improving reproductive health by reducing micronutrient deficiencies.

IV. METHODOLOGY

A. Population

The main interest of the project was in girls, but the school setting made it possible, and even necessary from an ethical point of view, to involve the boys as well. This provided the additional advantage of enabling the team to collect data on adolescent boys, a group that has received even less attention than their female peers. Thus, the population consisted of girls and boys between the ages of 12 and 15 at the time they were enrolled, attending 34 Junior High and pondok pesantren in two rural districts in East Java and the provincial capital, whose parents gave written consent for participation in the activities.

B. Location

The project was implemented in 24 junior high schools and 10 pondok pesantren in an urban and a rural area. The provincial capital, Surabaya, served as urban area, while the rural area was Madura, or more specific, the two westernmost districts on this island: Bangkalan and Sampang.

Surabaya is the second largest city in Indonesia, with approximately three million inhabitants and all the characteristics of a large city in a developing country. Madura is a traditional rural area, where nutritional problems are known to be widespread; both macro and micronutrient deficiencies are quite common.

The two main types of school available in Indonesia for the 12-15 year age group were covered by this project: junior high schools and pondok pesantren. Throughout this document the latter term is used, because there is no equivalent found outside this particular cultural context. The term pondok pesantren is applied to a heterogeneous group of schools, which have in common that the pupils board, and that a strong emphasis is laid on Islamic religious education. Most pondok pesantren offer some degree of general education as well, but some focus entirely on religion. They are privately owned and run by religious leaders.
C. Selection of interventions

There are four types of intervention to prevent and treat micronutrient deficiencies:
1. Supplementation
2. Dietary intervention
3. Education
4. Fortification

For this project, supplementation and dietary intervention were chosen.

1. Dietary intervention was implemented in five pondok pesantren in order to be able to determine whether or not such an approach is as effective as has always been presumed. The team was interested both in the effectiveness of this approach to improve micronutrient status and growth of adolescent girls, and in its feasibility, especially taking into consideration the traditional eating habits of the population under study.

2. The supplementation approach was used to test whether this is a viable approach in a school setting as well as to add to the discussion on daily versus weekly supplementation.

The dietary intervention was implemented in the pondok pesantren, and the supplementation in the junior high schools.

Because of their nature as boarding schools, the pondok pesantren offered an optimal situation for a dietary intervention: availability of kitchens and pupils staying in school, which facilitated monitoring consumption of food other than the intervention given. The reason the supplementation was best implemented in the junior high schools, is that the interventions were randomized by grade and pondok pesantren do not structure their classes into grades.

D. Field workers

Field workers were either graduates from the Nutrition Academies in Malang (East Java) and Semarang (Central Java), or of the Nursing Academy of the Islamic Hospital in Surabaya. In addition, several members of Fatayat Nahdlatul Ulama, the young women’s organization of one of the largest NGOs in Indonesia, were trained to join the team.
### E. Timeline of activities

**Table 1.**

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<td>Endline survey in pondok pesantren</td>
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<td>Survey IV in junior high schools (endline supplementation II)</td>
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<td>Follow-up survey of alumni</td>
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<td>Survey V in junior high schools (baseline new pupils)</td>
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<td>Supplementation round III: multivitamins</td>
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<td>Survey VI in junior high schools (endline supplementation III)</td>
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V. PROGRAMMATIC ASPECTS OF IMPLEMENTATION

A. Data collection schedule

Data were collected during the following periods:
2. April – May 1997
3. May 1997
4. August 1997
5. December 1997
6. March 1998
7. August 1998
8. March – May 1999

B. Methodology

During the baseline survey (October 1996-January 1997), data were collected on all pupils in all 34 schools. In April-May 1997, March 1998 and March-May 1999, data were collected in all schools except the pondok pesantren (total 24 schools), and in August 1997 and August 1998, the new pupils in the first grades in these schools were examined prior to being enrolled in the project. In May and December 1997, data were collected in the pondok pesantren: baseline data of the pupils who were to be enrolled in the dietary intervention, and endline data of all pondok pesantren pupils, respectively.

Socio-economic, anthropometric and morbidity data as well as pubertal status, dietary recall and hemoglobin were collected on all pupils in the sample (aged 12-15 years at baseline, informed consent from parents/guardians), except for certain data, which were only collected from a subsample (see Table 2).

Table 2. Data collected at each round of data collection

<table>
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<tr>
<th></th>
<th>Pondok pesantren</th>
<th>Junior High Schools</th>
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<tr>
<td></td>
<td>Pre-diet</td>
<td>Endline diet</td>
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<tr>
<td>TOTAL POPULATION</td>
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<tr>
<td>Socio-economic status</td>
<td>X</td>
<td>X</td>
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<td>Anthropometry</td>
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<td>24 VASQ</td>
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<td>Hemoglobin</td>
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<td>X</td>
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<td>SUBSAMPLE</td>
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<tr>
<td>Serum retinol</td>
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<td>Serum zinc</td>
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<td>Physical fitness</td>
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<td>Academic test</td>
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<td>Stool samples</td>
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Based on available data for Indonesian female adolescents, a prevalence of anemia of 30% was assumed. To allow detection of a 50% reduction in this prevalence, and accounting for 25% drop-out from the study, it was calculated that 168 subjects in each cohort were needed to obtain significance at the p<0.05 level, and 80% power. Therefore, three*12 pupils per school for the supplementation schools, 12 pupils per school for control schools, and a total of 168 divided over the diet schools were included in the subsample. Although this already accounted for drop-out, a slightly larger number (3*15 and 15 per school, respectively for the supplementation and controls) was taken.

The anthropometric measurements comprised height, weight and mid upper-arm circumference (MUAC). Height was measured without shoes using a 'microtoise' which was fixed to a wall in the school. Weight was measured with digital scales, with no shoes and light clothing (school uniform) on. MUAC was measured on the bare left upper arm, which necessitated the use of a separate room to measure the girls, if their sleeves were too tight to roll up.

Dietary recall focused on vitamin A-rich foods, using the 24-VASQ method described elsewhere (de Pee et al, submitted for publication). Hemoglobin was determined in blood taken from the fingertip with the use of a HemoCue device.

The Cooper test consisted of running a distance of 1.4 km. The academic test was designed to test the ability to think abstractly and was always corrected by the same person to avoid inter-observer error. Stool samples were examined for the presence of parasite eggs, using the Kato-Katz method. The venous blood collected (3cc) was centrifuged and the serum was stored at -20° C before analysis on retinol, beta-carotene, ferritin and iron content.

C. Programmatic aspects

Surveys were well conducted by the staff and readily accepted by the intervention groups, and 15 field workers could collect data from approximately 5,000 respondents in one month.

Data collection in schools is very different from data collection in the community. On the one hand, it is easier because all respondents are concentrated in one place. On the other hand, there is limited freedom in constructing a time schedule, which should be both acceptable to the schools and efficient for the research team.

Another factor which had to be taken into account in planning the surveys was the difference in size between the schools and the fact that some of the schools had classes only in the mornings, others only in the afternoons, and a few had classes all day long. In addition, the distances between the schools sometimes meant it would take up to two hours to move from one school to the other.

In order to be able to adjust quickly to conditions in the schools and to overcome logistic challenges, different working systems were used in conjunction: distinct teams working independently and joining forces when necessary, a division of manpower according to workload, adding logistic/administrative staff to the field
team, coordinating examinations of the subsample (venous blood taking, cooper test, intelligence test) with the general survey or disconnecting them.

Optimal speed and efficiency was achieved not only from experience of the team of field workers, but also by the fact that the schools (teachers and pupils alike) grew more used to the routine and the initial fear of some pupils was dissolved.

VI. SUPPLEMENT DISTRIBUTION

A. Phases of the intervention

The interventions involving supplementation were implemented in 2 distinct phases as indicated in Figure I (attached to this report).

At the start of the GIRLS project, baseline data were collected on 6,492 pupils of 34 schools; 1,326 of these pupils attended 10 Islamic boarding schools and were involved in the dietary intervention. 24 three-grade junior high schools with 5,166 pupils, two-thirds of whom lived in urban areas, were allocated either to the supplementation group (n=3,210) or the control group (n=1,956). Each grade of each school in the supplementation group was randomly allocated to one of three regimes of weekly supplementation:

1. 60 mg iron
2. 10,000 IU vitamin A
3. both iron and vitamin A

All three regimes were given in all schools. Thus, the three groups that received supplementation were similar in size, had a similar composition in age and in the relative proportion of urban and rural pupils. Pupils in the control schools did not receive any intervention, and data were collected among them like in the other schools. The intervention started just before the fasting month (January 1997) and lasted through March 1997. During this period, 14 weekly supplements were distributed by the field workers. Where possible, the supplements were taken in the classroom under the supervision of the field workers. During holidays and fasting month, the supplements were taken at home and compliance was recorded on forms as reported by the pupils.

Because the GIRLS project was implemented in schools, at the beginning of the new school year the pupils in grade 3 graduated and left school, while new pupils came into the schools, and thus into the study. The pupils who were formerly in the first and second grades, moved up a grade, but were given the same supplementation as they had received the year before, while the new pupils in grade 1 were given the same supplementation as the former third grade pupils of each school had received.

Based on a mid-phase evaluation, which revealed low compliance for the iron pills and minimal impact of the vitamin A supplementation on hemoglobin concentration, the regimes were revised. Coated iron pills with the same content as before were used, and the dose of the vitamin A pills was increased to 20,000 IU vitamin A. In addition,
pills were distributed in a single-blind placebo-controlled design in which every pupil in all 24 junior high schools received two tablets once per week. These were either iron and placebo, vitamin A and placebo, vitamin A and iron, or two placebos. This refinement was implemented in October 1997, and lasted for 22 weeks, until the end-line data collection in March 1998.

During the second phase, the extension of the project, three different approaches were pursued (see Figure 1, attached to this report).

1. The aim of the first approach was to evaluate further the programmatic aspects of a school-based program. In the first and second grades of the urban schools and the second and third grades of the rural schools, the teachers were asked to distribute vitamin A tablets (20,000 IU), with low intensity involvement of field workers.

2. The second approach was based on the observation that compliance for iron was poor, especially in the urban schools, among the pupils who had participated in the first round of supplementation. Therefore, it was decided to distribute iron tablets in the third grades of the urban schools, with intensified supervision and interactive classroom activities aimed at raising awareness of the need for iron supplementation and creating better rapport with the pupils.

3. The third approach was to distribute multi-micronutrient supplements in the first grade of rural schools. As it had become evident that micronutrient deficiencies were common in adolescents participating in the project, the next step was to evaluate the impact of multi-micronutrient supplementation in the schools. The first grade of the rural schools were chosen as population for this intervention because they had not yet received any of the other supplementations, which minimized the chance of any accumulative effect of interventions. In addition, throughout the earlier phases of the project, both the teachers and the pupils in the rural schools had shown a more cooperative attitude. As this part of the study was aimed at evaluating the relative impact of two different multi-micronutrient supplements, each given either on a weekly or on a daily basis, it was a very intensive intervention and optimal cooperation was essential.

B. Programmatic aspects

1. Vitamin A supplementation

The teachers were instructed to distribute the vitamin A tablets and record compliance. Because of the pressure they felt to finish the set curriculum in due time, this extra task was felt as a burden by some of the teachers. However, the majority were active and enthusiastic in the distribution and monitoring process. Because of the 1999 general elections and the sudden change in the schedule of the educational system, there was no opportunity to collect complete endline data in the pupils receiving this intervention. Therefore, only selected data were collected on a subsample.
2. Iron supplementation

The distribution of the supplements was entirely in the hands of the field workers. Every school was visited on a weekly basis by a team of two field workers. The close contact between the pupils and field workers offered the opportunity to give information on a continuing basis about the goals of the intervention and the importance of taking the supplements. On some occasions this information took on the form of a quiz with a ballpoint or note pad as prize, to stimulate the pupils to actively think about health and nutrition.

On ordinary days the field workers could distribute the supplements directly and they could supervise the taking of the tablets. However, during holidays and during the Islamic fasting month of Ramadhan, this was not the case, and alternative approaches were developed. As far as possible, the supplements were distributed directly to the pupils, although sometimes they had to be given via teachers or other pupils, to be taken at home. Self-reported compliance was recorded at the next contact with the field workers. When a holiday lasted for more than a week, several supplements were given in advance together with a card on which the dates to take them were indicated. The same cards were used by the pupils to record their consumption of the supplements.

3. Multivitamin supplementation

A special note is needed on the distribution of the multiple-micronutrient supplements. As described above, two different tablets were used. One was produced in Indonesia and contained small amounts of several micronutrients, while the other (much larger) tablet was produced in the United States and contained 100% RDA (Recommended Daily Allowances) of most micronutrients. Because no tablets were available that contained five times the amount in these tablets, the pupils who received weekly supplementation had to take five tablets at a time. Especially in the group receiving the large dose this was a major problem.

General notes on supplementation

During three consecutive endline surveys, there was political unrest in the country. The 1997 general elections did not disrupt the GIRLS activities as these took place at the schools. However, they did cause a sudden change in the examination schedule in the schools, which forced the endline data collection to start earlier than planned. During the May 1998 riots, activities were winding down toward the holidays. 1999, again, saw general elections and a change in the schools’ schedule, to the extent that we were not able to collect complete endline data of the vitamin A supplementation.
VII. DIETARY INTERVENTION
(May-Nov 1997)

A. Preparatory phase

The goal of the dietary intervention was to assess the effectiveness of the use of natural foods rich in iron to improve the iron status of adolescent girls. The basic design is detailed in Figure 2 (attached to this report).

This intervention was implemented in pondok pesantren (Islamic boarding schools) as these schools could provide the infrastructure and situation necessary for this intervention. For the GIRLS program, ten pondok pesantren were selected in Bangkalan and Sampang, Madura’s two westernmost districts. Five of these schools were selected to receive the dietary intervention, based on the presence of sufficient facilities (in particular a large kitchen), while the others served as controls. Four hundred and nine girls participated in the dietary intervention from start to finish. Data were collected as in the other schools (see section on data collection). In addition, to assess the effect the intervention had on their normal diet, a complete dietary recall was collected from them at the time they were enrolled, as well as after one and two months. Each menu in the high iron group was sampled twice for analysis in September 1997, while the menus in the low iron group were sampled twice in October.

The original plan to compare a high-iron diet to no special diet was improved so that a high-iron diet was compared to a low-iron diet, both were high in calories to allow for optimal iron absorption. The high iron group menus consisted of rice, green leafy vegetables, sources of heme iron, tempe and vitamin C-rich fruit. Vegetables used included dark green leafy vegetables and carrots. Foods from animal origin were beef, chicken, shrimps, liver, spleen, intestines, and shellfish. The menus for the low iron group consisted of rice, non-green leafy vegetables and legumes, as well as fruit with low vitamin C content, corned beef, eggs, chicken, shrimp and fish. Every school was provided with a 10-day rotating list of recipes to be used once daily for six days per week. All meals were distributed and consumed under close supervision of field supervisors, except on Sunday, when an easy-to-prepare meal was cooked, with the appropriate iron content. The recipes were adjusted accordingly to suit tastes, availability of ingredients, and portion size.

B. Daily activities during the dietary intervention

1. Food preparation

The preparation of the food took place in close cooperation with the schools. One of the pupils in each school did the shopping. Ingredients that could not be stored long like fresh vegetables and fish were bought every day, whereas cooking oil and rice were bought every other day. A teacher was in charge of coordination and received money for buying ingredients every two days. The cooks were chosen by the leader of the school. Some where school staff, while others were women who lived nearby. Incentives (Rp 3,000 per day) were given each week to: the pupils who did the shopping, the cooks, the teachers who assisted in the supervision, and to the leader of the school.
Per *pondok pesantren* there were usually two cooks, except when the numbers of participating pupils were too large and more cooks were added as necessary. The cooks would cook the food according to the recipes, under supervision of field workers and teacher.

2. *Distribution of meals*

Meals were given once daily, 7 days per week. The field workers would supervise during 6 days per week, except on Sundays when easy to prepare meals were cooked with the right iron content. The field workers filled special dishes, one per pupil with the prepared food, while the pupils themselves were responsible for washing and bringing to the meal the next day to be filled again.

In general the meals were given at lunchtime, except in one school where they were given at approximately 9 am, as the timetable in this *pondok pesantren* did not allow disturbance at noon. The preparation and consumption of the meals was supervised by 2-4 field workers per school, depending on the number of pupils.

The field workers supervised the pupils while they were eating, and recorded leftovers of each component (rice, vegetables, meat, fruit) as proportion of the original portion. The field coordinator visited each school every other day, as the distances between the school were too large to allow daily supervision. In addition, the meals were given at the same time in almost all schools.

The field workers were provided with base-camps (two in Sampang and one in Bangkalan) to enable them to visit the schools whenever necessary and to enable better communication between field workers. To this goal the field workers also moved from one *pondok pesantren* to the other every 4-6 weeks. In this way they were able to exchange information and experiences with each other.

The actual intervention started on 19 May, 1997. As was to be expected, in the first month there were several difficulties to overcome. For instance, the difficulty of the pupils to finish their food, and the availability of certain ingredients, which was especially true for Sampang. Although the portion sizes had already been decreased, they were still quite large for the pupils who are used to eat very little. Not only the portion size but also the fact that they had to eat vegetables was something new to them. In general, the Madurese do not generally consume substantial quantities of vegetables, as they consider it as “goat’s fodder.” One day, when a pupil was doing the shopping for the dietary intervention and she bought a large amount of vegetables, the vendor asked her how many goats she had, as she bought so much fodder. The problems in obtaining the right ingredients in Sampang were solved by buying them in a nearby village, where they might be available or even by ‘importing’ them from Bangkalan.

As field workers and pupils grew accustomed to the routine of the intervention, things went more smoothly. The number of pupils who did not finish their meals decreased as well as the volume of the leftovers.
Reasons for not finishing their portions ranged from fear of allergy to boredom. Other reasons were fear of growing fat and thus losing their attraction to the opposite sex, and fear of defecating every day. The latter is of special importance to them since sanitation in the pondok pesanren is generally poor. In one of the schools receiving a high iron diet with a high vegetable and papaya content, there was only one latrine for 100 pupils. Therefore, HKI assisted in the construction of additional latrines. Interestingly, pupils reported that they typically defecate 1-2 times per week, which could be due to their low fiber diet, and they consider this the most normal and healthy pattern. The field workers explained to them that they would not grow fat on this diet, and that regular bowel movements are healthy, which increased compliance to the diet.

In July-August a change in the composition of the pupils population took place as many left the schools. Reasons for leaving were either graduation or marriage, or both. In order not to end up with a too small number of pupils participating in the intervention, 69 new pupils were enrolled and baseline data were collected on all of them.

Toward the end of the intervention several constraints were encountered. Pupils did not finish their food because they were fasting, bored or busy with other activities like washing clothes. Those who were fasting were given permission to eat the food after they had broken the fast at sunset, while boredom was ‘treated’ by increasing the variation in the ways the food was prepared without changing the contents or portion sizes. For instance, in one school the pupils did not finish the intestines on the menu. When they were asked why, they said the sight made them feel sick as the intestines looked like worms. On the pupils’ request, the intestines were fried, which solved the problem.

In one of the schools there is always a shortage of water during the dry season, to such an extent that the pupils only take a shower once a week. They have to buy water to wash their clothes, or walk a long distance to find water and wash their clothes there. They were given the opportunity to have their meal early, before they set out on their search for water. Another problem was that no water was available to wash the dishes for the diet. This was solved by buying water and storing it in special drums especially for the washing of the dishes used for the dietary intervention.

The dietary intervention ended on 20 November 1997. After the end of the intervention, data were collected again. The collection finished on 20 December 1997, ten days before the start of the fasting month Ramadhan.

VIII. FOLLOW-UP STUDY
(Jun-Aug 1998)

Between the middle of June and the end of August 1998, a follow-up study was undertaken among the graduates of 1997. The purpose of the follow-up study was a) to monitor whether there would be a long-term effect of the supplementation intervention, and b) to obtain data on a broader age group.
The original idea to invite the graduates to the office in Surabaya or the base-camp in Madura was updated when field workers suggested organizing reunions at the schools. This would not only improve the enthusiasm of the respondents to come and to be examined, but it would also be a nice way to strengthen the relationships with the schools by showing our concern for their alumni. Although no one on the team could envision what these ‘reunions’ would be like, it seemed the only way to gather the alumni.

The process was simple: after the idea was broken to the Headmaster (many of whom were quite skeptic about the chance of success of the undertaking), some of the alumni were contacted. In some cases the school acted as intermediate, in others the field workers met the alumni at their present school. Those who could be contacted were asked their opinion about the idea. They were very enthusiastic and organizing committees were formed of these alumni. Several meetings were necessary between the field workers and the alumni to finalize all preparations.

The alumni generally distributed the invitations themselves. They also kept a record of the enthusiasm of their former classmates to come to the event. This record was necessary to order the lunch. The set-up of the different reunions was generally the same, although the setting was not. Most were held in school, but several were held at the house of one of the alumni – such as the alumni’s initiative.

After the first reunion, the team soon fell into a routine, as the schedule was very tight, with 19 events in four weeks.

An hour before the official time on the invitation, the field workers were present at the site. Several times these preparations even started on the day before. Decorations were put up for the party and equipment was set up for the examinations. Tables and chairs were arranged, or (especially when at the alumni’s house) carpets were spread out to sit on. A corner was closed off with a curtain for the MUAC measurements on the girls.

As soon as the alumni started to arrive, the field workers invited them to a voluntary examination. Although reluctant at first, as soon as they saw their braver friends being examined, most alumni were willing to be interviewed, measured, and even to have their finger pricked for hemoglobin determination.

Points of concern had been the willingness to come, the willingness to be examined, and the willingness to have a venous blood sample taken. However, these concerns turned out to be unnecessary. Almost two-thirds of the number of alumni honored the invitation, and of these, more than 92% were willing to be examined, including hemoglobin. This is an especially high percentage, since they still remembered the earlier examinations, which used ordinary lancets causing soreness of the finger, which sometimes lasted for days. But they were curious about the new tool used (Softclix), which can be set for a certain depth of the prick to be delivered, and which is by far not as painful as the older method. No complaints were heard about these examinations, except “it does not even hurt!”

The collection of the venous blood samples was even more surprising. It was by no means possible to anticipate the number of alumni present at the time of the
examination, and how many of the original subsample would be among them, let alone their willingness to be examined. Therefore, this time the possibility to have their blood examined was offered to all alumni. The result was, that 75% of the original target was reached, although half of the original subsample who were present refused to have their blood taken. Those who were never part of the original subsample provided more than 50% of the number of blood samples collected.

In general, the willingness to be examined differed widely between the schools and the sexes. Girls were more willing than the boys. However, among the boys some interesting phenomena were encountered. The general atmosphere in their peer group seemed more important in the boys than in the girls. In most schools, it seemed that it was more done to refuse and to stick to this refusal. In one or two, however, it was definitely cooler to be ‘brave’ and have your blood taken.

The difference in willingness and awareness as observed in the field, seems partly caused by the difference in access to information (location of the school). Another factor might be the general intelligence of the pupils (as reflected in the criteria for acceptance into the school, and activities of the alumni). One of the schools with the most difficult-to-approach pupils is located at the very utmost periphery of Surabaya next to a prostitution area. The pupils come from families who really have to struggle to stay afloat, especially during the current crisis. One of the alumni of this school now pays his school fees by working at a sandal factory in the afternoon, and another has started a street-side ‘café’.

After the examinations were finished, or, in the case of a large number of alumni, it turned 10 o’clock, the actual reunion started. If necessary, those not yet examined were called during the reunion. As is the custom, the reunions were officially opened with speeches from the Headmaster (if present), a representative of HKI, and a representative of the alumni. After that, it was time for a game, which was almost standard. A boy and a girl were selected by passing round two glasses of water, while music was playing. The ones holding the glasses when the music was stopped were called to come forward. The boy would prick a balloon containing little bits of paper and a small note containing a task. These tasks were made up by the alumni themselves and reflected very clearly their adolescence, even in strictly religious surroundings, where contact between persons of opposite sex is not possible. Some examples of tasks: feed your partner, drink with straws from the same glass, declare your love to your partner, put on your husband’s tie, and more of the same genre. At a few schools, there was a stage where several bands performed, paid for by the alumni themselves.

After games and other amusement (in some schools there were performances of song, dance, declaration of poetry, and even comedians) were over, lunch was eaten together. Alumni and teachers were given the opportunity to ask questions about HKI and the current program. Questions ranged from HKI’s history and role in public health in Indonesia, to ways to grow taller, the purpose of these examinations and the pills distributed when they were still in Junior High School, as well as the possibilities for them to join the HKI team.
The GIRLS project was implemented for three years in 34 schools in rural and urban East Java. Activities consisted of different interventions aimed at reducing the prevalence of micronutrient deficiencies in school-attending female adolescents. Because of the school setting, male adolescents were also included. The feasibility of dietary interventions in – at least – certain school settings has been demonstrated. Preliminary analyses show that:

1. Iron deficiency anemia and vitamin A deficiency are highly prevalent among female and male adolescents, which makes it probable that they also suffer from deficiencies of other micronutrients;
2. Supplementation with iron and vitamin A were effective in reducing deficiencies in these micronutrients in female and male adolescents;
3. Giving one daily meal with high iron content for six months was effective in improving iron status in female adolescents.

Therefore, the following recommendations are made:

1. Currently adolescents do not receive targeted micronutrient supplementation. However, both the increasing evidence of high prevalence of micronutrient deficiencies in this age group, and need to prepare women for the nutritional toll of pregnancy, emphasizes the need to supplement adolescent girls with micronutrients. It is highly likely that the most appropriate approach will be to deliver multi-micronutrients, as micronutrient deficiencies seldom occur in isolation;
2. The effectiveness of a supplementation intervention is determined by the efficacy of the supplement used, the nutritional status of the population and their compliance to the supplementation. Compliance is influenced by the perceived benefit and harm caused by the supplements. It is essential to the success of the supplementation to ensure optimal compliance. In planning supplementation interventions, special care should be taken to investigate factors negatively influencing compliance and to find ways to overcome these;
3. In areas with high school enrolment, schools are an appropriate channel for supplementation of adolescent girls. The benefit of the supplementation should be clear to the teachers in the schools, as their active participation is crucial to the success of the intervention. Obviously, where school enrolment of female adolescents is low, other channels should be considered, such as workplaces or women’s gatherings;
4. Preliminary analysis of the results of this study show high prevalence of iron and vitamin A deficiency among both female and male adolescents, which makes it highly probable that they also suffer from other deficiencies. In order to be able to target future interventions, more research is necessary to gain insight in their health status, including prevalence levels of micronutrient deficiencies. Innovative approaches should be developed to be able to collect more data on this specific age group.
5. Finally, the following specific questions were recommended as areas where additional knowledge would be valuable:
• What are the prevalences of specific micronutrient deficiencies among female and male adolescents in different areas and countries?

• Are there any identifiable subgroups within the adolescent population (e.g., female/male, urban/rural, age-specific, puberty specific) that would benefit more from supplementation than the general adolescent population? Do girls benefit more from supplementation than boys? What is the prevalence of micronutrient deficiencies in adolescent girls and boys?

• What are the functional consequences of these deficiencies, and are they different in different subgroups?

• What is the long-term effect of micronutrient supplementation of female adolescents? Is this different from the long-term effect in male adolescents?

• What are the factors influencing compliance to supplementation in female and in male adolescents? How can these factors be influenced?
X. REFERENCES

10. IVACG 1997
Figure 1. Diagram of GIRLS Project supplementation groups

- **Legend**
  - **Urban**
  - **Rural**

- **Fe** = Iron
- **VA** = Vitamin A
- **Multiple Micronutrients**

- **HD** = High daily dose
- **HW** = High weekly dose
- **LD** = Low daily dose
- **LW** = Low weekly dose

**Supplemented schools**
- **Grade I**
  - Fe
  - VA
  - Fe+VA

- **Grade II**
  - Fe
  - VA
  - Fe+VA

- **Grade III**
  - Fe
  - VA
  - Fe+VA

- **Control schools**
  - Grade I
    - Control
  - Grade II
    - Control
  - Grade III
    - Control

**Year 1**
- **PHASE I**
  - New students
  - Graduated

**Year 2**
- **PHASE II**
  - New students
  - Graduated

**Year 3**
- New students
  - Graduated
Baseline survey

High iron diet

Low iron diet

Endline survey

Dropouts (due to graduation & marriage)

Figure 2. Diagram of GIRLS Project dietary intervention groups
ANNEX TO THE PROGRAM REPORT OF THE

GIRLS Project

Gizi: Intervensi pada Remaja Lewat Sekolah

Improving Reproductive Health through School-Based Interventions among Adolescents in East Java, Indonesia 1996-1999

PROJECT RESULTS

Implemented by
Helen Keller International/Indonesia
in collaboration with the Government of Indonesia

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I. RESULTS

This results section, which is an annex to the previously submitted program report, provides the answers to the goals of the GIRLS project (listed below). As described in the program report, the project was implemented in four different groups of schools in two settings: boarding schools and general junior high schools in a rural setting (Madura island, East Java), and Islamic and general junior high schools in an urban setting (Surabaya, East Java).

The purpose of the GIRLS project was to describe and improve the micronutrient status of adolescent girls. However, because the project was implemented in schools, it was also possible to collect data on adolescent boys. Only the dietary intervention was implemented exclusively among adolescent girls.

The GIRLS project was implemented in urban and rural settings. However, the data presented here are not necessarily representative of adolescents in general in those urban and rural settings, because certain types of schools were sampled, rather than taking a real random sample of adolescents. The differences found, therefore, mainly reflect differences between the types of schools and the students who attend them.

The goals of the project were the following:

1. To test the effectiveness of iron-folate and vitamin A, given alone or in combination, in reducing anemia and vitamin A deficiency, and improving growth.

2. To test the effectiveness of daily versus weekly multi-micronutrient supplements in reducing anemia and vitamin A deficiency, and improving growth.

3. To test the effectiveness of a daily meal, prepared to be either high or low in both iron and vitamin A, in reducing anemia and vitamin A deficiency, and improving growth.

4. To determine the relative benefits of iron-folate or vitamin A supplementation in rural and urban settings.

5. To determine the prevalence of anemia and vitamin A deficiency among female adolescents in rural and urban communities.

6. To assess the direct causes and underlying factors, as well as the processes, which lead to quantitative and qualitative micronutrient deficits in the habitual diets of female adolescents in rural and urban communities.

7. To assess the appropriateness of the school as a channel to address the nutritional problems of female adolescents.

The results presented in this document are described by each component study undertaken as part of the project and the goals being addressed by each study. These goals are also discussed in the conclusions.
Baseline data were collected among 3,493 girls and 2,999 boys, divided across the school types as shown in Table 1.

Table 1. Numbers of girls and boys in the different groups of schools at baseline.

<table>
<thead>
<tr>
<th>AREA</th>
<th>TYPE OF SCHOOL</th>
<th>GIRLS (3493)</th>
<th>BOYS (2999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td></td>
<td>1604</td>
<td>1338</td>
</tr>
<tr>
<td></td>
<td>Boarding school</td>
<td>1031</td>
<td>295</td>
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<tr>
<td></td>
<td>General JHS</td>
<td>573</td>
<td>1043</td>
</tr>
<tr>
<td>Urban</td>
<td></td>
<td>1889</td>
<td>1661</td>
</tr>
<tr>
<td></td>
<td>Islamic JHS</td>
<td>1012</td>
<td>736</td>
</tr>
<tr>
<td></td>
<td>General JHS</td>
<td>877</td>
<td>925</td>
</tr>
</tbody>
</table>

JHS: Junior High School

1.1. Anemia and vitamin A deficiency among adolescents

The prevalence of anemia among adolescents in rural and urban schools is shown in Figure 1, while the prevalence of low vitamin A status (serum retinol concentration <1.05 μg/L) is shown in Figure 2.

Figure 1. Prevalence of anemia (Hb < 120 g/L) among adolescent girls (n=3493) and boys (n=2999), per school type.
The prevalence of anemia among adolescent girls was 20-30%. The largest difference among girls was found between the religious boarding schools and the general schools in the rural area (30.2% and 21.5%, respectively). These differences reflect socio-economic differences between the students attending the different types of school, and these differences are larger than the differences observed between students of rural and urban schools. Anemia among adolescent boys was less prevalent (10-25%), and higher at the rural than the urban schools. Additional analyses showed that the prevalence of anemia was lower among older boys who were already pubertal. Such a difference with puberty and age was not found among girls.

The prevalence of low serum retinol concentration was similar in urban and rural schools and almost the same among girls and boys, at 35-55%. Among girls, the highest prevalences were found in the rural general schools, which were all situated on Madura Island, and the urban religious schools. The relatively high prevalence at the urban religious schools might be associated with the fact that the students were predominantly of Madurese ethnicity. The Madurese have dietary patterns that differ substantially from the Javanese (among others, in the fact that they prefer not to eat leafy vegetables). Among the boys, the proportion with low serum retinol concentrations was highest among those who attended the rural boarding schools. At the boarding schools, the students are responsible for their own meals, which seems to result in a lower nutritional status.

1.2. Impact of the intervention studies

A series of intervention studies were conducted to address goals 1, 2, 3, 4 and 7. Three studies were done with vitamin A and iron/folate supplements, one with foods naturally rich in iron, and one with multi-micronutrient supplements. The second and third study with vitamin A and iron/folate supplements were designed after the results of the first and second study, respectively, had become known and were conducted in order to find ways for achieving a better impact.
1.2.1. **First intervention study (1996/1997): weekly supplementation with either 10,000 IU vitamin A, 60 mg iron with 250 µg folate, both or nothing**

The impact of the first intervention study (the design of which has already been described in the program report) on concentrations of hemoglobin and serum retinol is shown in Figures 3, 4 and 5. These will be discussed one by one.

Figure 3 shows the impact of the different supplementation regimes on hemoglobin concentrations among pre-pubertal and pubertal anemic girls. Among pre-pubertal girls, no impact from the interventions was found. Although, among pubertal girls, there was a difference between the group that received iron tablets and the group that received vitamin A, both groups neither differed from the control group nor from the group that received both supplements.

**Figure 3. Impact of first intervention (1996/1997) on hemoglobin concentrations among anemic adolescent girls, per pubertal status.**

![Graph showing the impact of different supplementation regimes on hemoglobin concentrations among pre-pubertal and pubertal girls.](image)

**Notes on the figure**
C = Control group; VA = Vitamin A supplementation group; Fe = Iron supplementation group; VAFe = Vitamin A and Iron supplementation group

The impact of the interventions on the hemoglobin concentrations of anemic pre-pubertal and pubertal boys is shown in Figure 4. Similar to the findings among pre-pubertal girls, no impact was found among pre-pubertal boys. But, among pubertal boys who received vitamin A supplementation, either alone or in combination with iron, there was a trend for a better response than among the control group and the group that only received iron.

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2 Addressing goals 1, 4 and 7 of the project

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Figure 4. Impact of first intervention (1996/1997) on hemoglobin concentrations among anemic adolescent boys, per pubertal status.

![Graph showing impact on hemoglobin concentrations among boys]

Notes on the figure
C = Control group; VA = Vitamin A supplementation group; Fe = Iron supplementation group; VAFe = Vitamin A and Iron supplementation group

Serum samples were collected from a subsample and the impact of the different supplementations on serum retinol concentrations among 138 girls and 108 boys with low serum retinol concentrations is shown in Figure 5. No impact was found among the girls. Among boys, however, the increase in serum retinol concentration after supplementation with vitamin A, either alone or in combination with iron, was higher than in the groups that did not receive vitamin A. This would also explain the trend for a higher increase of hemoglobin concentration among the pubertal boys who received vitamin A supplements. Vitamin A is known to have an effect on hemoglobin concentration when vitamin A and iron deficiency co-exist.

Figure 5. Impact of first intervention (1996/1997) on serum retinol concentrations among adolescent girls (n=138) and boys (n=108) with low serum retinol concentrations (< 1.05 μmol/L) at baseline.

![Graph showing impact on serum retinol concentrations among girls and boys]

Notes on the figure
C = Control group; VA = Vitamin A supplementation group; Fe = Iron supplementation group; VAFe = Vitamin A and Iron supplementation group
1.2.2. Second intervention study (1997/1998): placebo-controlled, weekly supplementation with 20,000 IU vitamin A, 60 mg iron with 250 μg folate, or 20,000 IU vitamin A + 60 mg iron with 250 μg folate

Some changes were made in the supplements after the results of the first study became known. The iron tablets used in the second intervention were sugar-coated to avoid complaints about its taste and thus increase compliance. In addition, the dose of the vitamin A tablets was increased from 10,000 IU to 20,000 IU, and a placebo-controlled design was used. The schools that participated in this intervention were the same as the ones that participated in the first one, and students received the same type of intervention during this study as they had in the first (except for students in Grade 1 who had not participated in the first study). Neither the students nor the field workers were aware of this last fact during the course of the study.

The impact of this intervention on hemoglobin concentrations of anemic adolescent girls and boys is shown in Figure 6. The impact among girls was significantly higher in the group that received vitamin A and iron supplementation compared to the group that only received iron. Although none of the groups differed significantly from the control group, there was a trend for a better response in the vitamin A and iron group compared to the other two groups. This suggests that vitamin A supplementation had an impact, but iron supplementation did not. No impact was found among anemic boys.

Figure 6. Impact of second intervention (1996/1997) on hemoglobin concentrations among anemic adolescent girls (n=532) and boys (n=385).

Notes on the figure
C = Control group; VA = Vitamin A supplementation group; Fe = Iron supplementation group; VAFe = Vitamin A and Iron supplementation group

The supplementation impact on serum retinol concentrations among adolescent girls (n=124) and boys (n=138) with initial low serum retinol concentrations is shown in Figure 7. Neither among girls nor boys was there much impact from vitamin A supplementation on serum retinol concentration. This raises a question regarding the fact that there was an impact from vitamin A supplementation on hemoglobin concentration among girls, while no impact was observed on serum retinol concentration.

3 Addressing goal 1, 4 and 7 of the project
There was no impact from the vitamin A supplementation on hemoglobin concentration among the girls and boys with low serum retinol concentration. The lack of impact from the vitamin A supplementation on hemoglobin and serum retinol concentrations among this subgroup was probably due to the small numbers included and/or that the subsample may not have been completely representative of the full sample where an impact of vitamin A supplementation on hemoglobin concentration was found among girls.

Figure 7. Impact of second intervention (1996/1997) on serum retinol concentrations among adolescent girls (n=124) and boys (n=138) with low serum retinol concentrations (< 1.05 μmol/L) at baseline.

Notes on the figure
C = Control group; VA = Vitamin A supplementation group; Fe = Iron supplementation group; VAFe = Vitamin A and Iron supplementation group

1.2.3. Third intervention study (1998/1999): weekly supplementation with 60 mg iron with 250 μg folate or placebo among third-grade (14-16 years old) adolescents attending urban schools

Because the first two intervention studies tended to have less impact in the urban schools than in the rural schools, this study was implemented in the urban schools (n=16 schools). The third grade was chosen because the students in this grade had been enrolled in the project from the beginning and had shown low impact during the previous two studies. The main hypothesis for this lack of effect was that the compliance with supplementation had been poor, although consumption of supplements was observed in a way that was programmatically feasible in the schools. This third study was designed to test this hypothesis of poor compliance. In order to do that it was decided to supervise supplement consumption very closely. This way of supervising was much closer than what could realistically be achieved in a school setting, but it was necessary for testing the hypothesis of poor compliance. Therefore, this third study was designed to have very strict supervision, unlike what could realistically be achieved in a school setting, solely for the purpose of testing the hypothesis that the lack of impact was due to poor compliance when supervision was not very tight.

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The impact of this study on hemoglobin concentrations among 255 girls and 217 boys, as compared to the changes among 167 girls and 224 boys who received a placebo, is shown in Figure 8. No impact was found among the girls, while the boys showed a higher increase in hemoglobin concentration after having received iron supplementation than when they had received placebo. This was true not only for the overall group of boys, but also for subgroups, such as pubertal, anemic and non-anemic boys. This suggests that the boys complied better with the iron supplementation than they had done during the first two years and also complied better than the girls. After the results of the intervention became known, discussions with the students involved confirmed that this was indeed the case.

Figure 8. Impact of third supplementation intervention (1998/1999) on the hemoglobin concentrations of adolescent girls (n=422) and boys (n=461).

1.2.4. Fourth intervention study (1998/1999): daily or weekly supplementation with multivitamin tablets with different doses

At the same time as the iron supplementation study was conducted among third grade students at the general and religious urban schools, the first grade students in the general rural schools participated in an intervention with either a weekly or a daily supplement containing either a high or a low dose of multi-micronutrients. The high dose of multi-micronutrients was delivered through *Flintstone* supplements (purchased from the US), while the low dose was given in the form of *Supradyn* (produced in Indonesia). The composition of the two different tablets is shown in Table 2. Supplements were either given daily (1 per day) or weekly (5 at once). Thus, the amount of micronutrients provided to those who received daily doses and those who received weekly doses was the same; for those who received daily supplementation, the dosage was spread more evenly throughout the week.

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5 Addressing goals 2 and 7 of the project
Table 2. Composition of multiple micronutrient supplements.

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Flintstones</th>
<th>%RDA (Indonesian)</th>
<th>Supradyn Junior</th>
<th>%RDA (Indonesian)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>5000 IU</td>
<td>100.0</td>
<td>2500 IU</td>
<td>50.0</td>
</tr>
<tr>
<td>Vitamin B1 (Thiamin)</td>
<td>1.5 mg</td>
<td>20</td>
<td>1.0 mg</td>
<td>13.3</td>
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<tr>
<td>Vitamin B2 (Riboflavin)</td>
<td>1.7 mg</td>
<td>20</td>
<td>1.2 mg</td>
<td>14.1</td>
</tr>
<tr>
<td>Vitamin B3 (Niacin)</td>
<td>20 mg</td>
<td>20</td>
<td>15.0 mg</td>
<td>15.0</td>
</tr>
<tr>
<td>Vitamin B5</td>
<td>0</td>
<td>0</td>
<td>5.0 mg</td>
<td>10.0</td>
</tr>
<tr>
<td>Vitamin B6 (Pyridoxine)</td>
<td>2 mg</td>
<td>19</td>
<td>1.6 mg</td>
<td>15.0</td>
</tr>
<tr>
<td>Vitamin B12 (Cyanocobalamin)</td>
<td>6 mcg</td>
<td>20</td>
<td>3.0 mcg</td>
<td>10.0</td>
</tr>
<tr>
<td>Pantothenic Acid</td>
<td>10 mg</td>
<td>100*</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>60 mg</td>
<td>10</td>
<td>75 mg</td>
<td>12.5</td>
</tr>
<tr>
<td>Vitamin D3</td>
<td>400 IU</td>
<td>104</td>
<td>100 IU</td>
<td>26.0</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>30 IU</td>
<td>0.25</td>
<td>6.0</td>
<td>0.05</td>
</tr>
<tr>
<td>Biotin</td>
<td>40 mcg</td>
<td>2.67</td>
<td>60 mcg</td>
<td>4.0</td>
</tr>
<tr>
<td>Folate</td>
<td>400 mcg</td>
<td>100</td>
<td>100 mcg</td>
<td>25.0</td>
</tr>
<tr>
<td>Iron</td>
<td>18 mg</td>
<td>60</td>
<td>1.5 mg</td>
<td>5.0</td>
</tr>
<tr>
<td>Iodine</td>
<td>150 mcg</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Potassium</td>
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<td>0</td>
<td>10.0 mg</td>
<td>20.0</td>
</tr>
<tr>
<td>Calcium</td>
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<td>12</td>
<td>15.2 mg</td>
<td>1.8</td>
</tr>
<tr>
<td>Magnesium</td>
<td>20 mg</td>
<td>10</td>
<td>5.0 mg</td>
<td>2.5</td>
</tr>
<tr>
<td>Manganese</td>
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<td>0</td>
<td>50 mcg</td>
<td>2.5</td>
</tr>
<tr>
<td>Phosphorus</td>
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<td>20</td>
<td>11.4 mg</td>
<td>2.28</td>
</tr>
<tr>
<td>Molybdene</td>
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<td>0</td>
<td>40 mcg</td>
<td>0.4</td>
</tr>
<tr>
<td>Zinc</td>
<td>15 mg</td>
<td>75</td>
<td>2.0 mg</td>
<td>10.0</td>
</tr>
<tr>
<td>Copper</td>
<td>2 mg</td>
<td>100*</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* Percentage RDA values of Pantothenic Acid and Copper for Flintstones supplements shown in the table are percentages of American RDA.

The risk of still being anemic after having received multivitamins, iron or placebo—corrected for age, puberty and BMI—is shown for adolescent girls and boys in Figure 9 (data on groups that received iron or placebo are from the study among the third graders in the urban schools). If analyzed for subjects who were anemic at the start of the intervention only, the pattern is similar.
There was no difference in the impact of the different multi-micronutrient supplements; all the supplemented groups did better than the control/placebo groups. Boys who received multi-micronutrient supplements did as well as those who received iron supplements (3rd grade). Girls who received the multi-micronutrient supplements did better than those who received the iron supplements. It is difficult to explain why the response to the two multi-micronutrient supplements with such a different content of micronutrients, particularly iron (1.5 vs 18 mg), was the same.

1.2.5. *Fifth intervention study (1997): dietary intervention study with foods naturally rich in iron among adolescent girls attending Islamic boarding schools* 

The goal of the dietary intervention was to assess the effectiveness of the use of foods naturally rich in iron to improve the iron status of adolescent girls. The iron-rich diet provided 10 mg iron per day, while the iron-poor diet provided 5 mg iron per day. In combination with the foods consumed in addition to the meals provided, students in the iron-rich group consumed approximately 16 mg dietary iron per day, while students in the iron-poor group consumed approximately 11 mg dietary iron per day. Figure 10 shows that the change of hemoglobin concentration among the girls who were anemic at baseline was significantly higher for those who received the iron-rich meals compared to those who received iron-poor meals.

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* Addressing goals 3 and 7 of the project

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The meals were composed of locally available and acceptable foods and the amount provided was an amount that could realistically be purchased, prepared and consumed by the students. The fact that the improvement of hemoglobin concentration among anemic subjects was significantly higher among the students who consumed the iron-rich diet is good news for dietary approaches, especially because the iron-rich foods provided, which were to a large extent animal products, are also good sources of other micronutrients such as vitamin A (particularly retinol) and zinc.

II. CONCLUSIONS

The prevalence of anemia found among adolescent girls (20-30%) and boys (10-25%) and of low serum retinol concentrations (35-55%) indicates that micronutrient deficiencies are an important problem among this population group (goal 5 of the project). Such information had not previously been available at this scale. This project also assessed whether schools could be a good channel for delivering different types of strategies for reducing micronutrient malnutrition among adolescents and examined the impact of different strategies.

The results of the interventions with different kinds of supplements have been very limited, specifically in addressing goals 1, 2 and 4 of the project:

Vitamin A supplementation had an impact on both hemoglobin and serum retinol concentration among boys in the first study.
Vitamin A supplementation had no impact on hemoglobin and serum retinol concentration among boys in the second study.
In the second study, vitamin A supplementation had an impact among girls but only on their hemoglobin concentration.
Iron supplementation had no impact among girls, even in the third study, when supervision was maximized to an extent that would not be possible in a programmatic setting.
Only boys complied and benefited from iron distributed with strict supervision (third study). No difference in impact on hemoglobin concentration was observed between multi-micronutrient supplements with a 12-fold difference of iron content.

Impact tended to be better among students at rural schools, which may indicate that their compliance with supplementation was better.

In 1994, the Indonesian government made education compulsory for nine years. School enrollment is currently above 80%. Therefore, a large proportion of the adolescent population between 12 and 15 years of age can be found in schools. The GIRLS project has made use of this situation and all interventions were implemented within the existing school system. However, our results show that designing a program for the distribution of micronutrient supplements to adolescents in order to improve their nutritional status is not as easy as it would seem. Compliance with supplementation might be the main problem, because the dosages of micronutrients provided were high enough to improve micronutrient status, but improvements were very small. Thus, in-depth studies of adolescent behavior and opinions about health and supplementation are warranted in order to further pursue this topic of improving adolescent nutritional status and health through schools (goal 7 of the project).

The finding of an improvement of hemoglobin concentration when consuming an iron-rich diet means that a dietary approach for improving iron status, or perhaps even micronutrient status in general, among adolescents should also be considered (goal 3 of the project).

Goal 6 of the project, assessing the direct and underlying causes of micronutrient deficiencies, was addressed by all studies undertaken and different observations provided further insight in the issue. The main cause of micronutrient deficiency among Indonesian adolescents is an insufficient dietary intake, which is a problem that is not exclusive to adolescents. The diet of most Indonesians, like that of most developing countries’ populations, has a relatively low content of micronutrients with high bioavailability, particularly iron and vitamin A from animal products. Thus, because of the relatively high needs during adolescence, deficiencies are prevalent among this population group. The prevalence of morbidity, the other direct cause of micronutrient malnutrition, was low. In-depth analysis of factors related to anemia showed that the risk of being anemic was mainly determined by socioeconomic factors. The most realistic shorter-term intervention is therefore supplementation with a single or multiple micronutrients. Another important observation was that the adolescents at the boarding schools that participated in the project tended to consume very little food; some only consumed one meal per day.

In summary, the GIRLS project has shown that, in order to be successful, interventions with dietary supplements need to have strong supervision and cooperation between all the partners involved. Much work still needs to be done to understand the behavior of adolescents in order to improve compliance.
III. ANNEX: Scientific papers, presentations and publications generated by the GIRLS project

Scientific Papers


3. *Weekly vitamin A and iron supplementation leads to different responses in micronutrient status of adolescent boys and girls: a school-based intervention in Indonesia (working title for paper on first study).* Damayanti D. Soekarjo, Saskia de Pee, Martin W. Bloem, Roy Tjiong, Werner Schultink, Wil H. P. Schreurs, Muhilal. (in preparation)

4. *Weekly supplementation of vitamin A and iron through the school system increased hemoglobin concentration of adolescent girls and boys in East Java, Indonesia (working title for paper on second study).* Damayanti D. Soekarjo, Saskia de Pee, Martin W. Bloem, Alida Melse-Boonstra, Wil H. P. Schreurs, Muhilal. (in preparation)

5. *Compliance and response to weekly iron supplementation better among adolescent boys than girls: a school-based intervention in East Java, Indonesia (working title for paper on iron supplementation).* Damayanti D. Soekarjo, Saskia de Pee, Martin W. Bloem, Wil H. P. Schreurs, Muhilal. (in preparation)

Presentations

6. *Should vitamin A supplementation be included as part of an anemia control program for adolescent girls?: school supplementation program in East Java, Indonesia (presentation at IVACG 1997).* Damayanti Soekarjo, Martin W Bloem, Roy Tjiong, Saskia de Pee, Ray Yip, Benny Kodyat, Muhilal.

7. *Vitamin A and iron supplementation of adolescents through schools is necessary and feasible (poster presentation at IVACG 1999).* Damayanti D Soekarjo, Saskia de Pee, Martin W Bloem, Roy Tjiong, Ray Yip, Wil HP Schreurs, Muhilal.

Publications
