School-based supplementation studies addressing anemia among adolescents in Indonesia
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SUMMARY

Anemia is widespread in Indonesia and in many other developing countries, the most vulnerable groups being underfives and women of reproductive age (including adolescents). Despite the fact that very few surveys and studies have been performed among adolescents, all available data are consistent in showing that anemia is a public health problem in this group. Because of the detrimental effects of anemia, both on the development of the individual and on that of future generations, interventions are urgently called for. Improvement of dietary intake of iron, vitamin A and other micronutrients is a long-term goal. In view of the high prevalence of anemia, supplementation is the most suitable intervention as it is cost-effective and effects can be expected to take place within a few months (chapter 1).

The studies described in this thesis focused on the effectiveness of supplementation with iron and/or vitamin A of school-attending adolescents to reduce anemia prevalence. They were implemented as part of the OMNI (Opportunities for Micronutrient Interventions) project, developed by USAID.

Because of puberty-related changes, it is important to take maturity into account when designing studies or programs for this target group. The gold standard for maturity rating based on physical examination is, however, not culturally accepted in Indonesia. While for girls, menarche is an accepted proxy for maturity, so far there is no well-documented and accepted equivalent for boys. In the studies presented in this thesis, menarche for girls and nocturnal ejaculation for boys were used as parameters of maturity. No problems were encountered during the interviews, as in the mostly Moslem study population coming of age is also an important milestone from the perspective of religion. In chapter 2 these parameters were validated against biologically determined growth in weight, height and Body Mass Index. The agreement between puberty assessment by interview and the growth curves shows that menarche and nocturnal ejaculation are simple and valid parameters for puberty and acceptable for use in field setting in Indonesia and probably in other developing countries as well (chapter 2).

The baseline survey (chapter 3) indicated that anemia prevalence was 25.8% among girls, irrespective of maturity phase, and 24.5% and 12.1% among pre-pubertal and pubertal boys respectively. Socio-economic status, indicated by type of school attended, was an important factor determining the risk of anemia.

In this thesis, three supplementation studies are described that were implemented between October 1996 and May 1999 in 24 Junior High Schools, involving students aged 12-15 at enrollment. Supplementation was supervised except during holidays, when tablets were to be taken at home.
In the first supplementation study (chapter 4), for a period of 14 weeks subjects were given weekly supplementation with either 60 mg iron+250 μg folic acid (Fe group), 10,000 IU vitamin A (VA group), both (VAFe group), or nothing (control group). None of the interventions resulted in a significant increase in hemoglobin concentrations. This appeared due to poor compliance, partly related to side-effects of the iron tablets. Serum retinol concentration of boys, but not girls, increased with vitamin A alone but not in combination with iron. It is difficult to interpret these findings. In addition to poor compliance, they may be attributed to too short duration of supplementation, too small dose of vitamin A, or to sex differences in requirements and thus response.

Therefore, adjustments were made for the second study (chapter 5). To reduce side effects and enhance compliance, iron/folate was given as a sugar coated tablet with the same dose as before, while the dose of the vitamin A was increased to 20,000 IU per week. A placebo group was included in the design and the duration was increased to 22 weeks. Hemoglobin concentrations of urban subjects decreased in all groups. Weekly vitamin A+iron/folate supplementation for 22 weeks gave urban adolescents a small but significant protection against this decrease in hemoglobin concentration. In the rural areas, hemoglobin concentrations increased but no effect of the interventions was found. Indonesia faced an economic crisis in 1997, the effects of which were most felt among the urban poor, resulting in reduced dietary quality. Rural populations have the possibility to complement their diet by home gardening. Sugar-coating of iron tablets did indeed improve compliance by reducing side effects.

In the third study – only in the third grades of the urban schools – an assessment was made of the effect of more rigid supervision and nutrition education on compliance with iron tablets (chapter 6). For 19 weeks, students received either iron/folate or a placebo weekly.

With supervision, compliance rates, as recorded by field workers, were 87-98%, and lower in the iron group than in the placebo group. Without supervision, self-reported compliance decreased to around 50%, and in the iron group it was higher for girls than boys (48.2% vs 38.4%). Peer pressure not to take the tablets and lack of authority or limited skills for promoting behavioral change of field workers contributed to the poor compliance.

Despite comparable compliance rates under supervision among boys and girls, the expected significant difference in hemoglobin concentrations between iron and placebo groups was only observed among boys. Supervision thus did not ensure ingestion of the tablets, in particular among the girls. When specifically asked, girls admitted to having given the tablets to other family members. While girls pretended to take the supplements, boys defied instructions openly, leading to the difference in recorded compliance rates.

The results of the studies described in this thesis were not as straightforward as reported for the few other studies among adolescents. The critical review of relevant studies
(chapter 7) highlights the differences between the small number of published studies, which are mostly efficacy studies and the effectiveness studies in routine settings. Besides strictly supervising supplement ingestion, efficacy studies only report results of subjects who complied well. In contrast, the objective of the current studies was to determine the effectiveness of supplementation in a program setting. It was found that compliance – related to side effects - had a major impact on the effect of the interventions on hemoglobin and serum retinol concentrations.

The overview (chapter 8) concludes that institutions, such as schools, offer a window of opportunity to reach the target group, but that preconditions need to be fulfilled to optimize the effect of the supposedly easiest intervention, e.g. supplementation. All partners need to be involved in the planning and implementation of innovative programs. They include the appropriate Ministries and their representatives down to local level, and at micro-level the teachers, parents and students. This requires an inter-departmental approach and therefore good communication and coordination. It is especially important that teachers’ job descriptions are adjusted to accommodate their supplementation-related tasks. Mass media (in particular television) or traditional communication channels should increase awareness of the problem in the community at large, address client perceptions, and focus on the related behavioral change to be co-responsible for the reduction of the problem.

As far as management and logistics in a school setting are concerned, drinking water should be available, tablets should be “palatable” with respect to appearance and side-effects, and the supplementation program should be accommodated within the school schedules. In particular, creative solutions should be found with regard to supplement distribution and monitoring activities during holidays and examination periods.

Finally, while only evidence-based programs should be pursued, the question is whether randomized controlled trials are the golden standard for evaluation of interventions in routine settings. To be meaningful for policy makers and program manager it is more important to know what works, under which circumstances and at what cost, rather than what should work, based on results of studies under ideal - not real life - conditions. A plausibility approach is then more appropriate. This entails an evaluation based on a built-in monitoring system of inputs, outputs and outcomes. If all results point in the expected direction, it is plausible to attribute the outcome to the program.

The last chapter concludes with recommendations:

i. To include adolescents in any survey to determine the prevalence of micronutrient deficiencies, in particular iron, vitamin A and zinc and to report data separately per sex, age and maturity phase;

ii. To include adolescents as beneficiaries and agents of change in supplementation programs.
iii. To use schools as an (additional) channel to reduce anemia (and possibly other micronutrient deficiencies) among adolescents, supported by culture-appropriate and gender-specific social marketing for broad-based ownership of the program

iv. To continue supplementation interventions until quantity and quality of habitual diets are adequate

v. To focus on effectiveness rather than merely on efficacy studies for the evaluation of program performance.