Anemia and Iron Deficiency in Adolescent Students in Lima, Peru: Causes, Consequences and Prevention

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I. Background:

A national survey conducted in Peru in 1996 found that 36% of women of reproductive age and 57% of children under 5 years of age suffer from iron deficiency anemia (Encuesta Demografica y de Salud Familiar, 1996). In Lima, 50% of pregnant women are anemic during pregnancy (Zavaleta et al, OPS, 1994). Typical diets in Peru are based on cereals, roots, and legumes, which do not provide adequate sources of bioavailable iron. The most vulnerable groups to suffer from anemia are pregnant women and children under 3 years of age who cannot meet their higher iron requirements from this diet.

Iron supplementation is one of several strategies recommended to improve iron status among vulnerable populations. Although iron supplements are given to pregnant women receiving antenatal care at health centers, the prevalence of anemia remains high in Peru. In an effort to improve women's iron status before entering pregnancy as well as to alleviate the negative impact of iron deficiency and anemia on adolescent girls, experimentation with iron supplementation through the schools is beginning in several countries. This study in Peru aimed to assess the feasibility, efficacy and acceptability of reducing anemia through iron supplementation of adolescent girls in schools, using either a daily or intermittent dosing regimen.

II. Study Objectives:

- To assess the prevalence of iron deficiency anemia in a representative sample of adolescent school girls in Lima, Peru
- To estimate their levels of nutrient intake
- To estimate iron expenditures by menstrual losses in adolescent girls and the prevalence of menorrhagia in this population
- To assess the efficacy of an iron supplement administered as an intermittent dose to a group of adolescent girls

- To evaluate the impact of iron deficiency anemia on cognitive and affective variables through school achievement of adolescent girls
- To determine the levels of compliance to iron supplementation in school
- To understand the perceptions and attitudes of adolescent girls in relation to their nutrition, health, and iron supplementation

III. Study Components:

1. Assessing anemia prevalence

Anemia prevalence was assessed in a sample of adolescent schoolgirls (12-18 years old) from Lima, Peru. Subjects were selected in a two step sampling process. The schools randomly selected were Jose Olaya Balandra (public) in Chorrillos district, Francisco Bolognesi (public) in the district of Villa El Salvador, and San Jose de Clunny (private) in the district of Barranco. There were 381 girls who participated in the study and for whom there was a venous blood sample and anthropometric measures such as weight, height, and Body Mass Index (BMI).

Ten percent (10%) of girls were anemic (Hb<12g/dL) and anemia prevalence was similar among girls from all three schools. Hemoglobin was not correlated with weight, height, or BMI. Results from the serum ferritin tests found 25% of the girls to be iron deficient (SF<12µg/L).

2. Assessing nutrient intake

A subsample of 88 girls from the 381 girls who participated in the anemia prevalence survey was included in the nutrient intake assessment. These girls attended either Francisco Bolognesi (n=56) or San Jose de Clunny (n=32). A two-day consecutive 24-hour recall was taken to evaluate dietary intake. A food frequency questionnaire that asked about foods rich in iron and vitamin C was included in the survey.

Girls from both the private school (middle-high socioeconomic status) and public schools have diets that do not meet the recommended amounts of the following: iron, zinc, calcium, and thiamine. Public school girls' diets were also deficient in energy.

3. Estimating iron expenditures through menstrual losses and prevalence of menorrhagia

The sample of 381 girls who participated in the nutrition evaluation also participated in the study of iron expenditure. To estimate menstrual losses, girls were assigned a code and given pre-weighed sanitary pads and plastic bags with labels. Field workers weighed each bag daily. The menstrual losses for two consecutive periods were measured for each girl.

The mean and median loss of blood was 62.6 ml and 56.2 ml, respectively. These values are twice as high as those found in Sweden (30 ml) and Great Britain (26.5 ml). From these figures, the International Nutritional Anemia Consultative Group (INACG) estimates losses of 12.5 mg of iron per month. In this study, 25% of the girls had losses of >80 ml. There were no differences in age or among schools. The average age of menarche in this population was 12 years old.

4. Assessing the efficacy of iron supplements administered as an intermittent dose to adolescent girls

The study was a double blind placebo-controlled design in Francisco Bolognesi School. Three hundred and twelve (312) girls, ages 12-18, were randomly assigned to the 3 following groups.

1. Iron sulfate- 60mg elemental iron daily (M-F)
2. Iron sulfate- 60mg elemental iron taken two days in the week (M-F)
3. Placebo daily (M-F)

Supplementation was conducted for 17 weeks (August-December, 1996). Tablets were given at school between meals in the morning or afternoon for those who study during those hours. The field workers recorded the number of tablets and side effects reported by the girls.

Of the 296 girls who completed the study, it was observed that girls who received supplements had significantly ($p<0.05$) higher hemoglobin levels than girls in the placebo group. And girls who had taken a daily iron supplement had significantly ($p<0.05$) higher hemoglobins than those in the intermittent group. At the beginning of the study, the proportion of anemic subjects was similar in the three groups (19.8% in daily, 18.4% in the intermittent, and 15.5% in the placebo group). After the 17 weeks, the proportion of anemia in the daily group (10.9%) was lower than the placebo (22.7%) and the intermittent group (17.3%) ($p<0.05$). There were no differences in serum ferritin (SF) or free erythrocyte protoporphyrin (FEP) between the daily and intermittent groups at the end of the study. However, SF decreased significantly ($p<0.05$) in the placebo group.

The primary reason 16 girls did not complete the trial was due to school withdrawal; they moved to other cities or districts in Lima. Side effects were not a main reason to withdraw from the study and there was no difference in the 3 groups with respect to the occurrence of side effects (J. Nutr. 130:462S-464S, 2000).

5. Understanding perceptions and attitudes of adolescent girls in relation to their nutrition, health, and iron supplementation

A subsample of adolescent girls who participated in the iron supplementation study was asked about their perceptions and attitudes on nutrition, health and iron supplements. Twenty-eight adolescents participated in four focus groups. Specifically, the girls were asked about school and home, health problems, menstruation, anemia, and iron supplements.

Menstruation was considered to be a problem because of feeling tired, weak, with pains in the back, stomach, and waist. When asked about care during menstruation, the girls mentioned hygiene, and avoiding cold water, cold showers, and acidic drinks.

Girls were asked to describe a person with anemia. Some of their responses included sleeping all day, no appetite, poor performance in school, no participation in sports or social activities, and a pale appearance. Causes of anemia were poor diet, low hemoglobin, parasites, diabetes, and low calcium. Some girls related anemia to menstruation and said it is the reason women are more affected by anemia than men. The

treatment for anemia, as reported by the girls, is to eat well, eat a variety of foods such as fish, soups, and legumes, take vitamins with iron, avoid sweets, and play sports.

When asked about benefits and side effects of iron supplements, some girls mentioned they had headaches, felt tired and hungry, and had constipation at the beginning of the trial. However, these symptoms passed and they received support from the field team and the nutritionist to continue taking iron. Benefits from the tablets were improved appetite and school performance, feeling good, and one girl said that her hemoglobin increased.

Girls were asked what they thought about the iron tablet itself. Most said the size was fine. Although many girls did not like the taste of the tablet, and some thought the brown color of the tablet was strange, they did not stop taking the iron supplements.

IV. Study Outcomes and Conclusions:

- Iron deficiency is a nutritional problem that affects 25% of school-age adolescent girls within the study population in Lima, Peru; 10% of the study population was anemic with up to 20% anemic in the public school population.
- The girls' diet appears to be inadequate, especially in bioavailable iron foods, and does not meet the high iron requirements coming in part from heavy menstrual blood loss in this population.
- Iron supplementation delivered through the school and targeted to at-risk adolescents is an effective way to prevent anemia and iron deficiency, as well as to improve iron stores.
- Compliance with iron supplementation by school-going adolescent girls is very high if they are adequately motivated.
- Adolescent schoolgirls and teachers are willing to participate in interventions to prevent and control anemia.

As a follow-up to the intervention, IIN disseminated the results to the study participants, parents, school officials, funding agencies, and local leaders. Materials were developed to help publicize the results of the work.

IIN produced a book (Zavaleta et al. Anemia y Deficiencia de Hierro en Adolescentes Escolares en Lima, Perú. Causas, Consecuencias y Prevención) that summarized the placebo-controlled study findings and contained information on the prevalence of iron deficiency in school-going adolescent girls in Lima, which was presented at a public forum involving school authorities and local leaders. The book also addressed interventions to combat iron deficiency and its effects on school performance, self-esteem, and future areas of research and intervention. (The book is available on the IIN Web page, www.iin.sld.pe.)

Workshops were organized at the three schools using participatory methods to involve the students in identifying the causes and effects of iron deficiency anemia, as well as proposing prevention strategies. The conclusions of the workshops were published in a local newspaper's school page.

V. Recommendations:

- Develop and implement educational interventions on diet diversification and adequate combination of foods that can be integrated into the school curricula.
- Among very poor segments of the population, there are limited possibilities for obtaining a balanced diet due to factors such as economics, geography, culture, and lack of availability of iron-rich foods. Therefore, national and local programs should complement existing school-based food programs with fortified foods. These programs need continuous monitoring, and evaluation to determine the effectiveness of the intervention.
- Among some school-age girls with limited food availability, scarce resources, a high incidence of parasites, malaria, early pregnancy, and a lack of access to fortified foods, it is important to consider iron supplementation with folic acid and other micronutrients to prevent or correct anemia and other nutritional problems. In addition, any intervention needs an educational component, which includes counseling and information that will encourage and support the target population to take the supplements.
- Investigate the benefits of improving adolescents' iron status on school performance, attendance, and physical capacity.

VI. Publications:

Zavaleta N., Respicio G., and Garcia T., *Efficacy and Acceptability of Two Iron Supplementation Schedules in Adolescent School Girls in Lima, Peru*. J. Nutr. 130:462S-464S.

IIN website http://www.iin.sld.pe

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