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AN OVERVIEW OF STUDIES ON IRON DEFICIENCY IN INDONESIA[1]

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ABSTRACT

An overview of studies on the prevalence, causes and consequences of iron deficiency from Indonesia is presented. Prevalence of iron deficiency among the Indonesian population remains high, in spite of ongoing programs to reduce the prevalence. Studies demonstrated that among young children iron deficiency anemia reduces cognitive performance. Work productivity is negatively influenced by iron deficiency, not only among workers engaged in heavy physical labor but also among female factory workers engaged in light work. Indonesian studies further demonstrated that anemia may also be influenced by vitamin A deficiency.

Key words: Iron deficiency, Indonesia, anemia

INTRODUCTION

Iron deficiency is the most common nutritional deficiency worldwide, and it is prevalent in industrialized as well as developing countries. In Indonesia the magnitude and consequences of the deficiency have been recognized and the government has implemented several programs to reduce the prevalence among several target groups (see Kodyat et al. This issue).
The recognition of the magnitude of the problem of iron deficiency anemia and its consequences is based on the many surveys and studies on iron deficiency which have been carried out on a regular basis in Indonesia. These Indonesian studies have significantly contributed to the existing body of knowledge worldwide, and to the shape and extent of interventions currently used in Indonesia. It is the aim of this paper to review some of the most relevant studies from Indonesia.

REVIEW OF INDONESIAN STUDIES

Surveys on the prevalence of iron deficiency

Some awareness raising studies were conducted in the early 1970s on the prevalence and causes of anemia among pregnant women (1,2). These studies were conducted in areas where different types of staple foods were consumed. The prevalence tended to be higher in areas where

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rice was consumed as the main staple food (77% anemia) than in areas where also sweet potato (56% anemia) and cassava (46% anemia) were consumed. It became clear that iron deficiency was probably an important nutrition problem in Indonesia, and that there was an association between the prevalence of anemia and the staple food consumption. One of the questions which was raised at the time was whether rice would contain more substances which inhibit the absorption of iron than sweet potato or cassava. Although these studies did not provide a complete picture of iron deficiency and its causes in Indonesia, they sparked interest and lead to a large number of other studies on iron deficiency in Indonesia.

The latest surveys on the prevalence of anemia were carried out between 1991 to 1993 (3-5). These survey data show that the prevalence of anemia among pregnant women varies from 38% to 72% depending on the region, with 64% as the national average. It is striking that in the most developed province of the country, Java, the prevalence of anemia is still very high (rice as main staple food), and even higher than in the less developed eastern provinces of East Nusa Tenggara, Malukku, and Irian Jaya (also other staple foods such as sweet potatoe).

The results of the large anemia prevalence surveys (Table 1) are supported by several smaller surveys and studies. A study among 110 women in the second and third trimester of pregnancy in South Sulawesi reported a prevalence of 48% (6) . Prevalence of anemia among a group of women in the second trimester of pregnancy from Jakarta was 42% (7), and was 71% among a group of rural West Javanese women(8).

TABLE 1
Prevalence of Anemia in Pregnant Women in Different Regions in Indonesia

Province	Prevalence (%)	
	Pregnant women	Preschool children
West-Java	71.5	
Central Java	62.5	44.9
East Java	57.8	
North Sulawesi	48.7	
Southeast Sulawesi	67.4	
East Nusa Tenggara	51.0	48.9
East Timor	64.7	60.6
Malukku	48.4	48.8
Irian Jaya	38.0	35.8

Reference: 3-5.

Most information is available on the prevalence of anemia among pregnant women. There is however also some information available about other population groups. The data in Table 1 show that anemia is also common among preschool children. Some smaller studies indicated that the anemia prevalence among urban elderly is between 10 - 20% (9).

The surveys conducted in Indonesia also give an insight in the possible magnitude of the anemia problem in other countries in Southeast Asia where rice is the staple food and where the majority of the population can not afford to buy adequate amounts of meat and/or fish for frequent consumption.

Studies on iron deficiency and work productivity

The negative influence of iron deficiency on work productivity is well recognized by now. Early studies were carried out by Davies and coworkers among African workers (10,11). Basta et al (12) carried out a study among Indonesian rubber plantation workers of whom 45% were anemic. An anemic worker had a latex output of 20.9 kg per day whereas a non-anemic worker produced 25.8 kg per day. They demonstrated that since the workers were paid according to their work output, their earnings were correlated with the hemoglobin levels. A 2-month treatment with 100 mg elemental iron per day resulted in a significant improvement of hemoglobin status of the anemic individuals and of their work output and morbidity. The earlier studies of Davies (10,11) and Basta (12) showed that iron deficiency negatively influences an individuals output when doing physically demanding tasks. More recent work carried out in Indonesia showed that iron deficiency anemia is also associated with reduced productivity of workers engaged in less-physically-strenuous tasks (Table 2). A study among female loom workers in a jute-factory indicated that anemic workers produced 5% less than non-anemic workers (13). The study further showed that anemic female workers also performed 6.5 hours less homework per week. Anemia therefore did not only influence their economic productivity but also influenced their family life. Another study was carried out among female cigarette rollers (14). Anemic cigarette rollers also produced about 5% less than their non-anemic counterparts. This negative influence on productivity remained significant after correcting for confounding factors such as low body mass index, and work experience.

TABLE 2
The Impact of Anemia on Work Productivity of Different Workers

		Production of workers	
Type of Workers	**Type of production**	Anemic	Non-Anemic
Rubber tappers	Latex (kg/day)	20.9 kg	25.8 kg
Cigarette rollers	Cigarette (piece/ hour)	603 piece	632 piece
Loom workers	Jute (% of mean production)	97.4%	102.7%

The studies among Loom Workers (13)and Cigarette Rollers (14) were cross-sectional, whereas the study among Rubber Tappers (12) included an intervention.

The studies on work productivity demonstrated that a successful, large-scale program to reduce anemia in the Indonesian population would have substantial benefits, not only on work productivity but also in terms of health and social conditions. Based on these considerations programs are in place in Indonesia to supplement female factory workers (see Kodyat et al. This issue).

Studies on the impact of iron deficiency on learning capacity

Several studies were carried out on the impact of iron deficiency on learning capability of young children (15-18). The effects of iron supplementation on school performance was investigated in iron-deficient anemic and non-anemic children with an average age of 11 years (15). The study was placebo controlled and iron supplementation lasted 3 months. Behavioral tests included an adapted nonverbal IQ test, an educational achievement test, and a concentration test. Anemic iron treated children showed an about 10% increase in the educational achievement test score, whereas anemic placebo treated children showed a 2%

decrease in scored value between start and finish of supplementation. There was no difference in IQ between the two groups of children at start, but anemic children did have lower achievement scores compared to non-anamic children at baseline.

The effects of iron deficiency on attention and learning performance was also investigated in preschool children with an average age of 54-57 months (17). The children were divided into 3 categories: iron-replete, iron-depleted and iron deficient anemic. Supplementation lasted 8 weeks and was placebo controlled. Cognitive function of the children was tested using two discriminative learning tests, one oddity learning tests, and a picture vocabulary test. Before the start of the supplementation there was no difference in psychological test results between iron-replete and iron-depleted children. Iron replete children learned faster than anemic children. The study concluded that iron deficiency anemia produces alterations in specific cognitive processes related to visual attention and concept aquisition. The alterations were fully reversed after iron treatment.
The possibility to reverse the developmental delays due to iron deficiency was further investigated in 12-18 month old anemic infants (18). The effect of iron supplementation on performance in the Bayley scales of mental and motor development was measured in a randomised, double-blind trial. Before intervention the mean mental and motor scores of iron-deficient anemic children were 10% lower than the scores of non-anemic iron deficient children and of iron sufficient children. Due to iron supplementation the mental and motor development scores of the iron-deficient anemic children increased from about 90 to 110 points, whereas the scores of the placebo group remained at about 90 points. At the end of the supplementation the scores of the anemic children arrived at the same level as those of the iron sufficient children.

The results of these studies indicate the importance of iron deficiency is childhood development. They also indicate that in developing countries where the prevalence of iron deficiency is high, adequate human resource development is at risk. In spite of this knowledge currently no large scale programs exist to combat iron deficiency among children.

Studies on interventions

The current iron supplementation program for pregnant women in Indonesia is different from the WHO recommendations in a sense that WHO recommends pregnant women to take 120 mg per day in areas where anemia is common whereas in Indonesia pregnant women are provided with 60 mg iron per day. The decision to take 60 mg in stead of 120 mg per day was based on the results of non-published studies carried out by the Nutrition Research and Development Centre in Bogor, also considering the limitations of the available budget on the one hand and the about 5 million pregnant and lactating women on the other hand. The importance of iron supplementation during pregnancy in the Indonesian context was again stressed by a recent study among pregnant women from West Java (19). Consumption of one or more iron tablets per week during pregnancy was associated with increased neonatal weight (by 172 g on average) and length (by 1 cm on average). Iron tablet consumption also was a significant predictor of whether or not the child was full-term at birth. The iron supplementation program for pregnant women is already in place for more than a decade, but unfortunately the prevalence of anemia remains to be high at about 60%. Apart from program related reasons such as tablet distribution, program coverage, and compliance with tablet intake, a recent study indicated that there may also be another reason for the remaining high prevalence of anemia. The iron metabolism is influenced by an individuals vitamin A status

(20), and many people in Indonesia have a marginal vitamin A status. Supplementing pregnant women on a daily basis with both 2.4 mg retinol and 60 mg iron for 8 weeks provided to be more effective than supplementing with 60 mg iron alone (21). Hemoglobin concentration of the iron supplemented women increased from 103 to 113 g/L whereas the concentration of the women who received both iron and vitamin A increased from 103 to 118 g/L. The hemoglobin concentration of the placebo group did not change significantly. It was concluded that an improvement in vitamin A status may contribute to the control of anemia during pregnancy.

Taking this influence of vitamin A into consideration it was investigated whether an increased consumption green leafy vegetables could contribute to an improvement in iron status (22). Green leafy vegetables contain provitamin A carotenoids and they do contain iron. One group of anemic breast feeding women was given a daily portion of stir-fried vegetables for 12 weeks, another group received a wafer enriched in amounts comparable to the vegetables with iron (4.8 mg), β-carotene (3.5 mg), and folic acid, and a third group received a placebo wafer. There were no between-group differences in changes in hemoglobin and ferritin concentration indicating that neither the vegetable consumption nor the wafer positively influenced the iron status. Reasons which were suggested as an explanation for this lack of improvement were a possible low bioavailability of iron from both vegetable and wafer, and a too low amount of iron given. It should however be remarked that the women were mildly anemic with an average hemoglobin concentration of 110 g/L, and that vegetables were already a common component of the daily diet.

Further studies on supplementation are described elsewhere in this issue by Schultink and Dillon (This issue).

SUMMARY

It can be concluded that studies from Indonesia have contributed significantly to the body of knowledge on the consequences of iron deficiency and on possible strategies aimed at improving the situation. Specifically it has become clear that iron deficiency can significantly influence the work productivity potential of a nation as well as its learning potential. This means that the consequence of iron deficiency clearly goes much further than a simple anemia. Furthermore, it became clear that a micronutrient deficiency such as iron deficiency can not be seen in isolation but should be considered in association with other micronutrients such as vitamin A.

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