



## IVACG Statement

# Vitamin A and Iron Interactions

**V**itamin A deficiency and iron deficiency anemia, the two major nutritional problems in developing countries, often coexist. This may be due to inadequate dietary intake of both vitamin A and iron or to a relative deficiency of one or the other. Studies in humans and laboratory animals shed light on the interrelationship between these two conditions.

In one of the earliest human studies, adult subjects maintained on vitamin A–deficient diets developed anemia despite adequate iron intake.<sup>1</sup> The anemia responded to vitamin A but not to iron supplementation. Studies in experimental animals also confirmed the role of vitamin A in hematopoiesis.<sup>2–4</sup> Clinical and community studies have documented an association between vitamin A deficiency and iron deficiency anemia. In a cross-sectional study of children in northeast Thailand, serum retinol was found to be positively associated with serum iron and ferritin.<sup>5</sup> Other studies have found a significant correlation between serum retinol and hemoglobin concentration.<sup>6–8</sup> Among Indian preschool children, hemoglobin values were found to be lower in those who had serum retinol below 20 $\mu$ g/dL compared with those with normal levels.<sup>9</sup> Vitamin A supplementation of deficient children resulted in a significant increase in hemoglobin, hematocrit, and serum iron.

These observations suggest that vitamin A deficiency can contribute to anemia and that vitamin A supplementation will have a positive effect on iron status. This is supported by data obtained from community intervention trials. Vitamin A fortification of sugar in Guatemala<sup>10</sup> and of monosodium glutamate in Indonesia<sup>11</sup> not only improved vitamin A status of the population but also increased hemoglobin levels.

These interactions between vitamin A and iron have also been noted in adolescent girls. In Bangladesh, positive correlations were found between serum retinol and hemoglobin, hematocrit, and serum iron.<sup>12</sup>

Intervention studies in Indonesian girls showed that combining vitamin A with iron supplementation was more effective in increasing hemoglobin levels than giving iron alone.<sup>13</sup> Similar observations have been made in pregnant women. The increase in hemoglobin was greater in women receiving iron plus vitamin A than in those receiving iron alone.<sup>14,15</sup> Combined supplements were effective in eliminating anemia in 97% of the women, compared with 68% with iron alone.<sup>15</sup>

These findings suggest that apart from correcting iron deficiency, improvement in vitamin A status will increase iron utilization.

**Vitamin A deficiency can contribute to anemia.**

The mechanisms by which vitamin A modifies iron status are poorly understood. Studies in laboratory animals indicate that vitamin A deficiency does not decrease iron absorption.<sup>16</sup>

Hemoglobin synthesis is reduced, but whether this is due to decreased iron supplies to the bone marrow or

inhibition of erythropoiesis is not precisely known. Vitamin A-deficient animals show increased iron accumulation in the liver and spleen, suggesting that vitamin A deficiency may impair mobilization of iron stores.<sup>3,4</sup>

Thus, vitamin A deficiency can affect iron metabolism, leading to anemia. Vitamin A supplementation, however, cannot overcome iron deficiency in all settings. In

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**Improvement in vitamin A status will increase iron utilization.**

Nepalese women with a high prevalence of hookworm infection, vitamin A supplementation had little impact on hemoglobin levels.<sup>17</sup> In northern Ghana, where malaria is

endemic, no correlation was found between vitamin A and iron status, nor did vitamin A have any effect on the prevalence of anemia (unpublished).

In conclusion, available evidence indicates that vitamin A deficiency is often associated with iron deficiency anemia and that vitamin A supplementation can have a beneficial effect on iron status. However, it is important to remember that iron deficiency is the primary cause of anemia

and that vitamin A cannot overcome severe underlying iron deficiency. The interventions most likely to reduce anemia are those that improve the intake and bioavailability of iron and reduce common infections, particularly hookworm and malaria, where they are endemic.

## References

1. Hodges RE, Sauberlich HE, Canham JE, et al. Hematopoietic studies in vitamin A deficiency. *Am J Clin Nutr* 1978; 31:876–885
2. Mejia LA, Hodges RE, Mohanram M, et al. The relationship between vitamin A deficiency and anemia. *Clin Res* 1976; 24:133A
3. Mejia LA, Hodges RE, Mohanram M et al. Anemia in vitamin A deficiency. *Clin Res* 1976; 24:315A
4. Roodenburg AJC et al. Comparison between time dependent changes in iron metabolism of rats as induced by marginal deficiency of vitamin A or iron. *Br J Nutr* 1996; 71:687
5. Bloem MW, Wedel M, Egger RJ, et al. Iron metabolism and vitamin A deficiency in children in northeast Thailand. *Am J Clin Nutr* 1989; 50:332–338
6. Mejia LA, Hodges RE, Arroyave G, et al. Vitamin A deficiency and anemia in Central American children. *Am J Clin Nutr* 1977; 30:1175–1184
7. Wolde-Gebriel Z, West CE, Speek AJ, et al. Interrelationship between vitamin A, iodine and iron status in school children in Shoa Region, central Ethiopia. *Br J Nutr* 1993; 70:593–607
8. Palafox NA, Gamble M, Kjolhede C, et al. A comparison of serum retinol levels with hemoglobin concentration before and after vitamin A capsule distribution to children in the Republic of Marshall Islands. In: Report of the XVII IVACG Meeting, Guatemala, 1996. Washington, DC: IVACG, 1996;78
9. Mohanram M, Kulkarni KA, Reddy V. Hematological studies in vitamin A deficient children. *Int J Vitam Res* 1977; 47:389–393
10. Mejia LA, Arroyave G. The effect of vitamin A fortification of sugar on iron metabolism in preschool children in Guatemala. *Am J Clin Nutr* 1982; 36:87–93
11. Muhilal, Parmaesih D, Idjradinata, et al. Vitamin A fortified monosodium glutamate and health, growth and survival of children: a controlled field trial. *Am J Clin Nutr* 1988; 48:1271–1276
12. Ahmed F, Khan MR, Karim R, et al. Relationship between serum vitamin A and iron status in adolescent girls in Dhaka City. In: Report of the XVII IVACG Meeting, Guatemala, 1996. Washington, DC: IVACG, 1996;93
13. Angeles I, Schultink W, Sastroamidjojo S, et al. Interactions of micronutrients to build pre-pregnancy iron reserve in adolescent girls: the role of vitamin A. In: Report of the XVII IVACG Meeting Guatemala, 1996. Washington, DC: IVACG, 1996;78
14. Panth M, Shatrugna V, Yashodara P, Sivakumar B. Effect of vitamin A supplementation on hemoglobin and vitamin A levels during pregnancy. *Br J Nutr* 1990; 64:351–358
15. Suharno D, Muhilal. Vitamin A and nutritional anaemia. *UNU Food Nutr Bull* 1996; 17:7–10
16. Sijtsma KW, Van den Berg GJ, Lemmens AG, et al. Iron status in rats fed diets containing marginal amounts of vitamin A. *Br J Nutr* 1993; 70:777–785
17. Stoltzfus R. Effect of maternal vitamin A or  $\beta$ -carotene supplementation on iron deficiency anemia in Nepalese pregnant women, postpartum mothers and infants. In: Report of the XVIII IVACG Meeting, Cairo, 1997. Washington, DC: IVACG, 1998;86

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Established in 1975, the International Vitamin A Consultative Group guides international activities for reducing vitamin A deficiency in the world. IVACG concentrates its efforts on stimulating and disseminating new knowledge, translating that new knowledge to assist others in its practical application, and providing authoritative policy statements and recommendations that others can use to develop appropriate prevention and control programs.

This statement was prepared at the request of the International Vitamin A Consultative Group (IVACG) by Dr. Vinodini Reddy. It was reviewed and approved by the IVACG Steering Committee:

David Alnwick, MSc  
Paul Arthur, MD, MPH, MSc  
Omar Dary, PhD  
Frances R. Davidson, PhD, IVACG Secretary  
Abraham Horwitz, MD, MPH, IVACG Chair  
Vinodini Reddy, MD, DCH, FIAP  
Suttalak Smitasiri, PhD  
Alfred Sommer, MD, MHSc, IVACG Steering Committee Chair  
Keith P. West, Jr, DrPH

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IVACG Secretariat  
ILSI Research Foundation  
1126 Sixteenth Street, NW  
Washington, DC 20036-4810  
USA



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