The tragic consequences of vitamin A deficiency (blindness, illness, and premature death) have stimulated extensive efforts to prevent this deficiency. Perhaps most notable in scope and influence is the WHO’s recommendation since 1998 that high-potency supplements should be given every 4–6 months to children 6 to 59 months old who live in the affected regions of the world. The WHO estimates that 1.25 million deaths in 40 countries have been averted by this programme.

Many of these countries have also addressed the problem by fortifying commonly consumed foods, such as cooking oil or sugar. Agricultural programmes have developed both biofortified and genetically modified foods with increased vitamin A content.

Unfortunately, it is very difficult to assess the impact of vitamin A supplementation because, although blood vitamin A is reduced in cases of deficiency, it is also reduced with infections even if there are adequate amounts of vitamin A stored in the liver. Blood vitamin A is reduced with moderate deficiency, but does not show if a person has borderline deficient, healthy, or excessively high vitamin A nutrition (which also may be unhealthy). Public health officials have not had sensitive techniques available for evaluating whether vitamin A supplementation or food fortification programmes are effective, and they have had to make do with extremely non-specific techniques, such as counting the number of children receiving supplements or fortified foods, and the number of childhood deaths.

Fortunately, there is a stable isotope technique that provides a sensitive and accessible assessment of vitamin A in the whole body. This technique measures blood samples to determine the dilution of an oral dose of isotope labelled vitamin A after it mixes with the (unlabelled) vitamin A already in the body. This is the vitamin A labelled isotope dilution (VALID) technique. The VALID technique can be used to assess vitamin A status, the success of vitamin A supplementation or fortification, the amounts of vitamin A that humans require, and how well the pro-vitamin A compounds, such as carotene from local plant foods, are.

STABLE ISOTOPES: THE METHOD OF CHOICE TO ASSESS VITAMIN A INTERVENTIONS

Testing a child for vitamin A nutrition using the VALID technique in northern Thailand. (Photo: T. Pongcharoen, Thailand)
converted to useful vitamin A in the body. With this method, body vitamin A can be measured using only blood samples, yielding information that would not otherwise be available without biopsies of the liver, where the body stores vitamin A. Work in this area has been developed and validated through experiments with animals and humans since the 1970s, including comparisons with liver vitamin A measured in patients undergoing routine surgery in Bangladesh and the United States of America.

In collaboration with other agencies, the IAEA has sponsored publications on the detailed application of this stable isotope method that can be found on the IAEA Human Health Campus at nucleus.iaea.org/HHW/Nutrition/VitaminA/RefsVitaminA/index.html#publ. The IAEA has also supported use of the method in studies by international investigators in developing countries.

The value of the VALID technique is demonstrated by two recent examples. Because rice is an important dietary staple in northern Thailand, this food was selected for fortification with iron, zinc, and vitamin A. Schoolchildren consumed the fortified rice or unfortified control rice as part of their school lunch for five months. Although blood measurements of iron and zinc nutrition improved, blood vitamin A did not change in the group given fortified rice. However, a follow-up study using the VALID technique revealed that children consuming the fortified rice had an increase in body vitamin A stores, despite no difference in blood vitamin A. This verified the benefit of rice fortification with vitamin A for these children, which would not have been detected with other methods.

In another fortification study with Mexican preschool children, application of the VALID technique showed that milk drinks fortified with vitamin A increased their body vitamin A stores, compared to their initial values, or to those of other children that did not receive the fortified milk. Blood vitamin A increased slightly in the children who received the fortified milk, and decreased in the control group, providing a complementary, but much less clearly interpretable result.

The IAEA is sponsoring additional studies in very young children (1–2 years old) with the VALID technique to assess the vitamin A value of consuming *Moringa oleifera* leaves in Mexico, of kale cooked in peanut butter (compared with kale cooked in lard) in Zimbabwe, and of maize biofortified with vitamin A in Zambia. A 2013 meeting with our collaborative nutrition research centre, the St. John’s Research Institute (SJRI), in Bangalore, India, fostered interaction among international investigators who provided an update on progress in the development and application of the VALID technique and made recommendations for it to be used to help evaluate public health interventions.

Further plans are under way to use the VALID technique to verify that nutrition programmes are helping children meet their nutritional need for vitamin A, without accruing excessive body vitamin A stores that could have long-term adverse effects on the liver, the nervous system, and several other organ systems.

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