Vitamin A Supplementation Applied to Vision
Mini-Review Analysis

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Vitamin A deficiency is an endemic health problem globally affecting an estimated 122 developing countries (2). Vitamin A, as preformed vitamin A retinal, is needed to maintain a healthy visual system, therefore deficiency of vitamin A displays as symptoms and disorders such as varying stages of xerophthalmia leading to total blindness. Worldwide estimates by the World Health Organization conclude that approximately 5.2 million pre-school age children and 9.8 million pregnant women are affected by night blindness, an early stage of xerophthalmia; respectively, this indicates 33.3% of the pre-school age population and 15.3% of pregnant women in population are vitamin A deficient (2). Xerophthalmia, and progressively ensuing blindness, from vitamin A deficiency (VAD) is preventable by supplementation of vitamin A, increased dietary intake and fortification of vitamin A food sources as vitamin A cannot be synthesized within the body and must be externally obtained. VAD remains the leading cause of preventable blindness greatly affecting impoverished nations, such as Africa and Southeast Asia.

If the vision cycle is interrupted due to low levels of vitamin A, as supported by low serum retinol levels in blood circulation, symptoms of VAD display as disorders affecting the eye as encompassed within xerophthalmia. Xerophthalmia is an umbrella term of the “clinical spectrum of ocular manifestations of VAD” to include, in order of progressive disorder severity and classification, night blindness, Bitot’s spot or conjunctival xerosis, to potentially blinding stages of corneal xerosis, and keratomalacia as corneal ulceration and necrosis leading to corneal scarring (13). Therefore, xerophthalmia is both a reliable indicator of vitamin A deficiency as well as a resulting disorder which may lead to total blindness often associated with increased mortality.

According to Ross, “among children under 5 years of age, around 3 million have ocular signs of VAD, and 140 million have inadequate vitamin A status (11).”The earliest ocular sign and functional indicator of VAD manifests as night blindness resulting from a lack of vitamin A in rod receptors (12), at the point in which xerophthalmia presents, VAD is in its most severe stage (11) requiring immediate vitamin A supplementation. As xerophthalmia generally displays in clusters within developing regions due to similarity within populations of dietary intake and income, ocular manifestations are acceptable cost-effective clinical criteria to determine a high public health risk of VAD and problem. Therefore a decrease in prevalence and severity will denote successful intervention methods. Intervention methods may be evaluated and considered effect as a decrease in prevalence of >0.5% Bitot’s spots due to keratinizing metaplasia of the bulbar conjunctiva (12), pupillary dark adaptation per night blindness as a threshold better than -1.24 log cd/m^2 (11); both conditions are indicative of moderate to severe VAD (12) and the most commonly assessed stages of xerophthalmia (13). Vitamin A supplementation is an effective treatment reducing the prevalence of night blindness and xerophthalmia but remains controversial in effects of Bitot’s spots as discussed in studies of regions at high risk and incidence of VAD (5, 7, 9).

The biochemical indicator and second assessment method (13) of VAD is assessment of serum retinol concentration taken in blood samples by which a level below 0.70 micromoles per liter, or 20 micrograms per deciliter (6), demonstrates VAD (11). However, this method mandates high cost and burdensome hours of sample collection, as well as many confounding influences such as zinc and protein deficiency, and presence of infection (11) as often occurring due to increased susceptibility in VAD (12). Other confounding factors of plasma retinol levels include nutrient or fat malabsorption, celiac disease, cystic fibrosis, pancreatic insufficiency, and prolonged PEM, and “levels should be assessed in
the presence of vitamin D supplementation because of shared absorptive mechanisms (6).” Hence, retinol serum levels may be utilized in assessment of large populations and effective intervention methods but should not be determinant indicator per individual (11). As individual serum retinol levels, relative dose-response test may be used as indirect measure by obtaining preliminary and postliminary plasma retinol levels to administering vitamin A supplementation in which an increase of 20% would denote inadequate vitamin A levels (3).

Considering that xerophthalmia is directly related to VAD (10) and vitamin A supplementation is proven effective in significant reduction in the public health problem of xerophthalmia (4), “all individuals with xerophthalmia should therefore be treated with vitamin A (10)” as based on World Health Organization guidelines for treatment (9). Effective supplementation of vitamin A yields results of improvement in corneal lesions of approximately two days to one week, in Bitot’s spots within several days to two weeks, and one day to four weeks for retinal dark adaptation in night blindness (10, 12). However, in severe cases as corneal xerosis or ulceration, rarely seen aside from famine settings, requires immediate intervention of moderate to high vitamin A dosage, or risk total blindness within twenty-four to forty-eight hours (10).

Mass distribution of vitamin A supplementation as intervention methods have been approached in many varying methods. Children receive high dose supplementation along with routine immunizations or vaccinations, such as national immunization days, national health days and national micronutrient days (RVA), national food programs with fortified sources, and education in dietary modification accompanied by distribution of seeds for personal gardens of high content vitamin A foods (5) as horticulture intervention (7).

In the study conducted in a developing region in “An Evaluation of Strategies to Control Vitamin A Deficiency in the Philippines (7),” experimenters utilized three intervention distribution methods to children of 1-16 years of age to monitor over 18 months and evaluate efficacy of strategies relating to decreasing VAD prevalence as public health and horticulture intervention, massive dose distribution of 200,000 IU of vitamin A with 40 IU vitamin E, to prevent oxidation, reduce toxic symptoms, and improve storage in the liver, and the third as fortification with 15,000 IU per packet of monosodium glutamate, MSG, as assessed in being part of regular dietary intake of 2 packets per day per family of 6.5. Efficacy of intervention methods were based upon the “reduction of incidence and prevalence of xerophthalmia and VAD (7)” as evaluated by results in clinical eye exams and biochemical retinol serum levels. Aspects removed from the experiment was comparison to a control group deliberately eliminated due to ethical and humanitarian reasons and justified in that the “main objective of the project is to test the relative effectiveness of three different interventions (7).” Results indicated that horticultural intervention yielded insignificant results in active ocular manifestations and serum retinol levels; capsule distribution indicated a significant decrease in active clinical signs of xerophthalmia, and MSG fortification demonstrated greatest significance as both an increase in serum retinol levels as well decreased ocular manifestations. The result outcomes suggest that frequent low dose supplementation via food source fortification may be the best means of effective intervention of VAD validating the interpretation of results as collected by the two primary methods of VAD assessment. This legitimate interpretation advocates a vector of mass distribution applicable on national levels as supported by decreased vitamin A deficiency disorders and as it is cost-effective, mandating little relative labor to the population and distributor.
In a developing nation with high incidence of VAD, the interventional study of “The Impact of Mass Supplementation of Vitamin A (4)” was conducted in random selection of children aged 1-5 years, which had previously received 2 recent mass distributions of vitamin A, and evaluated xerophthalmia as a VAD indicator as monitored monthly concluding at 9 months with an untreated control group versus those administered vitamin A. The results found that mass supplementation “led to significant reduction in xerophthalmia and could be undertaken in areas where VAD is a public health problem (4)” as supported by the absence of Bitot’s spot in intervention children as compared to a prevalence of 4.36%-5.08% of Bitot’s spots within the untreated control children (4). Resulting data indicates and justifies a decrease in VAD with intervention as displayed by absence of Bitot’s spots, however the experimenters should have presented further supported with other ocular manifestations of xerophthalmia to increase validity is their assumption.

The “Impact of Vitamin A Supplementation on Prevalence and Incidence of Xerophthalmia in Nepal (9)” examined an intervention group ranging from less than 1 month to 72 months of age supplemented with 50,000-200,000 IU of vitamin A dependent on age at 4 month intervals versus a control group provided with placebo capsules, concluding results at 16 months. Ocular examinations were conducted to evaluate xerophthalmia focusing upon Bitot’s spots, corneal xerosis, and corneal ulceration-keratomalacia according to standard criteria and based upon subject history relating to night blindness. The placebo control group was removed upon incidents of mortality as justified by ethical and humanitarian reasons; this omission decreases some validity of conclusive results as dependent upon comparison between groups. Results indicated support of pre-existing evidence that “supplementation reduces the incidence of xerophthalmia, demonstrating a 63% reduction in new cases identified (9)” at conclusion of supplementation intervals, however the frequency of administration did not completely prevent new cases from occurring nor cure all cases present at baseline. Vitamin A supplementation decreased “new and persistent or recurrent cases of Bitot’s spots without night blindness (9).” As relevant to data collected, the assumption that “supplementation with 200,000 IU of vitamin A at 4-6 month intervals can reduce the incidence and prevalence of xerophthalmia substantially in a population at risk for VAD, age group notwithstanding (9)” is valid aside from application to age-groups which haven’t been tested.

Confounding factors omitted within the three original articles include other health factors which may affect retinol serum levels as indicated by xerophthalmia previously stated within the second assessment method of biochemical indicator, as well as any supporting evidence of retinol serum levels within two studies. Omission of retinol levels is to be expected due to labor-intense and high cost of obtaining blood samples and lab analysis. All three articles were proficient in stating possible unaccounted factors as variations which may lead to results. However, presentations of results were compact and simplistic as comparing supplementation administration in relation to specific anticipated results of VADD. Experimenters’ perspectives included only distribution on mass scales, but omitted interpretations accounting for specific individual results; this is justified by the hypothesis and objectives’ applying to mass populations, but it does beg to question validity applied to individual interventions. Nonetheless, “the effectiveness of vitamin A supplementation is so well establish that further interventional studies are not required,” but dosing efficacy and frequency of administration is needed in future research with respect to nutritional approaches in prevention of VAD (5).
Sources Cited:


