The effect of vitamin A micronutrient intervention on xerophthalmia prevalence in vulnerable populations

Jillian Gedeon, Tarun Rahman, Heather Riddoch, Haijiao Yan, BHsc.,
Interdisciplinary School of Health Sciences

uOttawa

Source: UNICEF Vitamin A supplementation, 2007

Introduction

Vitamin A is an essential nutrient in maintaining healthy eyes, vision, growth and development[1]. It functions in the visual cycle at the level of the eye by acting in the production of photosensitive pigments in the cells of the retina[1].

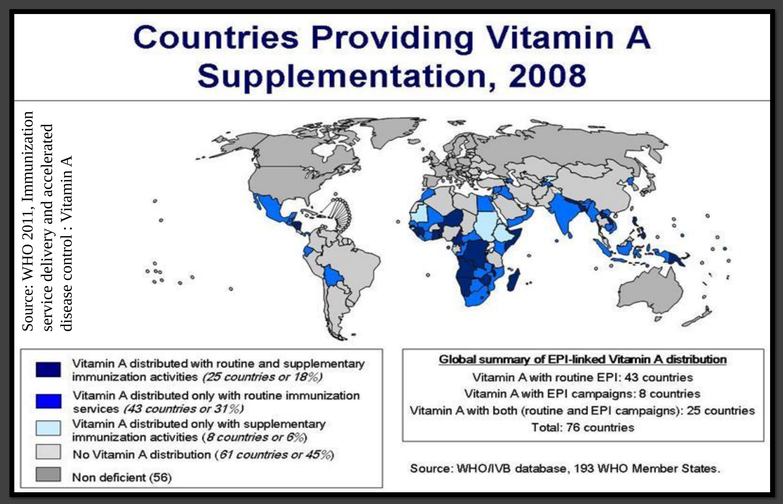
Vitamin A deficiency (VAD), which affects over 250 million preschool-aged children worldwide, is characterized principally by the prevalence of xerophthalmia[2]. VAD is the leading cause of preventable blindness in children, affecting 500 000 children annually[2]. Xerophthalmia encompasses a series of symptoms, most commonly Bitot's spots and night blindness. Bitot's spots, caused by the build-up of keratin debris superficial to the conjunctiva, are irregular in shape and are associated with conjunctival xerosis[3]. Night blindness, also known as nyctalopia, is limited visibility in low light settings[4].

Supported financially by the Canadian International Development Agency (CIDA), the Micronutrient Initiative (MI) supplies over 75% of the world's Vitamin A needs and has to date supplied over 5 billion vitamin A capsules[5]. The Ottawa-based NGO seeks to develop and implement innovative solutions to provide the world's vulnerable populations with the vitamins and minerals they need to survive and thrive[5].

The purpose of this literature review is to determine the effectiveness of vitamin A supplementation programs in reducing xerophthalmia and its associated symptoms in vulnerable populations – namely in infants and pre-school aged children using Bitot's spots and night blindness as indicators.

Research Question/Hypothesis

Does active micronutrient intervention, by providing vitamin A supplementation, decrease prevalence of xerophthalmia in vulnerable populations as indicated by the prevalence of Bitot's spots and night blindness in children less than 6 years of age?



Discussion

According to the compiled results, a reduction was observed in the prevalence of xerophthalmia due to vitamin A supplementation. Although some of the results proved to be insignificant and others were not well founded, a majority of findings indicated that vitamin A supplementation correlated positively with a decrease in prevalence of Bitot's spots and night blindness.

Interpretation of results is complicated by non-differential bias in methodology. The search strategy was not exhaustive as it was limited by database access. However, internal validity was not compromised due to the structured and rigorous nature of selection criteria.

Confounders in our methodology included gender and age. The prevalence of both Bitot's spots and night blindness are known to be higher in boys[12], however data collected was not gender-specific and therefore inferences can only be applied to children in general. Vitamin A supplementation greatly reduces xerophthalmia prevalence in infants under 65 months, while effects are reduced in children older than 65 months[10]. Therefore, results from this study are primarily applicable to vulnerable populations which fall within the 0-5 year age-range. Vulnerable populations for this study are defined as being vitamin A deficient as determined by serum-retinol levels[14].

Based on the results of the study, it is advisable that CIDA continues support of vitamin A supplementation programs in vulnerable populations. Current CIDA collaborations include partnerships with the Micronutrient Initiative, valued at $150 million[15], and with the United Nations Children's Fund (UNICEF), worth $9 million[16]. CIDA has also previously partnered with Helen Keller International[17] for vitamin A supplementation.

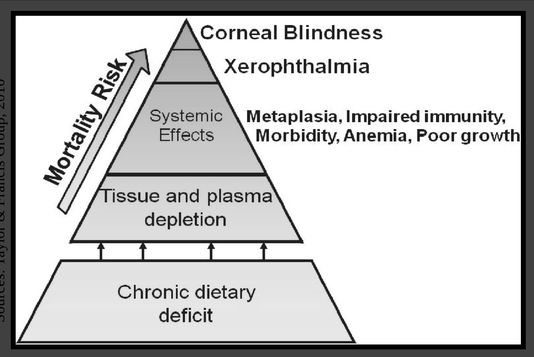
Source: UNICEF Vitamin A supplementation, 2007

Methods

SEARCH STRATEGY: The PubMed and SCOPUS databases were searched for randomized trials and supplementation programme reviews containing pre- and post-intervention evaluation data. Keywords used in the search included: vitamin A, vitamin A deficiency, vitamin A supplementation, xerophthalmia, night blindness, and Bitot's spots

SELECTION CRITERIA: Randomized controlled trials and vitamin A supplementation programme analyses were selected evaluating the effects of vitamin A supplementation on prevalence of xerophthalmia. 8 studies were selection based on availability of comparisons between pre- and post-intervention data or experimental group and control group data. Data collected was restricted to prevalence of Bitot's spots and/or nyctalopia.

DATA COLLECTION AND ANALYSIS: At least two reviewers assessed trials for inclusion and extracted data. Exclusion criteria were set so that only peer-reviewed trials were used from publications dated 1988 and onwards. The following information was collected in each study: relative risk (RR), odds ratio (OR) or p-value with associated confidence interval as well as loss to follow-up, setting and year.



Sources: Taylor & Francis Group, 2010

Results

#	Study description	Location	Results after Vitamin A supplementation			Comments
			Bitot's spots	Night-blindness	Total xerophthalmia	
1	RCT in Indonesia with children ranging from 0-60 months.[6] Control n= 11818 (240 LTFU) Experimental n= 12591 (337 LTFU) (1986)	Northern Sumatra, Indonesia	Control : 1.37% → 0.50% Experimental: 1.11% →0.10% RR: 1.2 → 5.0	Control: 1.27% → 0.7% Experimental: 1.08% → 0.21% RR: 1.2 → 3.3	Control: 2.3% → 1.2% Experimental: 1.9% → 0.3% P<0.05	Xerophthalmia prevalence ↓ by 85%. Significant.
2	RCT in Nepal with infants and children ranging from 1 month – 4 years. [7] Control n= 1711 (354 LTFU) Experimental n = 1871 (382 LTFU) (1995)	Sarlahi District, Nepal	Control: 1.26% → 1.40% Experimental: 0.75% → 0.48% RR: 0.70 → 0.34	Control: 1.16% → 0.41% Experimental: 1.15% → 0.11% RR: 0.27	Control: 3.29% → 2.05% Experimental: 2.31% → 0.64% RR: 0.37 (95% CI) (0.17-0.79)	↓ prevalence and incidence of xerophthalmia.
3	Pre-evaluation/Post-evaluation intervention program analysis in India looking children 1-5 years old [8] N = 818 (486 LTFU) (2002)	Chandigarh, India	Pre-evaluation : 0.60% Post-evaluation : 0.10% P > 0.05	N/A	Pre-evaluation : 24.6% Post-evaluation : 11.2% P <0.001	↓ 13.4% in xerophthalmia Significant.
4	Pre-evaluation/Post-evaluation intervention program analysis in Ethiopia looking at children 6 – 72 months [9] N= 4770 (483 LTFU) (2003)	Tigray, North Ethiopia	Pre-evaluation : 1.50% Post-evaluation : 0.50% P < 0.01	Pre-evaluation : 0.8% Post-evaluation : 0.90% P >0.05 therefore NS	N/A	↓ prevalence of Bitot's spots. Partially significant
5	Pre-evaluation/Post-evaluation intervention program analysis in a region in Mali looking at children 12– 66 months [10] N= 1524 (2002)	Mopti region, Mali	Pre-evaluation : 2.6% Post-evaluation : 0.8% OR: 0.29 P <0.01 (0.002)	Pre-evaluation : 5.5% Post-evaluation : 3.3% OR : 0.58 P <0.05 (0.02)	Pre-evaluation: 6.9% Post-evaluation: 3.3% P< 0.0001 OR: 0.46 (95% CI 0.32– 0.73)	↓ risk of xerophthalmia Significant
6	RCT in India with infants and children ranging from 1– 5 years [11] Control n= 211 (41 LTFU) Experimental n = 225 (51 LTFU) (2007)	Chandigarh, India	Control: 4.36%-5.08% had the disease. Experimental: NONE had the disease	N/A	N/A	↓ Bitot's spots
7	Pre-evaluation/Post-evaluation intervention program analysis in Philippines for children 12– 24 months for night blindness and children from 12-59 months for Bitot's test [12] N= 7607 (110 LTFU) (1996)	Philippines	Pre-evaluation: 1.09% CI: 0.87-1.35% Post-evaluation: 0.49% CI: 0.34-0.67%	Pre-evaluation: 2.32% CI: 2.7-3.63% Post-evaluation: 0.63% CI: 0.44-0.82%	N/A	Prevalence ↓ by 72% for night blindness and 52% for Bitot's spot
8	Pre-evaluation/Post-evaluation intervention program analysis in Vietnam looking at children 6– 36 months [13] N(night blindness)= 12900 (21314 LTFU) N(Bitot's spot)= 37920 (2002)	Vietnam	Pre-evaluation: 0.16 % Post-evaluation : 0.045 %	Pre-evaluation: 0.37 (1988) Post-evaluation: 0.20 (1998)	N/A	↓ Bitot's spots and night blindness

Conclusion

According to the presented data, vitamin A supplementation is a key intervention in reducing prevalence of xerophthalmia in vulnerable populations.

References

1. WHO. (1998). *Vitamin and Mineral Requirements in Human Nutrition. Second Edition.* Retrieved 03 27, 2011, from World Health Organization: http://whqlibdoc.who.int/publications/2004/9241546123.pdf
2. WHO. (2011). *Micronutrient Deficiencies.* Retrieved 03 28, 2011, from World Health Organization: http://www.who.int/nutrition/topics/vad/en/index.html
3. Shukla, M., & Behari, K. (1979). Congenital Bitot spots. *Indian Journal of Ophthalmology* , 63-64.
4. Danby, F. (2003). Night blindness, vitamin A deficiency, and isotretinoin psychotoxicity. *Dermatology Online Journal* , 30.
5. Micronutrient Initiative. (2011, 01 14). *What We Do.* Retrieved 04 02, 2011, from Miconutrient: http://www.micronutrient.org/english/View.asp?x=699
6. Sommer, A., Tarwotjo, I., Djuaedi, E., West, K. J., Loeden, A., Tilden, R., et al. (1986). Impact of vitamin A supplementation on childhood mortality. A randomised controlled community trial. *Lancet* , 1169-1173.
7. Katz, J., West, K. J., Khatry, S., Thapa, M., LeClerg, S., Pradhan, E., et al. (1995). Impact of vitamin A supplementation on prevalence and incidence on xerophthalmia in Nepal. *Investigative Opthamology and Visual Science* , 2577-2583.
8. Swami, H., Thakur, J., & Bhatia, S. (2002). Mass supplementation of vitamin A linked to National Immunization Day. *Indian Jouranl of Pediatrics* , 675-678.
9. Haidar, J., Tsegaye, D., Mariam, D., Tibeb, H., & Muroki, N. (2003). Vitamin A supplementation on child morbidity. *East African Medical Journal* , 17-21.
10. Schemann, J., Banou, A., Malvy, D., Guindo, A., Traore, L., & Momo, G. (2003). National immunisation days and vitamin A distribution in Mali: has the vitamin A status of pre-school children improved? *Public Health Nutrition* , 233-244.
11. Swami, H., Thakur, J., & Bhatia, S. (2007). Impact of mass supplementation of vitamin A. *Indian Journal of Pediatrics* , 443-447.
12. Klemm, R., Villate, E., Tuazon-Lopez, C., & Ramos, A. (1996). *Coverage and impact of adding vitamin A capsule (VAC) distribution to annual national immunization day in the Philippines.* Manila: Department of Health and Hellen Keller International.
13. Khan, N., Khoi, H., Giay, T., Nhan, N., Nhan, N., Dung, N., et al. (2002). Control of vitamin A deficiency in Vietnam: achievements and future orientation. *Food Nutrition Bulletin* , 133-142.
14. WHO. (2011). *Serum retinol concentrations for determining the prevalence of vitamin A deficiency in populations.* Geneva: Department of Nutrition for Health and Development (NHD).
15. CIDA. (2010, 08 13). *Project profile for reducing micronutrient malnutrition.* Retrieved 03 30, 2011, from Canadian International Development Agency: http://www.acdi-cida.gc.ca/cidaweb/cpo.nsf/vLUWebProjEn/E5C7319770A8E2B785257574003730C8?OpenDocument
16. CIDA. (2010, 11 08). *Project profile for Vitamin A Program for West and Central Africa - UNICEF.* Retrieved 04 03, 2011, from Canadian International Development Agency: http://www.acdi-cida.gc.ca/cidaweb/cpo.nsf/vLUWebProjEn/1A43BF46320EBAF1852577820039 49EC?OpenDocument
17. CIDA. (2009, 01 23). *Project profile for Vitamin A through Helen Keller International.* Retrieved 03 29, 2011, from Canadian International Development Agency: http://www.acdi-cida.gc.ca/cidaweb/cpo.nsf/vLUWebProjEn/EAA77394FD03BE01852577820038A920?OpenDocument