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Original article

Impact evaluation of EPI-PLUS and WIBS approaches in controlling vitamin A deficiency in Tigray and Harari Regions, Ethiopia

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Abstact

A comprehensive evaluative study on the impact of EPI-plus approach (vitamin A supplementation along with immunisation program) and WIBS approach (EPI-plus and other non health measures) in controlling vitamin A deficiency (VAD) was conducted in Harari and Tigray Regions. In each Region, one EPI-plus district and one WIBS district were randomly selected. In the pre-intervention survey conducted in May/June 1996, a total of 10964 children aged 6 to 72 months in randomly selected clusters of villages in the four districts were clinically examined for signs of xerophtalmia, while blood samples were collected from a sub-sample of 448 children for serum retinol analysis. In the post-intervention survey conducted in May/June 1997 in the same districts and same clusters of villages, 10460 children were clinically examined for signs of xerophtalmia, and blood was collected from a sub-sample of 580 children for serum retinol analysis. Results indicate that on the overall there is a substantial reduction in the prevalence of Bitot's spot in both regions (about 43% reduction in Harari and 66% in Tigrai). Over 4% reduction in Harari and about 30% reduction in Tigray was observed in the prevalence of children with low/deficient serum retinol levels. In Harari Region reduction in the prevalence of Bitot's spot was higher in WIBS area (about 54%) compared to the reduction in the EPI-plus district (40%). In Tigray Region, however, the reduction in bitot's spot was almost similar in both districts (over 64% in WIBS and 70% in EPI-plus). There was a similar insignificant reduction in the proportion of children with low/deficient serum retinol level in both districts in Harari Region (WIBS, 4.1% and EPI-plus, 5.1%), while the reduction in the proportion of children with low/deficient serum retinol levels in both districts in Tigray Region (WIBS, 42.6% and EPI-plus, 18.2%) was significant. As there was no control group, it may be difficult to conclude with certainty that the observed significant improvement in vitamin A status is entirely due to the ongoing interventions. However the potential contributions of the two strategies to the observed improvement in vitamin A status can not be under-estimated.

Introduction

Several studies in the past and present have established that vitamin A deficiency is a major public health problem in Ethiopia. The first study to be noted was the clinical examination of xerophthalmia on 7,000 pre-school and school-age children in 1957/58 conducted by Postmus (1). He found that 9% of the girls and 2.2% of the boys had Bitot's spots while approximately half of them had conjunctival xerosis. A subsequent study conducted by the Inter-departmental Committee on Nutrition for National Defence in 1959 also indicated that about 10% of pregnant women had vitamin A level of less than 10 g/100 ml (2). This survey also showed that 2% of the male children and 0.4% of female children had Bitot's spot. Another relatively recent study conducted by Guseppe De Sole in 1987 in Southern Ethiopia indicated that the average prevalence of Bitot's spot, corneal xerosis, keratomalacia and corneal scar were 5%, 8% and .05%, respectively (3).

A national nutrition survey carried out by the former Ethiopian Nutrition Institute in 42 semiurban survey sites representing four ecological Zones indicated an overall Bitot's spot rate of 1%, which was twice that of the cut-off point (0.5%) set by WHO as indicating a problem of public health significance (4). According to this rate about 6 - 8 million of the under six children in the country are estimated to be at risk of vitamin A deficiency. The prevalence of Bitot's spot was found to be higher among children in pastoral areas (1.6%), followed by those living in grain-cropping (1.1%) and cash cropping (0.4%) Zones and overall serum retinol levels were deficient in 16% and low in 44% of the children. No cases of xerophthalmia were reported from the "enset" (Enset Ventricosum, commonly known as false banana tree) staple area. This was attributed to the high consumption of green leafy vegetables, particularly kale, along with enset. However, the results of the recent survey in the region indicated that VAD is emerging as a public health problem in SNNPR (5).

The long-term strategy to control VAD is through ensuring a continuous and adequate consumption of foods rich in vitamin A. Due to poverty, ignorance, scarcity of foods rich in vitamin A and various traditional harmful feeding practices, it is very unlikely that this strategy can materialise in the near future. The medium term strategy to control VAD is fortification of widely consumed food with vitamin A. At present this strategy is just under consideration and will definitely take sometime before it materialises. Until such methods become available, an interim strategy is supplementation of vitamin A capsules to the risk group of the population.

Since 1989 an attempt was made by the former Ethiopian Nutrition Institute (ENI) to supplement vitamin A through the available health infrastructures of the MOH. Although the supplementation was disease targeted, universal supplementation was also attempted in one area where VAD emerged as an epidemic (6).

Based on the lessons learned from these trials and in an attempt to meet the universal goal of eradicating vitamin A deficiency in the year the 2000, MOH initiated and adopted universal vitamin A supplementation strategy in 1995. This is referred to as EPI-Plus approach in this study.

The aim of the program was to improve vitamin A status by bi-annually providing high dose of vitamin A capsule (200,000 IU) for all children between one year and five years of age, a single dose of 100,000 IU for all children under one year; a single dose of 2000,000 IU for lactating non-pregnant women, and 10,000 IU for women who are pregnant or at risk of being pregnant. The health infrastructure, particularly the EPI section, was given the responsibility to implement the program and EPI and MCH contacts were considered as an ideal means.

In the mean time UNICEF, in its efforts to ameliorate vitamin A deficiency problems in Ethiopia, begun to strengthen the ongoing Wereda Integrated Basic Services (WIBS) program by vitamin A relevant actions in all WIBS woredas. This approach is referred to as WIBS approach in this study. The vitamin A relevant actions included strengthened VAC distribution (in addition to the national EPI-plus program), distribution of vitamin A rich horticultural seeds as well as promotion of production and use of the horticultural crops, advocacy, and sensitisation activities for mothers and health workers through training, workshops, and seminars.

In 1996, UNICEF requested the Ethiopian Health and Nutrition Research Institute to evaluate the impact of these attempts in mitigating the sequele of vitamin A deficiency. Baseline data collection was conducted in May/June 1996 and post-intervention data collection was conducted in May/June 1997. Evaluation of the impact of these two approaches is deemed to be important for selecting appropriate type of intervention in Ethiopia. The result of the study is hoped to assist policy makers and institutions as well as NGOs working towards the elimination of vitamin A deficiency in Ethiopia.

Methods

This is an observational evaluative study which made use of constructed comparison groups to evaluate the relative impact of different approaches of VAD control programmes in Tigrai and Harari Administrative Regions. Stratified, multistage, cluster sampling was used to sample the study population. In the two Regions, one WIBS wereda, and another EPI-plus wereda were randomly selected. Clusters of all Farmers' Associations (FAs) were constructed and a cluster each in the four woredas were randomly selected. In these clusters, all children aged six months to six years were included for clinical assessment and blood samples were drawn from a systematically selected sub-sample for serum retinol analysis.

Clinical examinations of xerophthalmia were done in accordance with the World Health Organization classification of xerophthalmia. Physicians who were trained and standardised by an ophthalmologist undertook the clinical assessment. Blood was collected by a senior laboratory technician using a vacutainer system from a sub-sample of randomly selected pre-school children who have been clinically examined. The collected blood was centrifuged and the serum specimens were stored in a refrigerator until they were transported to South Africa (University of Stellenbosch) for analysis. Analysis was completed a few days after arrival using high performance liquid chromatography (HPLC). Data from completed questionnaires and laboratory results were entered into computers using SPSS/DE programme at EHNRI. Data cleaning and analysis was carried out using SPSS/PC statistical software.

Results

As indicated in Table 1, the overall prevalence of night blindness remained nearly the same before and after intervention in both Regions. Marked reduction in the prevalence of Bitot's spot in both Regions was observed. Nearly a three-fold reduction in Tigray, and a two-fold reduction in Harari Region and its surroundings. As can be seen from Table 2, the proportion of children with low/deficient (< 0.70 umole/litre) serum retinol values has markedly decreased after intervention in Tigray Region (63.1% vs. 43.8%) and slightly decreased (96.0% vs. 91.6%) in Harari Region and its surroundings. The proportion of children with normal retinol levels increased substantially in both Regions (36.8% vs. 56.2% in Tigray and 4.0% vs. 8.4% in Harari Region).

Table 3 shows the pre-and post-intervention prevalence of xerophthalmia by types of approach in Tigray Region. The prevalence of night blindness in WIBS Wereda has increased (0.8 vs.

13%) while it decreased in EPI-plus wereda (1.0 vs.0.6%). The prevalence of Bitot's spot has shown marked reduction in both WIBS (1.4 vs. 0.5%, 64.3% reduction from the baseline prevalence) Woredas.

Table 4 shows the pre- and post-intervention prevalence of xerophthalmia by types of approaches in Harari Region and its surroundings. The prevalence of night blindness in both WIBS and EPI-plus Weredas has decreased reasonably. (In WIBS, 6.9% vs. 4.0% and in EPI-plus 9.9% vs 8.9%). The prevalence of Bitot's spot has shown marked reduction in both WIBS (5.9% vs. 2.7%, 54.2% reduction from the baseline prevalence) and in EPI-plus (9.9% vs. 5.9%, 40.4% reduction from baseline prevalence) weradas.

As can be seen from Table 5, the proportion of children with low/deficient (<0.7 umole/ litre) serum retinol values in both WIBS and EPI-plus woredas in Tigray Region has reduced substantially (64.8% vs.37.2% in WIBS ans 62.0% vs. 50.7% in EPI-plus. The proportion of children with normal retinol values increased substantially in both approaches in the Region (35.2% vs. 62.8% in WIBS and 38.0% vs. 49.3% in EPI-plus wereda).

According to Table 6, there is a slight and insignificant reduction in the proportion of children with low/deficient (<0.70 umole/ litre) serum retinol values in both WIBS and EPI-plus in Harari Region (94.3% vs. 90.4% in WIBS and 97.8% vs. 92.8% in EPI-plus). There is also a slight increment in the proportion of children with normal retinol values in both approaches (5.7% vs 9.6% in WIBS and 2.2% vs. 7.2% in EPI-plus wereda). Table 7 indicates the mean values of serum retinol by approach and by region. Substantial and highly significant improvement in the mean values of serum retinol was found in WIBS Wereda of Tigray Region ($p<0.0001$). Similar improvement in the serum retinol values (SRV) was also observed in Tigray EPI-plus and Harari EPI-plus Weredas ($p<0.01$). However, there was no improvement in SRV in Harar WIBS Werada.

Discussion

Because Bitot's spot (X1B) is more VAD specific indicator and most reliable, objective and easy to standardize, most studies, par-ticularly evaluative type of studies, use Bitot's spot along with serum retinol levels as an indicator. Information on night blindness is usually subjective because of mothers' misconception of the signs and symptoms ofnight blindness and thus can not be reliably used for such evaluative studies, particularly in developing countries like Ethiopia. The mixed pattern in the prevalence of night blindness observed in this study appears to support these assertions. Eventhough night blindness is included in this report to show the point prevalence, the discussion is limited to the results of Bitot's spot and serum retinol values.

Several studies on the impact of vitamin A supplementation have shown substantial reduction on the prevalence of clinical signs of xerophthalmia and considerable improvements in serum retinol values. For example, in Mysore, India, nearly a three-fold reduction on the overall xerophthalmia prevalence was achieved after a one year supplementation program. Similar results were also obtained in Bangladesh, Nepals and Cebu, Philippines (7). Our results also indicate a similar reduction in the overall xerophthalmia prevalence rate in both Regions.

The post-intervention prevalence reduction in Tigray Region, which was about 60%, and the reduction in Harar Region, which was nearly 43%, concurs with the above-mentioned findings.

Regarding the impact on serum retinol values (SRV), the observed dramatic improvements in both Regions agree with other findings. In Brazil, for example, nearly a four-fold reduction in the prevalence of children with deficient SRV was noted. In Tigray Region, the proportion of children with normal SRV increased from 35.2% to 62.8% which indicates a 60% improvement when compared with the baseline findings. In Harar Region and its surroundings, this percentages of improvement reaches nearly two-folds.

Considering the two approaches, dramatic reduction in the prevalence of X1B was observed in WIBS and EPI-plus Weredas of both Regions. Regarding serum retinol values (SRV), a substantial increment (27.6%) in the proportion of children with normal SRV was observed in WIBS Wereda of Tigray Region,

about 4% improvement in Harar WIBS, about 11% in Tigray EPI-plus and in Harar EPI-plus. This pattern in post-intervention improvement in the prevalence rate of children with normal SRV is confirmed when the improvement in mean serum retinol value is considered. A mean SRV improvement of 0.18 umole/litre in Tigray WIBS is almost two-fold higher than the improvement in Tigray EPI-plus and Harar EPI-plus Weredas and over six-fold improvements than Harar WIBS. Although the clinical findings (X1B) in Harar WIBS indicate a substantial improvement, the biochemical result obtained is slightly less than what is found in other weredas.

Based on the reduction in the prevalence rates of X1B, and the reduction in the proportion of children with low or deficient SRV and improvement of a mean serum retinol values, it can be concluded that in both WIBS and EPI-plus Weredas of the two Regions, the prevalence of VAD has decreased. Tigray WIBS, however, appears to be more successful in achieving the desired intervention goals, followed by Tigray EPI-plus and Harar EPI-plus.

Although the improvement achieved in the vitamin A status and hence child survival is substantial, there still remains a lot of effort to be made if the global goal of eradicating VAD by the year 2000 is to be met.

In Tigray Region, the post-intervention prevalence of X1B is still just at the WHO cut-off point (0.05%) in both the weredas. Proportion of children with serum retinol values less than 0.70 umole/litre is, however, still extremely higher than the WHO cut-off point of 20% in both weredas. The situation is worse in Harari Region. The post-intervention prevalence of X1B is about eight times higher than the WHO cut-off points. The prevalence of SRV less than or equal to 0.70 umole/litre (90%) is still one of the highest in the world.

With the rate of the attained improvements in vitamin A status, it is very unlikely that the global objectives are met. Concerted and strengthened efforts are required if the prevalence of VAD should be reduced below the public health significance cut-off points. Constraints that impede the pace should be identified and appropriate solutions should be sought as soon as possible. Awareness of the community particularly the mothers, health workers, regional and wereda administrators regarding the importance of vitamin A in the well being of children and mothers must be upgraded through workshops, seminars, training, and others. It must be clear that, without Government involvement and support, the goal of eradicating VAD can not be achieved and therefore, Government support and involvement at all administrative levels must be strengthened. Along with the strengthening of the program implementation, mechanisms to supervise, monitor, and evaluate the process should also be instituted. We, therefore, strongly recommend biannual evaluation of the process. This will give opportunities to identify and rectify shortcomings on time. The ongoing annual impact evaluation of the intervention should also continue in order to be able to see the extent of the progress every year. In view of this, we recommend to carry out the first impact evaluation in Southern Region in June (exactly the same time with the baseline survey) and the second impact evaluation in Tigray and Harar Regions again in June (the same time the first impact evaluation was taken) in order to see the two-year impact of the program.

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Tables

Table 1: **Pre- and post-intervention prevalence of xerophthalmia in children aged 6 - 72 months in two Regions, Ethiopia**

Clinical signs	Number and percentages of children with clinical signs in each Region		
	Tigray	**Harari**	**Total**
Night blindness			
pre-intervention	46(0.8)	480(8.4)	581(3.85)
post-intervention	45(0.9)	367(6.4)	412(3.94)
Biot's spot			
pre-intervention	79(1.5)	435(7.6)	522(3.5)
post-intervention	22(0.5)	246(4.3)	268(2.56)
% reduction*	66,6	43,4	

95% confidence interv.	0.65-1.4	2.4-4.2	
Total examined			
pre-intervention	5253	5711	15087
post-intervention	4770	5690	10460

* percent reduction is computed as p0-p1/p0x100; where p0=pre-intervention prevalence rate and p1=post-intervention prevalence rate.

Table 2: **Distribution of pre-and post-intervention of serum retinol values in children aged 6 - 72 months in two Regions, Ethiopia**

Serum retinol mol/l	**Number and percentages of children with serum retinol values in each Region**		
	Tigray	**Harari**	**Total**
<0.35(deficient)			
pre-intervention	40(16.2)	103(51.8)	152(23.6)
post-intervention	19(6.8)	125(41.8)	144(24.8)
0.35.70(low)			
pre-intervention	116(47.0)	88(44.2)	250(38.9)
post-intervention	104(37.0)	149(49.8)	253(43.6)
0.70(low/deficin)			
pre-intervention	156(63.1)	191(96.0)	402(62.5)
post-intervention	123(43.8)	274(91.6)	397(68.4)
%reduction*	30,6	4,6	
95% confidence intr	11.2-27.9	0.2-8.5	
>0.70 (normal)			
pre-intervention	91(36.8)	8(4.0)	241(37.5)
post-intervention	158(56.2)	25(8.4)	183(31.5)
Total examined			
pre-intervention	247	199	643
post-intervention	281	299	580

*Percent reduction is computed as p0-p1/p0x100; where p0=pre-intervention prevalence rate and p1=post-intervention prevalence rate.

Table 3: **Prevalence of xerophthalmia before and after intervention in Tigray Region, by approach**

clinical signs	Number and percentages of children with clinical signs, by approach		
	WIBS	**EPI-plus**	**Total**
Night blindness			
Pre-intervention	22(0.8)	25(1.0)	46(0.8)
post-intervention	31(1.3)	14(0.6)	45(0.9)
Bitot's spot			
pre-intervention	38(1.4)	41(1.7)	79(1.5)
post-intervention	11(0.5)	11(0.5)	22(0.5)
% reduction*	64,3	70,6	
95% confidence intrv.	0.38-4.1	0.6-1.9	
Total examined			
pre-intervention	2782	2471	5253
post-intervention	2335	2435	4770

*percent reduction is computed as p0-p1/p0x100; where p0=pre-intervention prevalence rate and p1=post-intervention prevalence rate

Table 4: **Prevalence of xerophthalmia before and after intervention in Harari Region and its surroundings**

clinical signs	Number and percentages of children with clinical signs, by type of approach		
	WIBS	**EPI-plus**	**Total**
Night blindness			
Pre-intervention	196(6.9)	284(9.9)	480(8.4)
post-intervention	113(4.0)	254(8.9)	367(6.4)
Bitot's spot			
pre=intervention	168(5.9)	284(9.9)	435(7.6)
post-intervention	78(2.7)	168(5.9)	246(4.3)

% reduction from baseline*	54,2	40,4	
95% confidence intrv.	2.1-4.2	2.6-5.4	
Total examined			
pre-intervention	2854	2857	5711
post-intervention	2849	2841	5690

*percent reduction is computed as p0-p1/p0x100; where p0=pre-intervention prevalence rate and p1=post-intervention prevalence rate

Table 5: **Pre and post intervention distribution of serum retinol values (n(%), by type of approach, in Tigray Region**

Serum retinol values	**Type of approaches**		
mol/l	WIBS	EPI-Plus	Total
<0.35(deficient)			
pre-intervention	21(16.2)	18(14.9)	39(15.8)
post-intervention	8(5.5)	11(8.1)	19(6.8)
0.350.70(low)			
pre-intervention	60(48.0)	58(47.1)	118(47.8)
post-intervention	46(31.7)	58(	104(37.0)
0.70(low/deficin)			
pre-intervention	81(64.8)	76(62.0)	157(63.5)
post-intervention	54(37.2)	69(50.7)	122(43.4)
%reduction*	42,6	18,2	
95% confidence intr.	16.4-39.3	0.8-23.3	
>0.70(normal)			
Pre-intervention	44(35.2)	46(38.0)	91(36.8)
post-intervention	91(62.8)	67(49.3)	158(56.2)
Total examined			
pre-intervention	125	122	247
post-intervention	145	136	281

*percent reduction is computed as p0-p1/p0x100; where p0=pre-intervention prevalence rate and p1=post-intervention prevalence rate

Table 6: **Distribution of serum retinol values (n and %) by type of approaches before and after intervention in Harari Region and its surroundings**

Serum retinol values	**Type of approaches**		
mol/1	**WIBS**	**EPI-Plus**	**Total**
<0.35(deficient)			
pre-intervention	45(42.5)	61(65.6)	106(53.3)
Post-intervention	50(35.2)	75(49.0)	125(41.8)
0.350.70(low)			