

Evaluation of the implementation of the vitamin A supplementation programme in the Boland/Overberg region of the Western Cape Province



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Objective. To assess the implementation of the vitamin A supplementation programme in primary health care (PHC) clinics in a rural area of the Western Cape Province.

Material and methods. A study was conducted at 14 randomly selected PHC clinics. All children aged 6 - 60 months attending on the day of surveying with their mothers/caregivers were selected by purposive sampling, after they had been seen by a PHC nurse in the clinic. A structured exit interview was conducted with the mother/caregiver of each child. The information from 56 such interviews could be utilised for data analysis. The manager of each clinic was also interviewed.

Results. Seventy-seven per cent of the study population ($N=40$) was eligible for high-dose vitamin A supplementation on the day of the study, based on the criteria of the vitamin A supplementation protocol. However, 25% of these children ($N=10$) did not receive vitamin A, even though there was an indication to administer it. Only 39% of mothers ($N=22$) reported that they were aware of the supplementation programme. All the health facility managers of the clinics had received training in the programme. Staffing problems and stock shortages appeared to play a role in inadequate implementation of the programme at some clinics. In addition, health facility managers reported that many children failed to receive their vitamin A dose because parents did not bring them regularly to clinics.

Conclusions. The vitamin A supplementation programme appears to be reasonably successfully implemented in the Boland/Overberg region. Informing mothers about the importance of vitamin A supplementation and regular clinic attendance, as well as improving the availability of human and material resources and logistic support at PHC facilities, may further enhance the implementation and success of the programme.

Vitamin A deficiency is a significant public health problem in developing countries worldwide, affecting some 127 million preschool children.^{1,2} Deficiency significantly increases the risk of severe illness, and even death from common childhood illnesses such as diarrhoea and measles, and can cause severe visual impairment and blindness.³ It has been estimated that 40 million children worldwide suffer from xerophthalmia and keratomalacia, which can both be reversed in their early stages by vitamin A supplementation.⁴ A meta-analysis found that vitamin A supplementation led to a 30% reduction in mortality due to diarrhoea.⁵

In line with these findings, another meta-analysis of several community-based trials found that vitamin A supplementation could reduce all-cause mortality in children aged 6 months to 5 years by 23%.⁶ In pneumonia associated with measles, supplementation with high doses of vitamin A has been shown to have a protective effect in reducing mortality and morbidity in children.^{7,8} The beneficial effect of vitamin A, however, does not extend to children with acute respiratory tract infections unrelated to measles.⁹⁻¹³

The 1994 South African Vitamin A Consultative Group (SAVCG) national survey showed that 1 in 3 children

aged 6 - 71 months in South Africa (SA) had marginal vitamin A status (i.e. a serum retinol below 20 µg/dl). The prevalence of vitamin A deficiency was highest in non-urban areas in children with poorly educated mothers. Eye signs of vitamin A deficiency were uncommon.¹⁴

According to the World Health Organization's criteria, vitamin A deficiency is a significant public health problem in 8 out of the 9 South African provinces. Food fortification alone, and in the short term, does not provide sufficient vitamin A to address deficiency states in countries with a high prevalence of vitamin A deficiency.¹⁵ These considerations led the South African Department of Health to implement a national vitamin A supplementation programme. A curative vitamin A supplementation protocol, which targeted high-risk mothers and children for vitamin A supplementation, was implemented in the Western Cape in 1999. This programme has since been combined with a preventive component, that all children under 5 years of age receive a high-dose vitamin A supplement every 6 months, while all breastfeeding mothers receive high-dose vitamin A supplementation within 6 - 8 weeks post partum.¹⁶ Currently, the indications for curative vitamin A supplementation are severe malnutrition (marasmus, kwashiorkor and marasmic kwashiorkor), persistent diarrhoea, measles and xerophthalmia.¹⁷

Recent research has focussed on the benefits of vitamin A in HIV-infected children,¹⁸⁻²³ several of these studies have shown that vitamin A supplementation to HIV-positive infants and children can play an important role in reducing mortality and morbidity related to HIV.^{19,20,22,23} Since HIV is the leading cause of death in children under 5 years of age throughout SA,²⁴ vitamin A supplementation to this group could be beneficial.

No formal evaluation of the current vitamin A supplementation programme in SA has yet been performed, although there are anecdotal reports of poor coverage in some areas. The aim of this study was to determine how effectively the combined supplementation programme was being implemented as at April 2005 at PHC facilities in the Boland/Overberg region of the Western Cape by on-site assessment; also the opportunities at clinic level for vitamin A supplementation, and the number of identified opportunities for supplementation which were missed. In addition, the awareness of mothers/caregivers of children eligible for vitamin A supplementation with regard to the supplementation programme was assessed.

Methods

Study design and sampling

A descriptive cross-sectional study was conducted during April and August 2005 at PHC clinics in the Boland/Overberg Region of the Western Cape. This

region is classified as rural; it stretches from Worcester and surrounding towns in the Boland region to Caledon and surrounding towns in the Overberg. There are fixed clinics in the towns and townships, as well as satellite clinics that serve outlying and farming areas. Final-year dietetic students completed the fieldwork, having received training in data collection and procedures relevant to this study. The fieldworkers were briefed on the protocol of the study and trained in the provincial vitamin A supplementation protocol¹⁸ and standard paediatric weighing and measuring techniques.²⁵ Weight was measured to the nearest 0.1 kg and height to the nearest 0.1 cm. Scales were zeroed between measurements. Fieldworkers were also 'standardised' in terms of prompts for the questionnaires. The structured interview questionnaire was adopted from a previous study to determine whether opportunities for vitamin A supplementation were being utilised in the metropole region of Western Cape Province,²⁶ and was adapted to include criteria and implementation from the vitamin A supplementation protocol.

Simple random sampling was used to select 14 of the 55 clinics in the area for inclusion in the study. The data were collected over a period of 14 days. Each clinic in the sample was visited once. Sampling took place from Tuesdays to Fridays, between 10h00-13h00, during the weeks of data collection. The selected clinics were contacted beforehand to determine the most suitable day during the selected weeks for visiting. On each day of data collection, all children aged 6 - 60 months attending the particular clinic that day with their mothers/caregivers were selected by means of purposive sampling, after they had been seen by a PHC nurse practitioner in the clinic. The facility manager of each clinic in the study was also interviewed.

Data collection and analysis

All children were weighed on the clinic's scale (Masskot, Medway or UC-321 scale). Recumbent length was measured in children <36 months using a measuring board with a stationary head and movable footboard, while a stadiometer was used for older children. Weight was measured to the nearest 0.1 kg and height to the nearest 0.1 cm.²⁵

After the children had been seen by the nurse practitioner, Road to Health Cards (RTHCs) and clinic notes were consulted to determine which children in the study population had received vitamin A on the day of the study, the doses administered, and to record the child's underlying clinical condition (Part One of the questionnaire). Children who received vitamin A supplementation on the day of the study, according to the indications of the provincial criteria, were denoted as 'used opportunities' for supplementation, and the reason for the supplementation was recorded (i.e. preventive or curative). Children qualifying for vitamin A supplementation on the day of the study but who did not receive a dose of vitamin A were denoted as

'missed opportunities'. Identified 'missed opportunities' were referred back to the nurse practitioner with the recommendation to administer vitamin A. Children who did not qualify for supplementation on the day of the study were also identified.

Fieldworkers conducted a structured exit interview (Part Two of the questionnaire) with the mother/caregiver of each child to assess her awareness of the vitamin A supplementation programme and growth monitoring. The mother/caregiver was also questioned about the child's health over the preceding 3 months.

Fieldworkers completed questionnaires for 71 children-and-mother/caregiver pairs. Children <6 months of age were excluded because the vitamin A supplementation criteria differed, depending on whether a child was breastfed or formula-fed during the first 6 months of life. Children with vomiting illness and those whose mothers did not consent to participating in the study were also excluded. Fourteen children had to be excluded at the time of data processing because of criteria violations. One child was also excluded because the date of birth had not been noted in the questionnaire. Therefore, the final study population used in data analysis comprised 56 children from the 14 clinics.

Additionally, the health facility manager or deputy manager of each clinic was interviewed about the procedure for vitamin A supplementation. The questionnaire addressed the extent and impact of training given to PHC nurse practitioners on the implementation of the vitamin A supplementation programme, the availability of vitamin A capsules in the clinics, difficulties experienced by PHC nurse practitioners regarding the supplementation programme, and the recording of vitamin A supplementation statistics on the RTHCs.

Data were captured and analysed using Microsoft Excel 2000 and Statistica 7.1, with the assistance of a statistician. Descriptive statistics were used to report the results. A *p*-value of <0.05 was regarded as statistically significant. The Mann-Whitney *U*-test was used to determine whether there were statistically significant differences between the birthweights of boys and girls. NutStat, a component of Epi-info version 3.3.2, was used to analyse the nutritional status of the children. Regarding anthropometry, underweight, wasting and stunting were expressed as the proportion of individuals with a Z score of <-2 SD below the median of the reference values of the Centre for Disease Control (CDC).²⁷

The study protocol was submitted to the Committee of Human Research of Stellenbosch University (SU) for ethics approval (project number N05/04/058). The standard informed consent form used by the Faculty of Health Sciences, SU, was adapted for the study.

Results

Demographic status, anthropometry and reasons for clinic attendance of study population

A total of 56 children were included in the study: 25 boys (45%) and 31 girls (55%). Their mean age was 22.1 (SD 14.36) months. The mean birthweight of the children for whom data were available (*N*=54) was 3 015 (SD 702) grams. The mean birthweight of the boys (*N*=23) was 3 081 (SD 770) grams and did not differ significantly from that of the girls (*N*=31), which was 2 967 (SD 657) grams (*p*=0.92). Twenty per cent of the children (*N*=11) had been low-birthweight babies.

Of the study population, 8.9% of the children (*N*=5) were stunted (height-for-age Z-score <-2 SDs); 10.7% (*N*=6) were underweight (weight-for-age Z-score <-2 SDs); and 3.6% (*N*=2) of the children were wasted (weight-for-height Z-score <-2 SDs) (Fig. 1). There were no recorded cases of kwashiorkor or night blindness in the study population.

Growth monitoring was the main reason given for clinic attendance (46.4%, *N*=26). Of the 56 children in the study, 96.4% of the mothers (*N*=54) said that their child had been weighed by clinic personnel on the day of the study. Weights were not plotted on RTHCs in the case of 2 (3.6%) of the children. Of the mothers interviewed, only 26.8% (*N*=15) reported that they had been given feedback on their child's growth. The other main reasons for attending the clinic were immunisation (19.6%, *N*=11) and illness or infections (8.9%, *N*=5) (Fig. 2).

None of the mothers/caregivers reported that their child was HIV-positive (there were no records to verify this), while 5% of the population (*N*=3) had tuberculosis. Twenty-one per cent (*N*=12) of the mothers reported that their child had had recurrent diarrhoea (>1 episode of watery, loose stools in 24 hours over the past 3 months). Of these children, 67% (*N*=8) were brought to the clinic at least once for this problem. Only 1 mother mentioned the problem to the clinic nurse on the day of the study, and only 2 mothers were asked by the nurse about diarrhoeal illness on the day of the visit. Fifty-two per cent of mothers (*N*=29) reported that, during the

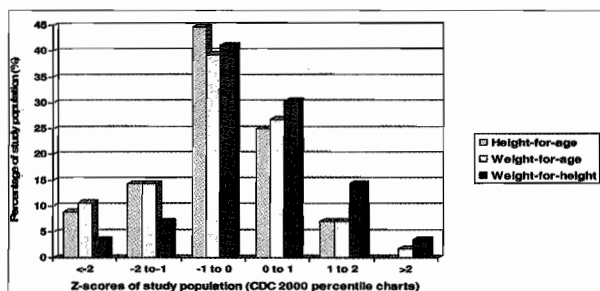


Fig. 1. Anthropometric parameters distribution using Z-scores (*N*=56).

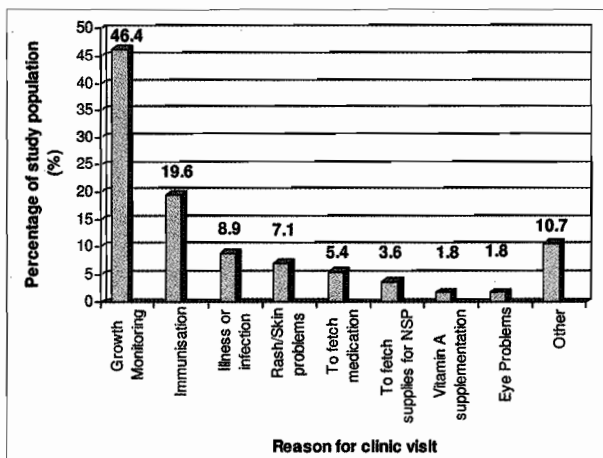


Fig. 2. Primary reason for clinic attendance in the study population (N=56).

past 3 months, their child had been coughing severely enough to warrant medical attention. Of these children, 82% (N=24) were brought to the clinic at least once for this problem. Whereas 45% (N=13) of the mothers whose child had presented with a cough or illness in the past 3 months mentioned the problem to the nurse on a clinic visit, only 38% (N=5) of these mothers reported that attention had been given to the problem on that day.

Administration and recording of vitamin A supplementation

Four children (7.1%) were not included in this section of data analysis because information regarding the indications for vitamin A supplementation and the dose given was incomplete. Sufficient information was available to assess whether vitamin A was correctly administered in 52 (93%) of the children in the study population. Twenty-one per cent (N=11) of the latter children had received a high-dose vitamin A supplement less than 6 months prior to the day of the study (as documented in their RTHC or clinic notes) and therefore did not qualify for another dose on the day of the study. One child in the study population received vitamin A on the day of the study, although, according to data available, the child did not qualify for a dose based on the vitamin A supplementation protocol. In total, 40 children were to have received vitamin A on the day of the study. Table I depicts the numbers and percentages of children who qualified

to receive vitamin A supplementation and those who actually received a dose on the day of the study. The reason(s) for these missed opportunities could not be determined from information in the children's files. Overall, therefore, it appears that 1 out of 4 children who qualified for vitamin A supplementation according to the provincial vitamin A supplementation protocol, did not receive it on the day of the study.

Currently, there are 3 types of vitamin A capsule (50 000, 100 000 and 200 000 IU) available for supplementation at clinics.²³ The administration and dose of vitamin A was correctly documented on the RTHC of 97% (N=29) of children who received it on the day of the study.

Mothers' awareness of the vitamin A supplementation programme

All 56 children were included in this section of data analysis. Only 39% (N=22) of interviewed mothers reported that they knew about the programme at the time of the interview. Twenty-four of the mothers (43%) were either under the impression that their child had never received, or were unsure of whether their child had received, vitamin A previously. Only 5.4% (N=3) of mothers were able to give a reason why vitamin A was given to their child. These included either 'to protect the child from illness' or 'because the child was ill'.

Interviews with PHC facility managers

At the time of the study, there were 44 nurse practitioners working at the health facilities concerned, of whom 93% (N=41) had received vitamin A supplementation training from the regional dietitian.

All the health facility managers interviewed (N=14) reported that only registered nurse practitioners administered vitamin A at their clinics, which was in accordance with Department of Health regulations.²³ Approximately 1 in 3 (36%) health facility managers reported that they had not experienced any problems in implementing the programme. The balance of managers (64%) identified a number of constraints in the implementation of the programme. Health facility managers were free to mention more than one area of constraint; these have been grouped according to core issues for the purpose of presenting the data in Fig. 3.

Table I. Total numbers and percentages of children who qualified for and who actually received vitamin A supplementation on the day of the study

	Children qualifying for vitamin A	Children who received vitamin A	Missed opportunities
Preventive dose	33 (82.5%)	27 (67.5%)	6 (15%)
Curative dose*	7 (17.5%)	3 (7.5%)	4 (10%)
Totals	40 (100%)	30 (75%)	10 (25%)

*Indications for a curative dose of vitamin A supplementation in this study included growth faltering and persistent diarrhoea.

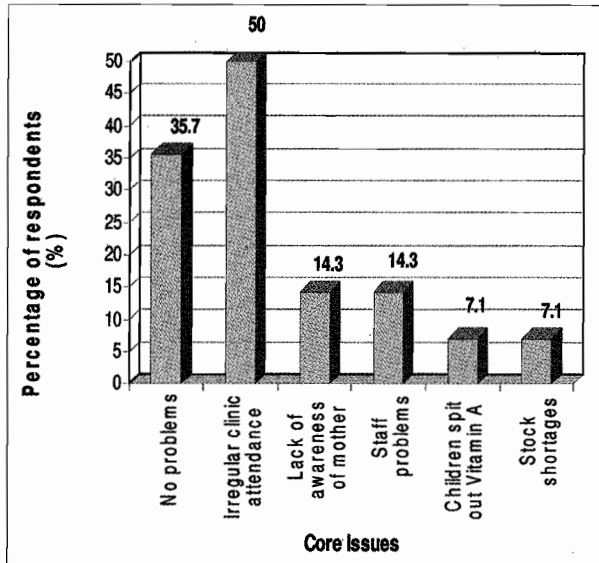


Fig. 3. Constraints in the implementation of the vitamin A supplementation programme as identified by facility managers (N=14).

When the health facility managers were asked specifically about stock availability, 71% of them (N=10) had not experienced any problems with availability of vitamin A capsules at their clinics. Twenty-nine per cent (N=4) reported that there had been occasions when there was no vitamin A stock at their clinic. Identified constraints included:

- capsules expiring before consumption (N=1)
- poor availability of the 50 000 IU capsules (N=1)
- stock not received due to low stocks at the depot (N=1)
- staff not yet accustomed to the programme (N=1)
- insufficient supply of vitamin A capsules in general (N=1).

At 71% of the clinics (N=10), the facility manager compiled the statistics on vitamin A supplementation at the clinic. At 2 clinics (14%), a designated nurse practitioner was responsible for completing the clinic health statistics, while at the other 2 clinics, each nurse practitioner compiled the statistics (14%), which were checked by the health facility manager each month before submission to the regional office of the Department of Health.

Statistics were: collected daily and summarised monthly by 43% of the clinics (N=6), collected and summarised daily by 36% (N=5), and collected daily and summarised weekly by 7% (N=1) of the clinics. At 2 (14%) of the clinics, statistics were kept monthly. Fig. 4 depicts in which clinic vitamin A supplementation was recorded as reported by facility managers. On 3.6% (N=2) of the RTHCs of children in the study, no mention was made of a vitamin A supplement even though the latter had been dispensed.

Health facility managers made the following suggestions for improving the programme:

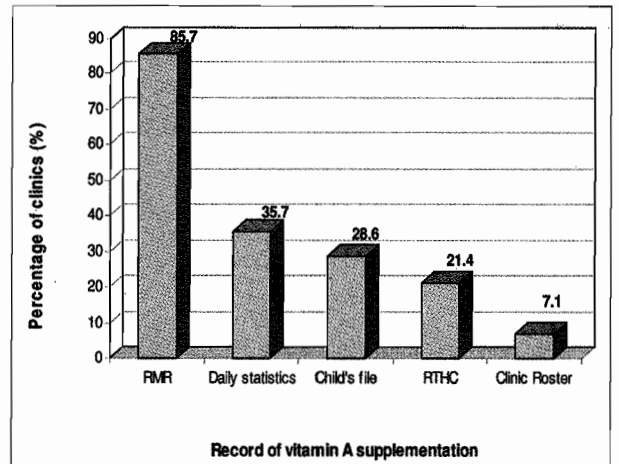


Fig. 4. Percentage of clinics documenting vitamin A supplementation by clinic records (N=14). (RMR = Routine Monthly Report; RTHC = Road-to-Health Card.)

- employ more qualified staff members (N=3)
- train more health staff members (N=2)
- allow other clinic staff members to administer vitamin A (N=2)
- health promotion in local communities, such as vitamin A campaigns, posters, regular talks and arranging 3 - 6-monthly visits to local crèches (N=4).

Discussion

In this study, 75% of the children who were eligible for vitamin A supplementation on the surveyed days, received it. This is as good as, or better than, the national average coverage rates reported for the other provinces (72.8% and 13.9% for children aged 6 - 11 months and 11 - 59 months respectively during the period April 2004 - March 2005).²⁸ However, it is still short of the target for 2007 set by the Department of Health, aiming at 80% coverage for children of 12 - 59 months.²⁹ The high rate of missed opportunities for vitamin A supplementation in our study population is of concern, implying that if the practices observed in this study are representative, large numbers of children are being omitted from vitamin A supplementation, despite the recommendation of the provincial Department of Health that all eligible children be screened at each clinic visit to see if a dose of vitamin A is indicated.¹⁷

Persistent diarrhoea appeared to have been a common problem in this study population. Since vitamin A supplementation has been shown to be associated with a reduction in the mortality risk in children with diarrhoea,⁶ the missed opportunities for such supplementation assumes even greater significance. The prevalence of colds and coughs also appeared to be high in this group, as reported by the mothers/caregivers of the children; however, current research does not support vitamin A supplementation as being beneficial in children with non-measles-related respiratory tract infections.^{9-13,30}

Many of the mothers/caregivers interviewed in this study were unaware of the vitamin A supplementation programme. Irregular clinic visits and poor clinic attendance after 18 months may lead to many children not receiving the 6-monthly vitamin A doses. Only one mother reported that she was specifically bringing her child to the clinic for vitamin A supplementation. Therefore, making mothers more aware of the benefits of vitamin A for their children could reduce the number of missed opportunities for supplementation and further motivate them to specifically request vitamin A for their children.

On the basis of the findings of the present study, it would appear that more attention needs to be paid to the monitoring and documentation of the vitamin A programme. Only 21% of the nurse practitioners interviewed reported that they recorded the vitamin A administered on the child's RTHC. Documentation of vitamin A supplementation is important to ensure that doses are given when required and to prevent over-dosage and possible toxicity. Provincial guidelines require that the vitamin A dose be noted in the following documents: the RTHC, the clinic folder, the Routine Monthly Report (RMR), and the Malnutrition Register in the case of children on the nutritional supplementation programme.¹⁷ From the results of this study, it appears that this is not always done. However, these findings must be put into perspective against the high workload as well as the other statistics that need to be collected at clinics. Merging the statistical forms for vitamin A administration may reduce the time taken to document statistics daily, thus reducing the overall workload.

Deficiencies in both human and material resources appear to be another core issue in the implementation of this programme. Although South Africa does not have a critical shortage of health care workers, according to the WHO, there is a definite shortage of qualified nursing staff in some regions.³¹ Currently, only registered doctors and nurse practitioners may administer high-dose vitamin A, according to the Pharmacy Act. Dietitians even are not allowed to administer high doses of vitamin A at this stage, although the National Nutrition Directorate is considering the possibility of enabling them to do so. Therefore, ongoing training of nurse practitioners is essential to ensure the effective administration of this programme. All nurse practitioners need to be trained as soon as possible after induction. Furthermore, the authorities at provincial and regional level who are responsible for procurement of vitamin A capsules should ensure that sufficient stock is available to be distributed to clinics at all times. Good stock control practices should be applied at clinic level to ensure sufficient stock and prevent the expiry of stock, which is another resource-demanding task. Maintaining accurate statistics is essential for good programme management, as it facilitates stock control and also helps to evaluate the effect of the programme.

A comprehensive approach should be taken when informing communities about the benefits of vitamin A. Dietary sources of vitamin A and fortified foods should be promoted.³² Exclusively breastfeeding up to 6 months is already being promoted in communities, and mothers should be encouraged to include appropriate complementary foods around 6 months, with continuing breastfeeding up to 2 years of age and beyond.^{33,34} Health promotion throughout communities at risk can raise awareness of the importance of vitamin A. This could involve visits to crèches and promotion days in local shopping centres and at local clinics. The benefits of integrating vitamin A supplementation programmes with existing programmes have been identified in other studies.^{15,32,35}

As growth monitoring is the most common reason for clinic visits in this and similar study populations, encouraging regular growth monitoring could lead to more clinic visits and indirectly more opportunities for vitamin A supplementation. Identifying children who are growth-faltering or underweight, and supplementing them according to the vitamin A supplementation protocol, is essential.

The percentages of underweight and wasted children in the study population correspond with national data from the SAVACG¹⁴ and National Food Consumption Survey (NFCS),³⁶ of 10% and less than 5%, respectively, despite the small sample population. The national figure for stunting (23%) was higher than that found in the study population. There were no recorded cases of kwashiorkor or night blindness in the study population, although this might have been misdiagnosed. However, the national data also indicate a low prevalence of eye signs of vitamin A deficiency.

The small sample population of this study, as well as self-reporting of some health data, can be viewed as limitations of the study. However, the study supplied important information on the critical issue of micronutrient malnutrition control, and it revealed some detail pertaining to the current status of the vitamin A supplementation programme in one of the rural regions of the Western Cape.

To conclude: 75% of the children who were eligible for vitamin A supplementation on the day of the study received it. This small-scale study, despite its limitations, would appear to indicate that informing mothers about the importance of vitamin A supplementation and regular clinic attendance may increase coverage. Improvements in the availability of resources (human and material), continuous training, and logistic support can further improve what appears to be a reasonably successful programme in the geographical area of the present study. Further such studies are needed, but on a larger scale, to define the success of the vitamin A supplementation programme at the provincial/national level. Such future studies should also include the supplementation coverage of children <6 months of age.

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1. West KP Jr. Extent of Vitamin A deficiency among preschool children and women of reproductive age. *J Nutr* 2002; 132: 2857S-2866S.
2. Potter AR. Reducing vitamin A deficiency could save the lives of countless children. *BMJ* 1997; 314: 317-318.
3. Nutrition for Health and Development. *Turning the Tide of Malnutrition: Responding to the Challenge of the 21st Century*. Geneva: World Health Organization, 2000.
4. Collier J. *Oxford Handbook of Clinical Specialities*. Oxford: Oxford University Press, 1999: 512.
5. Fawzi WW, Chalmers TC, Hererra MG, Mosteller F. Vitamin A supplementation and child mortality – A Meta-analysis. *JAMA* 1993; 269(7): 898-903.
6. Beaton GH, Matorell R, Aronson KJ, et al. *Effectiveness of Vitamin A Supplementation in the Control of Young Child Morbidity and Mortality in Developing Countries*. WHO, ACC/SCN State-of-the-Art Series Nutrition Policy Discussion Paper No. 13. Geneva: World Health Organization, 1993.
7. Hussey GD, Klein M. A randomised, controlled trial of Vitamin A in children with severe measles. *N Engl J Med* 1990; 323: 160-164.
8. Barclay AIG, Foster A, Sommer A. Vitamin A supplements and mortality related to measles: A randomised clinical trial. *BMJ* 1987; 294: 294-296.
9. Kjolhede CL, Chew FJ, Gadomski AM, Marroquin DP. Clinical trial of Vitamin A as adjuvant treatment for lower respiratory tract infections. *J Pediatr* 1995; 126: 807-812.
10. Nacul LC, Kirkwood BR, Arthur P, Morris SS, Magalhaes M, Fink MC. Randomized, double blind, placebo controlled clinical trial of efficacy of Vitamin A treatment in non-measles childhood pneumonia. *BMJ* 1997; 315: 506-510.
11. Fawzi WW, Mbise RL, Fataki MR, et al. Vitamin A supplementation and severity of pneumonia in children admitted to the hospital in Dar es Salaam, Tanzania. *Ain J Clin Nutr* 1998; 68: 187-192.
12. Stephensen CB, Franchi LM, Hernandez H, Campos M, Gilman RH, Alvarez JO. Adverse effects of high-dose vitamin A supplements in children hospitalised with pneumonia. *Pediatrics* 1998; 101: e3.
13. Fawzi WW, Mbise R, Spiegelman D, Fataki M, Hertzmark E, Ndosi G. Vitamin A supplements and diarrhoeal and respiratory tract infections among children in Dar es Salaam, Tanzania. *J Pediatr* 2000; 137(5): 660-667.
14. *Children Aged 6-17 Months in South Africa; their Anthropometric, Vitamin A, Iron and Immunisation Status*. Isando: South African Vitamin A Consultative Group (SAVACG), 1995.
15. Underwood BA. Vitamin A prophylaxis programs in developing countries: past experiences and future prospects. *Nutr Rev* 1990; 48(7): 265-272.
16. *Guidelines for the Implementation of Vitamin A Supplementation*. Pretoria: National Department of Health, Nutrition Directorate, 2004.
17. Vitamin A supplementation in Health Facilities of the Provincial Government of the Western Cape, Circular No. H 29/2005. Cape Town: Provincial Department of Health, Western Cape, 2005.
18. Le Jeune SRE, Ross D, Shetty PS. Vitamin A deficiency and infection with human immunodeficiency virus: what is the immunological evidence? *Nutrition Research* 1996; 16(8): 1437-1450.
19. Semba RD, Ndugwa C, Ferry RT, et al. Effect of periodic Vitamin A supplementation on mortality and morbidity of human immunodeficiency virus-infected children in Uganda: a controlled trial. *Nutrition* 2005; 21: 25-31.
20. Villamor E, Fawzi WW. Effects of Vitamin A Supplementation on immune responses and correlation with clinical outcomes. *Clinical Microbiology Reviews* 2005; 18(3): 446-464.
21. Villamor E, Mbise R, Spiegelman D, et al. Vitamin A supplements ameliorate the adverse effects of HIV-1, malaria, and diarrhoeal infections on child growth. *Pediatrics* 2002; 109(1).
22. Coutsooudis A, Bobat RA, Coovadia HM, Kuhn L, Tsai WY, Stein ZA. The effects of Vitamin A supplementation on the morbidity of children born to HIV-infected women. *Am J Publ Health* 1995; 85(8): 1076-1081.
23. Filteau SM, Rollins NC, Coutsooudis A, Sullivan KR, Willumsen J, Tomkins AM. The effect of antenatal vitamin A and beta-carotene supplementation on gut integrity of infants of HIV-infected South African women. *J Pediatr Gastroenterol Nutr* 2001; 32: 464-470.
24. Shung King M, Mhlanga RE, De Pinho H. The context of maternal and child health. Chapter 7. *South African Health Review* 2006. <http://www.hst.org.za/publications/697> (accessed 12 April 2007)
25. Lee RD, Nieman DC. *Nutritional Assessment*. 3rd ed. London: McGraw Hill, 2003: 163-215.
26. Hendricks M, Beardsley J, Mzamo B, Bourne L, Goeman H, van Niekerk L. *An Evaluation of the Vitamin A Supplementation Programme at Primary Health Care Clinics in the Western Cape Province*. Cape Town: School of Child and Adolescent Health, University of Cape Town, 2006.
27. Ogden CL, Kuczmarski RJ, Flegal KM, et al. Centers for Disease Control and Prevention 2000 Growth Charts for the United States: Improvements to the 1977 National Center for Health Statistics Version. *Pediatrics* 2002; 109(1): 45-60.
28. Vitamin A Supplementation: Train the Trainer Course, 2005 (unpublished data). Pretoria: Department of Health, United States Agency for International Development (USAID), 2005.
29. *Integrated Nutrition Programme: Strategic Plan 2002/03 to 2006/07*. Pretoria: National Department of Health, Directorate Nutrition, 2002.
30. Grotto I, Mimouni M, Gdalevich M, Mimouni D. Vitamin A supplementation and childhood morbidity from diarrhoea and respiratory infections: A Meta-analysis. *J Pediatr* 2003; 142: 297-304.
31. *World Health Report 2006: Working Together for Health*. Geneva: World Health Organization, 2006.
32. Villamor E, Fawzi WW. Vitamin A supplementation: Implications for morbidity and mortality in children. *J Infect Dis* 2000; 182 (Suppl. 1): S122-133.
33. *The Optimal Duration of Exclusive Breastfeeding. Report of an Expert Consultation. 28-30 March 2001*. Geneva: World Health Organization, Department of Nutrition for Health and Development, Department of Child and Adolescent Health and Development, 2001.
34. *Child and Adolescent Health, Progress Report 2000-2001*. Geneva: World Health Organization, Department of Child and Adolescent Health and Development, 2006. http://www.who.int/child-adolescent-health/NewPublications/Overview/WHO_FCH_CAH_02.19.pdf (accessed 10 January 2006).
35. Saitowitz R, Hendricks M, Fiedler J, le Roux I, Hussey G, Makan B. A proposed vitamin A supplementation programme for South Africa – design, coverage and cost. *S Afr Med J* 2001; 91(9): 755-760.
36. Labadarios D, ed. (Supported by: Steyn N, Maunder E, MacIntyre U, Swart R, Gericke C, Huskisson J, Dannhauser A, Vorster HH and Nesamvuni AB). *The National Food Consumption Survey (NFCS): Children Aged 1-9 Years, South Africa, 1999*. Pretoria: Department of Health, 2000.