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XEROPHTHALMIA AND TRACHOMA
IN BURKINA FASO, CHAD, MALI, AND NIGER

1986

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FOREWORD

Severe drought combined with economic, social and political upheavals has once again devastated large expanses of Africa. Millions are suffering. Thousands of children have died of malnutrition and disease. Among the survivors, many have been harmed irreparably. Prolonged hunger has stunted their growth and development; widespread deprivation of the essential nutrient vitamin A has robbed many of their sight.

Helen Keller International's objective in undertaking the rapid assessments described in this volume was to determine the extent to which blinding vitamin A deficiency had spread across the drought-stricken Sahel countries. The surveys clearly demonstrate that severe vitamin A deficiency is, and has been, a constant threat in that region. But it is not enough to have determined that thousands of children are in imminent danger of going blind. Thus, we do not see these surveys as an end in themselves. Their true importance lies in their instrumentality for the development of active, targeted nutritional blindness prevention programs.

In sum, these assessments are only the first step toward our goal of saving children's sight. We, who are partners in the community of concerned individuals, international health organizations, and governments, must now act together in order to prevent this needless cause of blindness in children.

Finally, and regrettably for those children who are already permanently blind, we hope that information gathered through these surveys may prove helpful in planning long-range education and rehabilitation strategies for the region.

HKI wishes to acknowledge with deep appreciation the financial assistance of the Agency for International Development, U.S. Department of State (USAID) and the United Nations International Children's Emergency Fund (UNICEF), and the helpful collaboration of the World Health Organization (WHO), Cooperative for American Relief Everywhere (CARE), and Medecins sans Frontieres.

JOHN M. PALMER, III
Executive Director
Helen Keller International

New York, February 1987

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SUMMARY

INTRODUCTION

Xerophthalmia, the leading cause of blindness in children, is found in many parts of Asia, Africa, and Latin America. The disease is strongly associated with malnutrition, diarrhea, measles, and infections of the respiratory or urinary tracts in young children.

Helen Keller International with experience gained from blindness prevention work with Kampuchean refugees in 1979, realized that children of displaced, starving populations were at high risk of developing xerophthalmia (the dry eyes and subsequent stages of nutritional blindness that are the first clinical signs of vitamin A deficiency).

Countries in the Sahelian zone of Africa experience periodic drought famine. The most recent devasting drought beginning in 1982, and which peaked in 1983, resulted in the deaths of thousands, and precipitated blindness caused by malnutrition. Concerned that drought in the horn of Africa placed children there at high risk of vitamin A deficiency, HKI dispatched a team to Sudan and Ethiopia in January 1985 to perform a rapid evaluation of the situation. High rates of xerophthalmia were observed and reported, resulting in the initiation of emergency intervention activities. In some groups up to 10 percent of the children had one of the overt signs of active xerophthalmia.(1) Trachoma also proved highly prevalent. HKI organized medical teams to return to Ethiopia and Sudan later that year to conduct further surveys and provide training and delivery of services (vitamin A and tetracycline) to the affected population.

As a consequence of these findings, HKI decided to collect data to determine whether xerophthalmia and trachoma posed public health problems in these countries as well as in other African countries, including Burkina Faso, Chad, Mali, and Niger, which were presumed to suffer similarly from the drought. An advance HKI team set the groundwork in the fall of 1985. Assessments were conducted between February and May 1986, the key results of which are presented in this report.

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1. Pizzarello, L.D. "Xerophthalmia Rates in Children in Ethiopia and Sudan," Am. J. Ophthal. 99:734-735, 1985.

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The goal of these assessments was to gather and present data to be used by governmental and non-governmental program planners and policymakers to structure prevention and treatment programs where needed.

Each survey was conducted by a team comprising an HKI team leader and consultant ophthalmologist, and health professionals representing the country's Ministry of Health, international private voluntary organizations, and/or United Nations organizations.

Rapid assessment implies a relatively inexpensive method which quickly provides a description of a condition of interest by which public health action and, to some extent, policy can be determined. This type of assessment is therefore particularly useful for epidemics and emergency (both acute and chronic) situations. Rapidity and efficiency are gained at the expense of sample size and selection and, therefore, potential representativeness. They provide, however, a rough gauge of the situation. If xerophthalmia is sufficiently severe, and is consistently encountered (as in these countries), it is likely to be significant and an important problem in the region.

HKI developed a methodology for the rapid assessment of the prevalence of xerophthalmia and trachoma in four chronically drought-stricken countries in West Africa. The assessments were based upon the assumptions that 200 children could be examined daily, and that a multi-stage, stratified sample of 2,000 children would be adequate to determine the prevalence of xerophthalmia in the region suspected to be at high risk of vitamin A deficiency. The methodology specified sampling based on the proportional representation of both urban and rural populations. Thus, the survey focused on the vaster rural areas.

Where census data were available, lists of provincial towns and villages were utilized to select a random sample of survey sites. As urban areas constitute a relatively small proportion of the population, only one urban site was randomly selected from all potential sites in each country. The number of rural sites chosen per province was determined to provide proportional representation of each province. Urban sites were defined as areas with $\geq$5,000 inhabitants; all other sites were categorized as rural. Villages with less than 600 inhabitants were excluded from the selection process based upon the assumption that 33 percent of the population is under 11 years of age and thus these villages would not yield a minimum child population of 200.

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The decision to include children over age five in the survey was made based upon the fact that older children in Ethiopia and Sudan were found to have active xerophthalmia.

Due to the survey tempo (the teams visited one or more villages per day) no household enumeration was conducted. Villagers were informed of the survey by local leaders and gathered in a central location. Where the child population exceeded 200 per village, informal stratificaton by position in line and/or by age group (0 to 1, 1 to 5, 6 to 10) was attempted.

Data collection consisted of five components: community survey, individual survey, anthropometric measurements, ocular exam, and delivery of vitamin A and tetracycline eye ointment. Demographic, public health, and nutritional information was gathered for each community surveyed through interviews with village leaders, including chiefs, midwives, schoolteachers, and other knowledgeable informants. Similar information was gathered for each sample child from interviews with an older person (usually the mother) who accompanied the child to the examination site.

Mid-upper arm circumference (MUAC) was measured utilizing insertion tapes on every fifth child examined (except in Mali where MUAC was measured on a 5 percent sample) and on all children clinically diagnosed to have xerophthalmia. Age and sex specific standards from the National Center for Health Statistics (NCHS) were applied to categorize MUAC as less than or greater than/equal to the 10th percentile, providing a dichotomous indicator of nutritional status. All sample children were examined for signs of xerophthalmia and trachoma (except in Niger where approximately 50 percent of children examined at each site were not examined for trachoma). All children examined (and often all children in the site) received a vitamin A capsule (200,000 International Units [IU]); all cases of clinically evident vitamin A deficiency and trachoma were provided standard treatment.(1) (Vitamin A capsules were donated by F. Hoffmann-La Roche.) Caretakers were instructed in the continuation of this treatment.

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1. WHO, Control of Vitamin A Deficiency and Xerophthalmia. World Health Organization, Technical Report Series 672, Geneva, 1982.

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Survey results are presented in the summary sheet for Burkina Faso, Chad, Mali, and Niger, and separately for each country in the following sections of this report. Each section presents results for the entire sample, and by province stratified by urban and rural status (or population group). All results are presented by age groups (0 to 5 years and 6 to 10 years) to allow for comparison with WHO criteria and other studies. Results by sex are also presented.

No statistical tests comparing the prevalence of xerophthalmia to the WHO classification were conducted as the WHO standards contain no confidence limits, but are merely a criteria for threshold values. If the prevalence of xerophthalmia is found to be greater than these threshold values, then it is deemed to be a public health problem.

Grades of xerophthalmia and trachoma were categorized by the following definitions:

<u>Xerophthalmia</u>

XN Night blindness reported by caretaker or ophthalmologist

X1B Bitot's spots

X2 Corneal xerosis or epithelial erosion

X3 Corneal ulceration, keratomolacia, descemetocele or perforation

XS Leucoma or adherent leucoma, staphyloma, or bulbar pthisis (only that associated with vitamin A deficiency and/or measles)

<u>Trachoma</u>

mild F2, F1 or P1, i.e., any sign of abnormality due to trachoma except F3, P2, or P3 (see below)

moderate Any F3 or P2 (F3 = five or more follicles in each of the three zones of the everted upper eyelid; or P2 = more prominent papillae, normal vessels appear hazy)

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severe	Any P3 (pronounced papillae with thickened and opaque conjunctiva)(2)

Children with active xerophthalmia were categorized by their most severe condition (i.e., grades of xerophthalmia are categorized as mutually exclusive and are thus additive).(3) Corneal scars resulting from vitamin A deficiency or measles are reported separately from active signs of xerophthalmia. Thus, both active and inactive signs are recorded for all children with clinical vitamin A deficiency. Children with trachoma were similarly categorized by severity of the condition. Xerophthalmia and trachoma were coded separately as independent variables.

The dissemination of these findings enables members of the international health community to be informed of the threat of vitamin A deficiency during the periodic droughts and famine plaguing countries in the Sahel of Africa. The provision of vitamin A supplementation not only protects children from nutritional blindness, but reduces the incidence and severity of diarrhea and respiratory disease, and consequently may prevent deaths precipitated by these diseases. HKI strongly recommends that organizations include vitamin A in any relief package.

HKI acknowledges with gratitude the contributions of numerous individuals and organizations throughout the planning and implementation of these surveys: the Ministry of Health in Burkina Faso, Chad, Mali, and Niger; UNICEF and USAID, which provided financial and logistical support; and CARE and Medecins sans Frontieres. Omofolasade Kosoko, M.D., M.P.H, Rogers Pierson, M.D., and Serge Resinkoff, M.D.; Celine Rousseau M.D., was consultant pediatrician; and Louis D. Pizzarello, M.D., M.P.H, and Alfred Sommer, M.D., M.P.H served as medical advisors. Ross Laboratories donated mid-upper arm measuring tapes, and supplies of vitamin A capsules came from F. Hoffmann-La Roche & Co. Ltd. for use during the surveys as well as and in the emergency interventions in Ethiopia and Sudan.

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2. Dawson, C.R., Jones, B.R., Tarizzo, M.L. Guide to Trachoma Control. World Health Organization, Geneva, 1981.

3. Night blindness was elicited only for children 2 to 10 years of age. While each community had a specific local term to connote this condition, it is a symptom and therefore a subjective measure, and assumed to be a less reliable indicator of vitamin A status than clinical signs.

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RESULTS

The results of these surveys indicate that xerophthalmia is a prevalent problem throughout the area. The reported rates of night blindness and the observed level of ocular signs of active xerophthalmia indicate severe ongoing vitamin A deficiency in Burkina Faso, Chad, and Niger. The rates of ocular signs observed in the surveyed area in these three countries surpassed the WHO criteria for constituting a public health problem. In Mali, the few ocular signs of active xerophthalmia found in a displaced persons camp suggest this population group or these individuals to be at high risk. An excess prevalence of corneal scars was found in all four countries, particularly in Chad and Mali, and reflects past acute vitamin A deficiency.

Trachoma was also found to be a widespread problem. Significant levels of potentially blinding trachoma (moderate and severe inflammation) exist to warrant interventions as part of primary health care activities in all four countries.

Helen Keller International, an American private voluntary agency with extensive experience in the field of blindness prevention, recommends that countries with evidence of chronic vitamin A deficiency (Burkina Faso, Chad, and Niger) introduce vitamin A supplementation programs for the general preschool-age population, which is at greatest risk of blindness, disease, and death. Countries with high rates of active ocular disease for older children--Burkina Faso and Chad--may wish to consider prophylactic vitamin A distribution to older children, although this group has slower growth rates and is less vulnerable to blindness, disease, and death than younger children. In Mali, HKI recommends that vitamin A capsules (200,000 IU) be made available in general and particularly in specialized health facilities and nutrition centers. The introduction of xerophthalmia surveillance is also recommended to facilitate early detection of nutritional blindness as periods of acute food shortage arise.

SUMMARY: AFRICA PREVALENCE SURVEYS - SURVEY PROVINCES CHOSEN FROM SAHELIAN AREAS

	Burkina Faso	Chad	Mali	Niger
DATE OF SURVEY	2/17/86-2/26/86	3/13/86-3/22/86	4/15/86-4/24/86	5/20/86-5/30/86
TOTAL COUNTRY POPULATION	6,600,000	4,800,000	7,600,000	5,800,000
POPULATION EXAMINED	2035	1711(1)	1786(1)	1999
AGED				
2-5	817 (40.1%)	781 (45.7%)	930 (52.1%)	957 (47.9%)
<6	1103 (54.2%)	1044 (61.0%)	1238 (69.3%)	1388 (69.4%)
≥6	932 (45.8%)	665 (38.9%)	537 (30.1%)	611 (30.6%)
METHODOLOGY	Village: random sample, 10 sites	Village: non-random selection, 14 sites	Village: non-random selection, 16 sites	Village: random sample, 10 sites
KEY FINDINGS				
Xerophthalmia - Aged <6				
XN(2)	23 (2.82%)	17 (2.18%)	60 (6.45%)	38 (3.97%)
X1B	3 (0.27%)	5 (0.48%)	0 (0.00%)	10 (0.72%)
X2	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (0.07%)
X3	2 (0.18%)	0 (0.00%)	1 (0.08%)	2 (0.14%)
XS(3)	1 (0.09%)	4 (0.38%)	5 (0.40%)	3 (0.22%)
Trachoma - Aged <6				
Mild	136 (12.33%)	46 (4.41%)		118 (19.06%)(4)
Moderate	82 (7.43%)	192 (18.39%)	108 (8.73%)(5)	129 (20.84%)
Severe	16 (1.45%)	119 (11.40%)		18 (2.91%)
Xerophthalmia - Aged ≥6				
XN	22 (2.36%)	11 (1.65%)	51 (9.50%)	29 (4.75%)
X1B	20 (2.15%)	11 (1.65%)	1 (0.19%)	4 (0.65%)
X2	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
X3	0 (0.00%)	1 (0.15%)	0 (0.00%)	0 (0.00%)
XS(3)	3 (0.32%)	6 (0.90%)	7 (1.30%)	5 (0.82%)
Trachoma - Aged ≥6				
Mild	95 (10.19%)	52 (7.82%)		31 (10.99%)(4)
Moderate	45 (4.83%)	51 (7.67%)	52 (9.68%)(5)	52 (18.44%)
Severe	7 (0.75%)	32 (4.81%)		3 (1.06%)

WHO CRITERIA FOR XEROPHTHALMIA <6

XN	>1.0%
X1B	>0.5%
X2/X3	>0.01%
XS	>0.01%

1. Includes children whose age is unknown.
2. Excludes children <2 years old.
3. All children with corneal scars presumed to be associated with vitamin A deficiency are included in this category, although those with active disease are also included in the most severe active category applicable.
4. First 44.6% children 0 to 5 and first 46.2% children 6 to 10 per village examined for trachoma in Niger. No children in urban site examined for trachoma in Niger. Rates reflect appropriate denominations. Universal examination of trachoma elsewhere.
5. Reported as a dichotomous variable.

CHAPTER 1

BURKINA FASO

INTRODUCTION

The assessment in Burkina Faso was conducted from February 17 to February 26, 1986 by a team composed of a public health specialist and a consultant ophthalmologist from Helen Keller International, survey and nutrition specialists of the Burkinabe Ministry of Health, and UNICEF's Food and Nutrition Program Officer (see APPENDIX I for team list). A stratified random sample of 2,035 children aged 0 to 10 were seen at 10 sites from the departments of Yatenga, Passore, and Sourou in northern Burkina Faso. The sex distribution of the sample population agreed with the expected values: 49.8 percent girls (n = 1013) and 50.2 percent (n = 1021) boys; one child's sex was not determined. The sample mean age was 66.2 ± 35.6 months (i.e., 5 1/2 years ± 3 years). The age distribution was: 54.2 percent (n = 1103) of the children 0 to 5 years of age, with slight underrepresentation of very young children (0 to 2 years, n = 462, 22.7 percent of total), and 45.8 percent (n = 932) 6 to 10 years of age. During the exam, children were accompanied by relatives or neighbors; 75.4 percent of the children were accompanied by their mothers.

DEMOGRAPHIC BACKGROUND

Information about the ten communities was elicited through interviews with village elders (village chiefs, midwives, local school teachers, or other knowledgeable informants). The average estimated population size of the nine rural sample sites was 2,268 ± 1,523. The principal ethnic group in the provinces of Yatenga and Passore is Mossi; Peulh and Marca are dominant in the province of Sourou.

The communities' sources of water (mostly covered wells with manual pumps) were within 2 km (most were under 500 meters) of the village. But some of the wells were already dry, despite the fact that the survey took place towards the beginning of the dry season, forcing the communities to search as far as 12 km for a secondary but viable water source. This problem was particularly evident in the

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village of Gonsin in Yatenga, and the two villages in Passore. Not surprisingly, these villages had higher rates of trachoma than most of the other sites.

Only one site (Lerry) had a medical facility (small dispensary) in the village itself. Other villages (including the urban neighborhood) were situated from 2 1/2 km to 15 km from the nearest clinic (average of 8.5 km, n = 9). However, "Vaccination Commando", the Burkina Faso vaccination campaign, had reached all villages surveyed. Half the sites had been vaccinated 12 or 13 months earlier, and the other half between 1 and 3 months earlier. Children were vaccinated against tetanus, measles, yellow fever, meningitis, and, in one site, tuberculosis. Of the survey sample population, 81 percent had received some form of vaccination.

Six sites had received some form of food aid over the last year, usually millet, sorghum, or other grains, and one village received medical aid as well.

The foods most commonly consumed in the village were reported as Baobab leaves*, gumbo*, beans, peas*, white millet, "petit mil," red sorghum, corn, peanuts, and kapot*. No information was obtained as to the amounts of food eaten, or the seasonal availability. All but 2 infants (98.96 percent) were breast fed for the first two years of life. No information on weaning foods was sought.

METHODOLOGY

Sample Selection

The departments of Yatenga, Passore, and Sourou were selected based upon the following criteria: they are located in the northern regions of Burkina Faso and are thus hypothesized to be at higher risk of xerophthalmia and trachoma; they are accessible; they have a sufficiently dense population; and UNICEF is active in the region of Yatenga and wished to know more about the vitamin A deficiency problem in that area.

The total population of these three departments hypothesized to be at high risk of xerophthalmia was obtained from the 1975 census of districts and villages supplied by the Ministry of Health. The number of rural sites selected for each province was ascertained to attain

* Vitamin A-rich sources.

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proportional representation for the total sample area (i.e., six sites were chosen from Yatenga since its population is slightly greater than that of Passore and Sourou combined). Rural villages were then chosen using standard random selection procedure. One urban area was selected at random from all potential urban locations in the survey area. The number of urban sites chosen (in this case one) was based upon the proportion of the population which was urban. One poorly serviced sector in the selected urban area was then selected non-randomly as the urban survey site.

Universal examination of children 0 to 10 was attempted in villages with $\leq$200 children. Informal stratification of children was conducted in larger villages by dividing the children who had gathered at a central location into four groups and examining the first 50 children in each group.

Data Collection

All sample children were examined for clinical signs of xerophthalmia and trachoma; every fifth child was measured for mid-upper arm circumference as were all children with clinical evidence of xerophthalmia. Information on night blindness was elicited using local words for the condition: "You Zondo" in More, "Souran Fie" in Marka, and "Toro Ye" in Samo.

RESULTS

Discussion

The total population surveyed in Burkina Faso consisted of 2,035 children of whom 1,103 (54.2 percent) were 0 to 5 years of age and 932 (45.8 percent) were 6 to 10 years old.

The distribution of clinical signs of xerophthalmia in children 0 to 5 years of age reflects a greater proportion of severe cases compared to older children who had proportionally higher rates of milder forms of active disease. Older children, however, had a higher rate of blinding sequelae, presumably from an accumulation of prior cases of corneal destruction.

This is consistent with the association traditionally observed between xerophthalmia and age.(1) It has been theorized that the clustering of milder forms of xerophthalmia, and particularly Bitot's spots, in children older than five years of age may partially reflect inactive disease. The aggregation of severe active xerophthalmia in younger children is posited to be associated with the rapid growth rate and high incidence of infectious diseases during the earliest years of life. Fewer corneal scars associated with prior vitamin A deficiency, i.e., inactive disease, were observed in younger children. The prevalence of vitamin A/measles related corneal scars is also of a public health proportion. The relationship between the prevalence and severity of disease reflects the age distribution of the nutritional blindness observed.

Rates of night blindness were similar in children 2 to 5 and 6 to 10. Approximately two times the rate of night blindness was observed in the entire sample compared to Bitot's spots. This 2:1 prevalence was previously observed by Sommer in West Java, Indonesia(1) and implies that the ascertainment of night blindness in Burkina Faso was relatively reliable.

The sex distribution of ocular signs of vitamin A deficiency (boys represented a higher proportion of the cases) is also consistent with previous observations in Indonesia(2) and Bangladesh(3), and may be attributed to cultural habits which determine sex differential dietary practices. Rates of night blindness were similar in boys and girls.

Geographic clustering of xerophthalmia was also evident. The highest rates of ocular signs were found in Yatenga, the northernmost province sampled, with intermediate rates in Passore and lowest rates in Sourou. Xerophthalmia was generally limited to night blindness in the urban site surveyed, except in children 6 to 10 who evidenced a high prevalence of Bitot's spots.

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1. Sommer, Alfred, Nutritional Blindness. Oxford University Press, New York, 1982.

2. Sommer, Alfred, "Increased Mortality in Children with Mild Vitamin A Deficiency," Lancet. September 10, 1983, pp. 585-588.

3. Helen Keller International and Institute of Public Nutrition, Bangladesh, Bangladesh Nutritional Blindness Study: 1982-1983. Helen Keller International, New York, 1985.

Of the examined recent diarrhea (in the two weeks preceding examination) was the sole risk factor of those measured (diarrhea, measles, and MUAC) associated with active xerophthalmia. The incidence of recent diarrhea was high: 11 percent in children 0 to 5 and 3 percent in children 6 to 10. The fact that little or no association was observed between xerophthalmia and other risk factors may simply reflect that almost all children were protected against measles by immunization and that the majority (75 percent) of children were malnourished. Thus, malnourished children and those who have not been immunized may still constitute high-risk groups.

Trachoma was found to be a serious problem in Burkina Faso (18.7 percent). Younger children had higher rates of trachoma (21 percent vs. 12 percent) than older children, probably because hygenic habits (particulary face washing) are less ingrained in the very young. Boys and girls had similar rates of trachoma.

Recommendations

Helen Keller International recommends that a program of prevention of vitamin A deficiency be implementated in Burkina Faso, beginning in the northeast provinces of the country.

The program should aim to increase the consumption of vitamin A by the target population, children ages 1 to 10 and mothers immediately following childbirth (as most children are breast fed in infancy), through provision of adequate stocks of vitamin A capsules and vitamin A capsule distribution, nutrition education, and the production of vitamin A-rich foods. In order to carry out such a program, health workers must be trained in the prevention, detection, and treatment of vitamin A deficiency.

Based on the high prevalence of xerophthalmia encountered in children 6 to 10 as well as children 0 to 5, megadose vitamin A capsules (200,000 IU) should be distributed prophylactically to children 1 to 10 years old every 4 to 6 months, and to mothers immediately (within the first month) after childbirth. Because measles, diarrhea, and severe malnutrition can precipitate xerophthalmia, HKI considers it prudent to recommend that the treatment schedule of vitamin A be given to all children with clinical signs of vitamin A deficiency, measles, severe malnutrition, or severe diarrhea.

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HKI also proposes the initiation of a trachoma control program which places emphasis on proper hygiene for the prevention of infectious eye disease, and administration of tetracycline eye ointment for treatment of trachoma should be conducted in conjunction with projects developed to improve access to water sources (such as well construction) and with simultaneous training in personal and environmental sanitation.

Table 1.1 BURKINA FASO - PREVALENCE OF XEROPHTHALMIA STRATIFIED BY AGE GROUP(1)

Age in Years	Classification	n	%
0-5	XN(2)	23	(2.82%)
	X1B	3	(0.27%)
	X2	0	(0.00%)
	X3	2	(0.18%)
	XS	1	(0.09%)
6-10	XN	22	(2.36%)
	X1B	20	(2.15%)
	X2	0	(0.00%)
	X3	0	(0.00%)
	XS	3	(0.32%)

1. XN, X1B, X2, and X3 categories mutually exclusive, coded by worst condition. XS categorized separately, i.e., not exclusively, from active disease.

2. Only in children ages 2 to 10 years old.

Table 1.2 BURKINA FASO - SEX DISTRIBUTION OF XEROPHTHALMIA STRATIFIED BY AGE GROUP(1)

Age in Years	Classification	Sex	n	%
0-5	XN(2)	Boys	10	(2.33%)
		Girls	13	(3.37%)
	X1B	Boys	2	(0.35%)
		Girls	1	(0.19%)
	X2	Boys	0	(0.00%)
		Girls	0	(0.00%)
	X3	Boys	2	(0.35%)
		Girls	0	(0.00%)
	XS	Boys	1	(0.18%)
		Girls	0	(0.00%)
6-10	XN	Boys	12	(2.63%)
		Girls	10	(2.10%)
	X1B	Boys	13	(2.85%)
		Girls	7	(1.47%)
	X2	Boys	0	(0.00%)
		Girls	0	(0.00%)
	X3	Boys	0	(0.00%)
		Girls	0	(0.00%)
	XS	Boys	3	(0.63%)
		Girls	0	(0.00%)

1. Categories mutually exclusive, coded by worst condition.

2. Only in children ages 2 to 10 years old.

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Table 1.3 BURKINA FASO - XEROPHTHALMIA BY PROVINCE STRATIFIED BY AGE GROUP

Age in Years	Province	Normal	XN(2)	X1B	X2	X3	XS	TOTAL
		n %	n %	n %	n %	n %	n %	N
0-5(1)	RURAL							
	Yatenga (5 sites)	654 (96.89%)	15 (2.22%)	3 (0.52%)	0 (0.00%)	2 (0.34%)	1 (0.17%)	675
	Passore (1 site)	107 (100.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	107
	Sourou (2 sites)	221 (97.79%)	5 (2.98%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	226
		982 (97.42%)	20 (2.67%)	3 (0.30%)	0 (0.00%)	2 (0.20%)	1 (0.10%)	1008
	URBAN							
	Passore (1 site)	92 (96.84%)	3 (4.41%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	95
6-10(2)	RURAL							
	Yatenga (6 sites)	532 (95.51%)	7 (1.53%)	15 (2.69%)	0 (0.00%)	0 (0.00%)	3 (0.66%)	557
	Passore (1 site)	89 (94.68%)	3 (1.55%)	2 (2.13%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	94
	Sourou (2 sites)	167 (94.35%)	9 (5.10%)	1 (0.56%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	177
		788 (95.17%)	19 (2.29%)	18 (2.17%)	0 (0.00%)	0 (0.00%)	3 (0.36%)	828
	URBAN							
	Passore (1 site)	99 (95.19%)	3 (2.88%)	2 (1.92%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	104

1. Categories mutually exclusive, coded by worst condition.

2. Only children 2 to 10 years old.

Table 1.4 BURKINA FASO - PREVALENCE OF TRACHOMA STRATIFIED BY AGE GROUP

Age in Years	Severity of Trachoma	n	%
0-5	Mild	136	(12.33%)
	Moderate	82	(7.43%)
	Severe	16	(1.45%)
	Refused	16	(1.45%)
	Uncertain	3	(0.09%)
6-10	Mild	95	(10.20%)
	Moderate	45	(4.83%)
	Severe	7	(0.75%)
	Refused	5	(0.54%)
	Uncertain	0	(0.00%)

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Table 1.5 BURKINA FASO - SEX DISTRIBUTION OF TRACHOMA STRATIFIED BY AGE GROUP

Age in Years	Severity of Trachoma	Sex	n	%
0-5	Mild	Boys	72	(12.74%)
		Girls	64	(11.92%)
	Moderate	Boys	49	(8.67%)
		Girls	33	(6.15%)
	Severe	Boys	12	(2.12%)
		Girls	4	(0.74%)
	Refused	Boys	7	(1.24%)
		Girls	9	(1.68%)
	Uncertain	Boys	2	(0.35%)
		Girls	1	(0.19%)
6-10	Mild	Boys	37	(8.11%)
		Girls	58	(12.18%)
	Moderate	Boys	21	(4.61%)
		Girls	24	(5.04%)
	Severe	Boys	2	(0.44%)
		Girls	5	(1.05%)
	Refused	Boys	1	(0.22%)
		Girls	4	(0.84%)
	Uncertain	Boys	0	(0.00%)
		Girls	0	(0.00%)

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CHAPTER 2

CHAD

INTRODUCTION

An assessment of xerophthalmia and trachoma among children 0-10 years of age in Chad was performed from March 11-21, 1986. The assessment team consisted of a pediatrician and consultant ophthalmologist from HKI, a French Cooperation ophthalmologist, and a Chadian ophthalmic nurse from the Ministry of Health, and a USAID health observer (see Appendix I for team list). Logistics and vehicles were provided by AID/N'Djamena, UNICEF, and CARE-Chad, with local support from Chadian officials, CARE, Africare, and Medecins Sans Frontieres.

A total of 1,711 children were examined in one urban site and 13 rural sites of three prefectures: Chari Baguirme, Batha, and Ouaddai. All children were examined for ocular signs of vitamin A deficiency (xerophthalmia) and trachoma. One out of every five children were measured for mid-upper arm circumference. 1,044 children (61.0%) were less than six years of age, of whom 424 (24.8% of total) were aged 0-2, and 665 (38.9%) were aged six to ten years. The age of two children was unknown. The sample mean age was 62.7 $\pm$ 35.1 months. The sex distribution was close to expectation: 47.3% (n = 809) boys and 52.7% (n = 901) girls; one child's sex was not recorded. Most children (66.7%) were accompanied to the exam by their mothers; others were accompanied by relatives and neighbors.

DEMOGRAPHIC BACKGROUND

Demographic information was gathered from community elders (village chief, school teacher, etc.) about the general status of the community. The average estimated village population was 375 inhabitants in the 11 rural sites providing this information; only three sites contained >1,000 inhabitants and the remainder varied from 80 to 400 people. Ethnic groups included Bournou, Kanembou, Baguirmian, Bilala, Arabes, Kouka, Kebgas and Ouaddaien. The rural populations were primarily sedentary with some surrounding nomadic subgroups.

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The principal source of water was from wells located in or close (less than 2 km in all sites) to the village, with secondary sources (also wells) ranging from 7 to 45 km distance. At every site however, village elders stated that recent rains and better harvests had vastly improved in comparison to the famine and drought situations of the year before. During that time, they had lost "many" inhabitants through emigration and famine. Informants at six sites claimed an emigration of more than half the population over the last two years.

Except for the urban site in N'Djamena, the nearest health facility or health agent was 16 to 45 km distant. Few children (16.4% overall) had been vaccinated; children in N'Djamena had been immunized within the last two months, but only six rural sites had received vaccination teams (primarily providing BCG and DPT) in the last 12-48 months, and six other rural sites had not seen a team for 6-10 years or more.

The primary foods consumed in the survey sites were millet in the form of "boule" with a sauce of greens (spinach)* or, if available, meat*. Some fish*, rice, and corn were eaten when available.

Children were reported to be primarily breast-fed until approximately one year of age, then gradually placed on a diet identical to that of adults; 65.5% of children 0-2 were breast-fed. Food aid, primarily as corn or sorghum, had been received in 11 sites in 1985, but medical aid at only two sites.

METHODOLOGY

Sample Selection

The three prefectures of Chari-Baguirme, Batha, and Ouaddai were chosen for assessment because they are located in the Sahelian Zone, and, most importantly, met criteria for appropriate logistical support and personnel safety. A country background of civil and military strife also led to some restriction of site selection. Beginning with an urban site in the capital of N'Djamena, a general route west to east was chosen, with deviation from the main axis road to achieve appropriate sample sites selected within the subprefectures en route.

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* Vitamin A rich sources

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The urban sample site in N'Djamena was selected at random from all possible neighborhoods in the city, excluding wealthy and expatriate neighborhoods. A staged selection procedure was used to initially select blocks, and then concessions (i.e., households) to be surveyed. A stratified sample of every third concession in the selected block was included in the sample.

Rural locations in the province of Chari Baguirme were randomly chosen from lists of provincial villages provided by local chiefs or sultanates. The remainder of rural sites were selected in a nonrandom manner based on distances from the previous day's sample site, the relative safety of travel to and from the survey sites, location within a reasonable travelling distance of the principal village, and absence of food aid (particularly Vitamin A-fortified food). Information regarding these criteria for site selection in rural Batha and Ouaddai was obtained from local informants. Examination of all children 0-10 was attempted in all rural sites, except in the relatively large site of Bodero in the prefecture of Chari Baguirme. All children who arrived at the central location in the neighborhood chosen for the survey site of Bodero were examined.

Data Collection

In all cases a local interpreter was made available, with some translation through the general interpreters of the team. All children 0-10 years were examined with a parent or knowledgeable adult to answer questions. Ages were approximated with important dates, and children with pubertal signs were examined separately and not included in the study.

All children were examined for clinical evidence of xerophthalmia and trachoma, and were given 200,000 IU of vitamin A. Children with xerophthalmia and those with trachoma were appropriately treated.

To obtain a history of night blindness, local community terms were used if available (e.g. "Mournou" or "Mordourou" in Bilala). Parents were closely questioned regarding night blindness by the interviewer, and a history for night blindness was also obtained by the ophthalmologist.

RESULTS

Discussion

The total population surveyed in Chad consisted of 1,711 children. The majority of children, 61.0% (n = 1044), were 0-5 years of age and 38.9% (n = 665) were 6-10 years old. Regardless of care taken in ascertaining age, it should be noted that ages are educated estimates as exact birth dates are not recorded or known.

Rates of night blindness were greater in children 2-5 years of age compared to those aged 6-10. Keratomalacia, however, was found exclusively in an older child, a six year old boy. The prevalence of Bitot's spots in older children was 3.4 times that seen in younger children, a proportion of which may represent nonresponsive (i.e., inactive) disease in the older children. Thus, while ocular signs of active xerophthalmia were more prevalent in older than younger children, and thus not entirely consistent with prior observations, the prevalence of night blindness and Bitot's spots in younger children still constitutes a problem of public health proportion.

Rates of corneal scarring in children 6-10 years old are 2.4 times that observed in children 0-5 years old; this reflects the accumulation of prior ocular signs with age in survivors.

Rates of night blindness in the entire sample were approximately twice that of Bitot's spots; this is consistent with prior observations in Indonesia and implies that reports of night blindness are relatively reliable in this population.(1)

The sex distribution of xerophthalmia was also consistent with expectation; boys had higher rates of ocular signs than girls in both age groups.(1,2) The observed sex differential in the prevalence of xerophthalmia may be attributable to cultural habits which determine dietary practices of boys compared to girls.

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1. Sommer, Alfred. Nutritional Blindness. Oxford Unversity Press, New York, 1982.

2. Helen Keller International and Institute of Public Health, Bangladesh, Bangladesh Nutritional Blindness Study: 1982 - 1983, HKI, New York, 1985.

Rates of night blindness were similar in boys and girls 0-5 years of age.

Geographic variability in rates of active xerophthalmia and corneal scars was apparent, but formed no consistent pattern across age groups. No clinical signs of xerophthalmia were observed in Blabline, the urban site surveyed.

Rates of malnutrition (defined as less than the tenth percentile of age and sex specific MUAC) and recent diarrhea were slightly higher in children with active xerophthalmia than in their counterparts. 27.3% and 80.0% of children 0-5 years old with active xerophthalmia had recent diarrhea or were malnourished, respectively, compared to 15.8% and 59.9% of non-xerophthalmic children in that age group. Of children 6-10 years old, 8.3% and 53.3% of those with active xerophthalmia had recent diarrhea or were malnourished, respectively, compared to 3.6% and 42.9% of their counterparts. Much xerophthalmia in older children could be attributable to a prior epidemic of measles; 62.5% of those with active xerophthalmia who were 6-10 years old had a history of measles compared to 44.9% of non-xerophthalmic children in this age group. Five of the six corneal scars observed in older children were directly related to measles and the sixth case was noted as possibly measles-related. Half of the corneal scars in younger children were associated with measles.

Trachoma was found to be very prevalent in Chad: 34.2% of children 0-5 and 20.3% of children 6-10 had active cases of trachoma, the majority of which were categorized as moderate or severe cases (87% and 76% of cases in younger and older children, respectively). The prevalence of trachoma was similar in boys and girls.

Recommendations

This assessment has shown that xerophthalmia and trachoma are problems of public health importance in the provinces surveyed in Chad. Chad is also subject to cyclic drought and food shortage conditions which exacerbate this endemic problem of vitamin A deficiency. Therefore, health planners in Chad should provide for a prevention and treatment program to improve the vitamin A status in its high risk populations. Any decision not to provide for an ongoing intervention approach should, at the minimum, prepare for the deterioration of nutritional status which occurs during a drought or food shortage situation.

Any approach to vitamin A deficiency and trachoma must take into consideration the Chadian health system and priorities for the allocation of scarce resources. Given these considerations, HKI suggests a phased-in approach to the treatment and prevention of trachoma and xerophthalmia with gradual expansion as appropriate to the health structure. Vitamin A supplementation in particular can be effectively integrated into other health efforts at low cost.

Specific actions which HKI recommends on the basis of this assessment and the experience of this agency include:

- The health system should assure the availability of an adequate supply of vitamin A capsules (200,000 IU) in central health stocks and all clinical facilities for the treatment and prevention of xerophthalmia. For estimates of supply needs: prevention = 2 capsules per child, per year treatment = 3 capsules.

- The prevalence of active and prior xerophthalmia in Chad indicates chronic vitamin A deficiency in the population. Thus, where prevention programs do not already exist, capsule distribution should be instituted. Although highest priority should be given to preschool children, our survey found evidence of probable active deficiency in 6-10 year olds, who should be included if feasible.

- Health workers should be trained to recognize and treat the signs of xerophthalmia. HKI also recommends use of vitamin A during treatment of conditions closely associated with vitamin A deficiency, including malnutrition, severe diarrhea, and especially measles.

- Health planning should include eventual integration into the health system of a full scale program with surveillance, training programs, vitamin A supplementation, and nutrition education. For example, vitamin A supplementation can be linked with maternal and child health care, immunization campaigns, or primary eye care programs.

- Agricultural programs should be encouraged to emphasize foods high in vitamin A.

- Trachoma, including blinding trachoma, was very prevalent in this population. It merits a strong public health program which includes public education in face washing, especially among younger children.

Mass distribution of tetracycline eye ointment, which does not in itself provide long term protection, would not be indicated, if it would consume scarce resources. Mass treatment, however, would provide long term benefits if conducted in conjunction with projects to improve and/or increase the availability of water concurrent with training in personal hygiene. Eventual development of a primary eye care system should include training in surgery for blinding trachoma sequelae.

Table 2.1 CHAD - PREVALENCE OF XEROPHTHALMIA STRATIFIED BY AGE GROUP(1)

Age in Years	Conditions	n	%
0-5	XN(2)	17	(2.18%)
	X1B	5	(0.48%)
	X2	0	(0.00%)
	X3	0	(0.00%)
	XS	4	(0.38%)
6-10	XN	11	(1.65%)
	X1B	11	(1.65%)
	X2	0	(0.00%)
	X3	1	(0.15%)
	XS	6	(0.90%)

1. XN, X1B, X2 and X3 categories mutually exclusive, coded by worst condition. XS categorized separately, i.e. not exclusively, from active disease.
2. Only in children 2-10 years old.

Table 2.2 CHAD - PREVALENCE OF XEROPHTHALMIA STRATIFIED BY AGE GROUP(1)

Age in Years	Condition	Sex	n	%
0-5	XN(2)	Boys	7	(1.89%)
		Girls	10	(2.44%)
	X1B	Boys	3	(0.59%)
		Girls	2	(0.37%)
	X2	Boys	0	(0.00%)
		Girls	0	(0.00%)
	X3	Boys	0	(0.00%)
		Girls	0	(0.00%)
	XS	Boys	3	(0.59%)
		Girls	1	(0.19%)
6-10	XN	Boys	8	(2.68%)
		Girls	3	(0.82%)
	X1B	Boys	6	(2.00%)
		Girls	5	(1.37%)
	X2	Boys	0	(0.00%)
		Girls	0	(0.00%)
	X3	Boys	1	(0.33%)
		Girls	0	--
	XS	Boys	3	(1.00%)
		Girls	3	(0.82%)

1. Categories mutually exclusive, coded by worst condition.
2. Only in children 2-10 years old.

Table 2.3 CHAD - XEROPHTHALMIA BY PROVINCE STRATIFIED BY AGE GROUP(1)

Age in Years	Province	Normal n	Normal %	XN(2) n	XN(2) %	X1B n	X1B %	X2 n	X2 %	X3 n	X3 %	XS n	XS %	Total N
0-5	RURAL													
	Chari Baguirme (4 sites)	361	(95.76%)	10	(3.48%)	4	(1.06%)	0	(0.00%)	0	(0.00%)	2	(0.53%)	377
	Batha (8 sites)	473	(98.34%)	5	(1.37%)	1	(0.21%)	0	(0.00%)	0	(0.00%)	2	(0.42%)	481
	Ouaddai (1 site)	113	(98.26%)	1	(1.27%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	1	(0.87%)	115
		947	(97.33%)	16	(2.19%)	5	(0.51%)	0	(0.00%)	0	(0.00%)	5	(0.51%)	973
	URBAN													
	Chari Bagurime (1 site)	70	(98.59%)	1	(2.08%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	71
6-10	RURAL													
	Chari Baguirme (4 sites)	208	(97.20%)	4	(1.87%)	1	(0.47%)	0	(0.00%)	0	(0.00%)	1	(0.47%)	214
	Batha (8 sites)	30	(94.32%)	6	(1.89%)	5	(1.57%)	0	(0.00%)	1	(0.31%)	5	(1.57%)	318
	Ouaddai (1 site)	94	(94.00%)	1	(0.99%)	5	(5.00%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	101
		601	(95.25%)	11	(1.56%)	11	(1.56%)	0	(0.00%)	1	(0.14%)	7	(0.99%)	631
	URBAN													
	Chari Baguirme (1 site)	32	(100%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	32

1. Categories mutually exclusive, coded by worst condition.

2. Only in children 2-10 years old.

Table 2.4 CHAD - PREVALENCE OF TRACHOMA STRATIFIED BY AGE GROUP

Age in Years	Severity of Trachoma	n	%
0-5	mild	46	(4.41%)
	moderate	192	(18.39%)
	severe	119	(11.40%)
6-10	mild	52	(7.82%)
	moderate	51	(7.67%)
	severe	32	(4.81%)

Table 2.5 CHAD - SEX DISTRIBUTION OF TRACHOMA STRATIFIED BY AGE

Age in Years	Severity of Trachoma	Sex	n	%
0-5	mild	Boys	22	(4.33%)
		Girls	24	(4.48%)
	moderate	Boys	93	(18.30%)
		Girls	99	(18.47%)
	severe	Boys	64	(12.60%)
		Girls	55	(10.26%)
6-10	mild	Boys	26	(8.70%)
		Girls	26	(7.12%)
	moderate	Boys	28	(9.36%)
		Girls	23	(6.30%)
	severe	Boys	16	(5.35%)
		Girls	16	(4.38%)

CHAPTER 3

MALI

INTRODUCTION

In Mali, the field assessment of xerophthalmia and trachoma among children 0 to 10 years old was performed between April 15 and April 24, 1986. The assessment team members and logistical support were coordinated through Mali Ministry of Health, UNICEF, Medecins sans Frontieres, CARE-Mali, and Helen Keller International (see team list Appendix I).

One thousand seven hundred eighty six children were examined in 14 rural sites, including 8 sedentary and 6 nomadic sites, and 2 sites of displaced persons in the regions of Tomboctou and Segou. In Tomboctou, half of the rural sites were nomadic, while all the rural sites in Segou located in the Soudano-Sahel zone were stationary. All survey areas had suffered from the 1985 drought and food shortage. The mean age of those surveyed was 55.5 $\pm$ 29.8 months; 1,237 (69.3 percent) were 0 to 5 years old, of which 493 (27.6 percent of total) were 0 to 2 years old, and 538 (30.1 percent) were 6 to 10 years old. The age of 11 children was unknown. The sex distribution was as expected: 891 (49.9 percent) were boys and 889 (49.8 percent) were girls. The gender of 6 children was unrecorded.

DEMOGRAPHIC BACKGROUND

Information about communities was obtained primarily from village elders (e.g., village chief, agent sanitaire) as well as through group consensus (particularly in the determination of dates and numbers). Ethnic groups examined included Songhrai, Bambara, Bozo, Bella, Tamashek, and Arabes. The average population size of the 12 rural sites providing population estimates was 777, ranging from 30 to 600 in nomadic sites and 500 to almost 3,000 in stationary sites. The 2 displaced-persons sites in Goundam and Macina contained 250 to 300 families and 20 families, respectively.

Most of the 13 sites obtained their water from wells, 12 of which are located within a 1 km distance. The primary water source for 3 villages was from nearby rivers. Secondary water sources were located 1 to 45 km away.

The 2 displaced-persons sites and 2 rural sites had a health facility or dispensary within the village; responses from 10 of the 12 remaining sites indicated that the nearest health facility was located an average of 25.8 ± 14.7 km distant (7 were more than 30 km). Twelve villages had been visited by a vaccination team (primarily providing BCG and measles immunizations) within the last 2 years, and 3 villages claimed they had never received immunizations.

Various non-governmental organizations provided food aid in the form of millet or sorghum to villages, and "bouillie" (millet with oil, and vitamin A-enriched non-fat dry milk) to young children, during the previous year. Some had ongoing programs at the time of this assessment. Twelve villages reported receiving food aid (sorghum, corn, "bouillie") during the famine in 1985, but only 4 had received medical aid. Nine villages reported some emigration due to the food shortages of 1985, while Goundam and Macina reported large gatherings of displaced persons on the outskirts of town. The primary food currently consumed was cooked millet with a meat* or dark green vegetable sauce. Seven sites reported occasional consumption of rice or corn, and 5 villages, primarily in Segou or on the Niger River, reported fish* consumption. Children were breastfed to age 2 to 3 years, but reportedly consumed the same foods as adults, beginning at age 1 year. 65.1 percent of children 0 to 2 years old were breastfed. Until recently, children in 6 villages in Tomboctou received varying amounts of "bouillie." The consumption of mangoes* was observed in the Segou region.

METHODOLOGY

Sample Selection

The regions of Tomboctou and Segou were chosen because of available logistical support, location in the Sahel or Soudano-Sahel zone, past history of food shortages, and non-governmental organizations request for data for future health planning. Random selection of sites was not conducted. With a two-week logistical constraint, 3 areas--Tomboctou, Goundam, and Gourma-Rharous in the Tomboctou region-- and one area--Macina-in Segou region-- were chosen. Two urban sites, Goundam and Macina, were chosen for their at-risk, displaced-persons populations.

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* Vitamin A-rich sources.

Four sites in nomadic populations were chosen to coincide with a prearranged health check of this widely dispersed population. All other sites (of stationary groups) were chosen by the team from a list obtained from local informants to meet the criteria for logistical accessibility and adequate population size. Universal examination of all children at the chosen site was attempted.

Data Collection

Children 0 to 10 years old were examined for ocular signs of xerophthalmia and trachoma. A history of night blindness was asked of the accompanying adult (69.6 percent mothers) using a pre-ascertained local term (e.g., Bambara: "Suranfiye") and others as agreed upon with the interpreter's aid. These other terms were usually explained as associated with seasons and times of hunger, and applyed primarily to young children. All children were given 200,000 IU of vitamin A orally and treated for clinical signs of xerophthalmia and trachoma.

RESULTS

Discussion

The total population surveyed in Mali consisted of 1,786 children, of whom 1,237 (69.3 percent) were 0 to 5 years old and 538 (30.1 percent) were 6 to 10 years old. Eleven children (0.6 percent) were of unknown age.

The prevalence of night blindness in Mali was 2 to 3 times that observed in the other West African countries surveyed, and 47 percent greater in older than younger children; 6.45 percent of the sample children 0 to 5 years old and 9.48 percent of those 6 to 10 years old were reported to suffer night blindness. This may reflect relatively invalid Bitot's spots estimates, particularly given the lack of substantiating clinical signs of active disease. The sole Bitot's spot observed was found in an 8-year-old child. One case of corneal ulceration with descemetocele was seen in a 3-year-old child who was severely malnourished but who did not participate in the local nutrition services available to the community. The fact that all remaining younger children surveyed were devoid of clinical signs of active xerophthalmia leads to the inference that this child is a special case, not representative of the general population.

Corneal scars, however, were quite prevalent in both younger and older children. Older children had a scar rate 3.25 times that of younger children, reflecting an accumulation of prior cases of active corneal destruction, probably arising during the peak of the drought-famine period in 1983, in surviving children.

Consistent with previous findings, clinical signs of active vitamin A deficiency were limited to boys, and corneal scars were more prevalent in boys (1.5 times in younger and 6.0 times in older children) than girls. Older boys had 43 percent higher rates of reported night blindness than girls, but rates of night blindness were equivalent in young boys and girls.

Clinical signs of active disease were found only in displaced-persons camps, along with the highest rates of reported night blindness and, in older children, corneal scars. Among young children, high rates of corneal scars were found in all 3 population groups (nomadic, displaced persons, and stationary). The fact that no corneal scars were observed in older children in the nomadic sites surveyed may well be a function of sample size; less than 100 nomadic children aged 6 to 10 years were examined. Reported rates of night blindness, however, were also lowest in nomadic sites.

The children with active ocular signs of xerophthalmia had no prior history of measles, but had substandard anthropometric measurements (less than the tenth percentile for age and sex). The 3-year-old X3 case had also suffered recent bouts of severe diarrhea. (Only 15.7 percent of those sampled had a history of measles, but many, 26.9 percent, had recent diarrhea.) All corneal scars in children 0 to 5 years of age were related to measles as were the majority (71.4 percent) of those in older children.

The prevalence of trachoma, which was categorized dichotomously, was high--approximately 10 percent of the sample. Unexpectedly, slightly higher rates were found in older (9.66 percent) than younger (8.73 percent) children. There was little sex differential in the prevalence of trachoma in younger children, but older boys had 48 percent more trachoma than older girls.

Recommendations

The unique case of corneal ulceration was observed in a severely malnourished boy who did not regularly attend the nutrition center located at the displaced-persons site in Goundam. This probably does not reflect chronic severe vitamin A deficiency in the population, but rather an individual circumstance (e.g,. poor weaning, other disease, neglect). Few ocular signs of active xerophthalmia were observed, but the excessive rates of corneal scars seen probably reflect the past acute nutrient deprivation experienced in the recent drought-famine. Rates of corneal scarring in both younger and older children indicate a problem of public health proportion.

The low prevalence of ocular signs of active vitamin A deficiency in conjunction with the relatively high prevalence of corneal scars suggests that the findings of the assessment may be due to biased sampling procedure, selective survivorship (if a peak of childhood mortality was recently experienced in Mali), and/or lack of an active xerophthalmia problem.

Helen Keller International, therefore, recommends that health planners in Mali institute surveillance for vitamin A deficiency in the general population, which would provide assessment during other seasons. Given the high rates of corneal scarring, HKI recommends programs for vitamin A supplementation during food-shortage crises.

Trachoma rates indicate a current public health problem, and thus warrant inclusion in public health measures.

Specifically, HKI recommends:

- Availability of adequate supplies of vitamin A capsules (200,000 IU) in central and regional health stocks for the prevention and treatment of xerophthalmia. Supply estimates can be based on: prevention: 2 or 3 capsules per child per year, treatment: 3 capsules per episode, not to exceed 3 treatment regimens per year.

- Training of health workers to recognize and treat xerophthalmia.

- Prophylactic vitamin A supplementation of preschool children in special target groups which appear to be at greatest risk during acute food shortages. Target groups might include displaced persons gatherings.

- Institution of active xerophthalmia surveillance in the general population as well as in high-risk groups, especially in drought and famine years.

- Implementation of short- and long-term measures to reduce the prevalence of trachoma. These would include education in personal hygiene and environmental sanitation, the development of new sources of water to increase its availability (which would facilitate hand and face washing), and mass treatment with tetracycline.

Table 3.1 MALI - PREVALENCE OF XEROPHTHALMIA STRATIFIED BY AGE GROUP(1)

Age in Years	Condition	n	%
0-5	XN(2)	60	(6.45%)
	X1B	0	(0.00%)
	X2	0	(0.00%)
	X3	1	(0.08%)
	XS	5	(0.40%)
6-10	XN(2)	51	(9.48%)
	X1B	1	(0.19%)
	X2	0	(0.00%)
	X3	0	(0.00%)
	XS	7	(1.30%)

1. XN, X1B, X2, and X3 categories mutually exclusive, coded by worst condition. XS categorized separately, i.e., not exclusively, from active disease.

2. Only in children 2-10 years old.

Table 3.2 MALI - SEX DISTRIBUTION OF XEROPHTHALMIA STRATIFIED BY AGE GROUP

Age in Years	Conditions	Sex	n	%
0-5	XN	Boys	29	(6.22%)
		Girls	30	(6.51%)
	X1B	Boys	0	(0.00%)
		Girls	0	(0.00%)
	X2	Boys	0	(0.00%)
		Girls	0	(0.00%)
	X3	Boys	1	(0.16%)
		Girls	0	(0.00%)
	XS	Boys	3	(0.49%)
		Girls	2	(0.32%)
6-10	XN	Boys	30	(11.24%)
		Girls	21	(7.84%)
	X1B	Boys	1	(0.37%)
		Girls	0	(0.00%)
	X2	Boys	0	(0.00%)
		Girls	0	(0.00%)
	X3	Boys	0	(0.00%)
		Girls	0	(0.00%)
	XS	Boys	6	(2.25%)
		Girls	1	(0.37%)

1. Categories mutually exclusive, coded by worst condition.

2. Only in children 2-10 years old.

Table 3.3 MALI - XEROPHTHALMIA STRATIFIED BY POPULATION TYPE AND AGE GROUP(1)

Age in Years	Population Type	Normal	XN(2)	X1B	X2	X3	XS	Total
		n %	n %	n %	n %	n %	n %	N
0-5	Sedentary Population (8 sites)	839 (94.91%)	42 (6.41%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	3 (0.34%)	884
	Displaced Persons (2 sites)	181 (92.82%)	12 (7.64%)	0 (0.00%)	0 (0.00%)	1 (0.51%)	1 (0.51%)	195
	Nomadic (6 sites)	152 (95.60%)	6 (5.04%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (0.63%)	159
6-10	Sedentary Population (8 sites)	300 (89.02%)	32 (9.50%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	5 (1.48%)	337
	Displaced Persons (2 sites)	90 (86.54%)	11(10.58%)	1 (0.96%)	0 (0.00%)	0 (0.00%)	2 (1.92%)	104
	Nomadic (6 sites)	88 (91.67%)	8 (8.33%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	96

1. Categories mutally exclusive, coded by worst condition.

2. Only in children 2-10 years old.

Table 3.4 MALI - PREVALENCE OF TRACHOMA STRATIFIED BY AGE GROUP

Age in Years	n	%
0-5	108 1	(8.73%) uncertain
6-10	52	(9.66%)

Table 3.5 MALI - SEX DISTRIBUTION OF TRACHOMA STRATIFIED BY AGE GROUP

Age in Years	Sex	n	%
0-5	Boys	50	(8.10%)
	Girls	57	(9.24%)
6-10	Boys	31	(11.61%)
	Girls	21	(7.84%)

CHAPTER 4

NIGER

INTRODUCTION

The assessment in Niger was conducted from May 20 to May 30, 1986 by a team composed of a public health specialist, an epidemiologist, and a consultant ophthalmologist from Helen Keller International, and health technicians, including an ophthalmic nurse, a nutritionist, and an interviewer, from the Niger Ministry of Health (see Appendix I for team members). A stratified random sample of 1,997 children aged 0 to 10 years old were seen in 10 sites chosen from the provinces of Tahoua, Maradi, and Zinder (see Appendix II for list of sites).

The sex distribution of the sample population agreed with expected values: 52.1 percent were girls and 47.8 percent were boys. Three children's sex was not determined. The sample mean age was 54.6 ± 33.4 months (i.e., 4 1/2 years ± 2 years, 10 months). The age distribution of the sample was: 69.4 percent (n = 1388) children 0 to 5 years old of whom 662 (33.1 percent of total sample) were infants 0 to 2 years old; and 30.6 percent (n = 611) children 6 to 10 years old. There was a slight underrepresentation of children aged 8 to 10 years (these 3 ages constituted only 12.6 percent of the sample). During the exam, 76.0 percent of the children were accompanied by their mothers; others came with other family members or neighbors.

DEMOGRAPHIC BACKGROUND

Using the community survey form, a variety of information about the 10 sample communities was elicited from village leaders. Nine sites were rural and 1 was urban. The current average estimated total population size of the 7 rural sample sites responding to this question was 1,215. The principal ethnic group in all 10 sites and, indeed, in the majority of the stationary population of Niger, was Haoussa. The rural communties' primary source of water is wells, located from 100 to 700 meters from the villages. The average distance to the nearest clinic in 7 of the 9 rural areas responding to this question was 15.4 ± 9.3 kilometers (9.2 ± 5.6 miles), with a range from 4 km to 30 km.

Clinic services are available to people from the urban site within the city itself. Over half of the children in the sample (69.5 percent) had been vaccinated over the past year. Vaccination teams had visited 6 sites within the past 6 months; 2 other sites had received their last visit of a vaccination team between 12 and 24 months ago. Information on vaccination was not determined in 2 sites. Children were vaccinated against tuberculosis, measles, and/or meningitis.

Eight sites received some form of food aid in the past year, and 2 received medical aid (information not determined in 2 sites). When asked what foods are commonly eaten, villagers in the 8 sites questioned responded that millet was consumed. Three sites said sorghum was also eaten, and 1 reported milk consumption as well. Over half of children 0 to 2 years old (69.3 percent) were breastfed.

METHODOLOGY

Sample Selection

The 3 provinces --Tahoua, Maradi, and Zinder-- were chosen primarily for logistical reasons, i.e., accessibility and population density; also AID and CARE have been active in these areas and are interested in child survival and vitamin A deficiency in this area.

The percent of the total population of the 3 provinces of Tahoua, Zinder, and Maradi was calculated from the most recent census (1976) provided by the Ministry of Health. The number of rural sites selected for each province was ascertained to attain a proportional representation for the sample area. Rural villages in stationary (non-nomadic) populations were then selected using standard random selection procedure. To achieve proportional representation of urban areas, 1 urban site was selected at random from all potential urban sites in the survey area. Within the urban site, a poor neighborhood was selected non-randomly.

The team attempted to examine all children 0 to 10 years old in villages with 200 children or less. Informal stratification of children was conducted in larger villages by dividing the children into 2 or 4 groups and examining the first 100 or 50, respectively, from each group. In villages where caretakers selectively presented young

children only during the first half of the day, stratification by age (i.e., selection of older children) was conducted during the latter half of the day.

Data Collection

All sample children were examined for clinical signs of xerophthalmia. Information on night blindness was elicited using the Haousa words "Doudoumi" or "Doufoun Ido." The first 100 children seen in the 9 rural sites were examined for trachoma as well. Children in the urban site were not examined for trachoma due to logistic constraints. The decision to examine children for trachoma in only half of the study population in the rural areas was based upon logistic and time limitations and the fact that trachoma was found to be a prevalent condition in the previous surveys conducted. Every fifth child was measured for mid-upper arm circumference, as were all children with clinical evidence of xerophthalmia.

RESULTS

Discussion

The total population surveyed in Niger consisted of 1,999 children of whom 1,388 (69.4 percent) were 0 to 5 years old and 611 (30.6 percent) were children 6 to 10 years old.

Severe signs of active xerophthalmia were found solely among children less than 6 years old. Rates of reported night blindness, however, were slightly higher in children 6-10 years old compared to those 2 to 5 years old. The prevalence of past vitamin A deficiency, i.e., vitamin- or measles-related corneal scars, was 6 times greater in older compared to younger children. This reflects the accumulation of prior cases of corneal destruction over time.

These observations are consistent with previous findings in Indonesia.(1) The prevalence of night blindness in children less than 6 years old was 3 times that of more severe ocular signs of active vitamin A deficiency, similiar to prior observations in preschool children from rural Bangladesh.(2)

Active xerophthalmia was not differentially associated with sex in younger children, but clinical signs of active xerophthalmia were limited to older males, and the rate of corneal scars in older boys was twice that observed in older females. Unexpectedly, the reported prevalence of night blindness in girls 6 to 10 years old was 47 percent greater than that of their male counterparts. Biased reporting of night blindness by sex in the village of Mattachi in Maradi province could account for almost the entire differential Bitot's spots rate reported between boys and girls. (Of the Bitot's spots cases reported in girls 6 to 10 years old, 26 percent were reported in Mattachi compared to 10 percent of XN cases in 6 to 10 year old boys; 22 percent of Bitot's spots cases in 2 to 5 years old girls were reported in Mattachi as compared to 10 percent in boys 2 to 5 years old.)

Geographic clustering of xerophthalmia was noted, with highest rates in Maradi (the southernmost sites surveyed were located in this province), intermediate rates in Tahoua, and lowest rates in Zinder (the easternmost province surveyed). Rates of night blindness were particularly high in the province of Maradi, and may reflect false positive reporting resulting in overestimation of Bitot's spots rates. Although night blindness is possibly overreported in Maradi, it is unlikely that the prevalence of night blindness in this province is low, particularly given the high prevalence of Bitot's spots, corneal xerosis, and keratomalacia.

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1. Sommer, Alfred, Nutritional Blindness. Oxford University Press. New York, 1982.

2. Helen Keller International and Institute of Public Health. Bangladesh Nutritional Blindness Study: 1982 - 1983. Helen Keller International, New York, 1985.

Six of the 11 (54.5 percent) corneal scars observed were in children from the village Bazaga in the province of Tahoua. This indicates a previous epidemic of vitamin A deficiency or measles in this community. One of the 2 children with Bitot's spots in Tahoua province was found in Bazaga, but the remaining Bitot's spot was found in an older rural child in a province where no scarring was observed, providing additional evidence that Bitot's spots generally represents active disease in older children.

Little night blindness was reported in the surveyed urban site, but Bitot's spots were found in both older and younger children in Bilbiss.

Diarrhea in the 2 weeks prior to examination was the only risk factor of those recorded (diarrhea, measles, and MUAC) associated with active xerophthalmia; 54.9 percent of children 0 to 5 years old with active xerophthalmia had recent bouts of diarrhea compared to 34.6 percent of their counterparts without active nutritional blindness. Slightly more older children with active xerophthalmia had diarrhea than those of the same age without xerophthalmia (18.2 percent compared to 12.5 percent, respectively). All older children with corneal scars had a previous history of measles; none of the younger cases of corneal scars had experienced measles. The lack of associaton between mid-upper circumference and xerophthalmia is likely a function of the general level of malnutrition (all children with active xerophthalmia and 87.8 percent of those measured without active xerophthalmia had MAUC's less than the tenth percentile for age and sex).

The prevalence of trachoma in the 9 rural sites was very high: 39.0 percent of all children examined for trachoma had active cases. The highest rates of trachoma (42.8 percent) were found in young children, whose hygienic habits are less formulated than older children (who had an overall prevalence of 30.5 percent). No sex differential in rates of trachoma was observed.

Recommendations

The rates of both xerophthalmia and trachoma observed in this survey indicate that these diseases represent serious public health problems in the regions surveyed. Helen Keller International strongly recommends that prevention programs be initiated.

Xerophthalmia prevention efforts, i.e. the provision of megadose vitamin A capsules (200,000 IU), should target children 1 to 5 years old as well as women immediately after childbirth (to protect breastfed infants).

HKI also proposes the strengthening of trachoma control efforts. Emphasis should be placed on proper hygiene to reduce transmission and on treatment of infections with tetracycline eye ointment. Improving the water supply and, particularly, increasing access to water would facilitate face washing. Conducted simultaneously, these actions would cure the extant cases and provide a long-term means to prevent future cases.

Table 4.1 NIGER - PREVALENCE OF XEROPHTHALMIA STRATIFIED BY AGE GROUP(1)

Age in years	Condition	n	%
0-5	XN(2)	38	(3.97%)
	X1B	10	(0.72%)
	X2	1	(0.07%)
	X3	2	(0.14%)
	XS	3	(0.22%)
6-10	XN	29	(4.75%)
	X1B	4	(0.65%)
	X2	0	(0.00%)
	X3	0	(0.00%)
	XS	5	(0.82%)

1. XN, X1B, X2, and X3 categories mutually exclusive, coded by worst condition. XS categorized separately, i.e., not exclusively, from active disease.

2. Only in children 2-10 years old.

Table 4.2 NIGER - SEX DISTRIBUTION OF XEROPHTHALMIA STRATIFIED BY AGE GROUP(1)

Age in Years	Condition	Sex	n	%
0-5	XN(2)	Boys	20	(4.18%)
		Girls	18	(3.77%)
	X1B	Boys	5	(0.73%)
		Girls	5	(0.72%)
	X2	Boys	0	(0.00%)
		Girls	1	(0.14%)
	X3	Boys	1	(0.15%)
		Girls	1	(0.14%)
	XS	Boys	2	(0.29%)
		Girls	1	(0.14%)
6-10	XN	Boys	10	(3.76%)
		Girls	19	(5.52%)
	X1B	Boys	4	(1.50%)
		Girls	0	(0.00%)
	X2	Boys	0	(0.00%)
		Girls	0	(0.00%)
	X3	Boys	0	(0.00%)
		Girls	0	(0.00%)
	XS	Boys	3	(1.13%)
		Girls	2	(0.58%)

1. Categories mutually exclusive, coded by worst condition.

2. Only in children ages 2-10 years old.

Age in Years	Province	Normal		XN(2)		X1B		X2		X3		XS		Total
		n	%	n	%	n	%	n	%	n	%	n	%	N
0-5	RURAL													
	Tahoua (3 sites)	372	(96.37%)	9	(3.11%)	2	(0.52%)	0	(0.00%)	1	(0.26%)	2	(0.52%)	386
	Maradi (3 sites)	397	(93.41%)	20	(7.33%)	5	(1.18%)	1	(0.24%)	1	(0.24%)	1	(0.24%)	425
	Zinder (3 sites)	411	(97.39%)	9	(3.21%)	2	(0.47%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	422
		1,180	(95.70%)	38	(3.08%)	9	(0.73%)	1	(0.08%)	2	(0.16%)	3	(0.24%)	1,233
	URBAN													
	Tahoua (Bilbiss) (1 site)	154	(99.36%)	0	(0.00%)	1	(0.65%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	155
6-10	RURAL													
	Tahoua (3 sites)	199	(93.43%)	11	(5.16%)	2	(0.94%)	0	(0.00%)	0	(0.00%)	1	(0.47%)	213
	Maradi (3 sites)	163	(91.06%)	14	(7.82%)	1	(0.56%)	0	(0.00%)	0	(0.00%)	1	(0.56%)	179
	Zinder (3 sites)	163	(96.45%)	3	(1.78%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	3	(1.78%)	169
		525	(93.58%)	28	(4.99%)	3	(0.53%)	0	(0.00%)	0	(0.00%)	5	(0.89%)	561
	URBAN													
	Tahoua (1 site)	48	(96.00%)	1	(2.00%)	1	(2.00%)	0	(0.00%)	0	(0.00%)	0	(0.00%)	50

1. Categories mutually exclusive, coded by worst condition.

2. Only in children 2-10 years old.

Table 4.4 NIGER - PREVALENCE OF TRACHOMA STRATIFIED BY AGE GROUP

Age in Years	Severity of Trachoma	n	%
0-5 (1)	mild	18	(19.06%)
	moderate	129	(20.84%)
	severe	18	(2.91%)
6-10 (2)	mild	31	(10.99%)
	moderate	52	(18.44%)
	severe	3	(1.06%)

1. 619 children 0-5 examined.
2. 282 children 6-10 examined.

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Table 4.5 NIGER - SEX DISTRIBUTION OF TRACHOMA STRATIFIED BY AGE GROUP

Age in Years	Severity of Trachoma	Sex	n	%
0-5(1)	mild	Boys	52	(16.72%)
		Girls	66	(21.43%)
	moderate	Boys	77	(24.76%)
		Girls	52	(16.88%)
	severe	Boys	10	(3.23%)
		Girls	8	(2.50%)
6-10(2)	mild	Boys	12	(10.34%)
		Girls	19	(11.45%)
	moderate	Boys	27	(23.28%)
		Girls	25	(15.06%)
	severe	Boys	2	(1.72%)
		Girls	1	(0.60%)

1. 619 children 0-5 examined.

2. 282 children 6-10 examined.

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APPENDIX I:

SURVEY PARTICIPANTS

BURKINA FASO

Ministry of Health

Ambroise Nanema	Nutritionist, Director of Maternal and Child Health
Elizabeth Quedraogo	Interviewer
Kyelem Sosthene	Ophthalmic Nurse, National Center for Blindness Prevention

Helen Keller International

Anne Paxton, MPH	Public Health Specialist
Omofolasade Kosoko, MD, MPH	Consultant Ophthalmologist

UNICEF

Zerfinish K. Bendow	Program Officer, Food and Nutrition Program

CHAD

Ministry of Health

Djimet Ngabgalia	Interviewer

USAID/Chad

Abel Albar	Health Assistant

Omofolasade Kosoko, MD, MPH	Consultant Ophthalomologist

Helen Keller International

Rita Leavell, MD, MBA	Pediatrician

Cooperation Francaise

Serge Resnikoff, MD	Ophthalmologist

MALI

CARE

UNICEF

Operation YELLEN

Zoumana Ko	Representative

Helen Keller International

Rita Leavell, MD, MBA	Pediatrician
Rogers Pierson, MD	Consultant Ophthalmologist
Celine Rousseau, MD	Consultant Pediatrician

NIGER

Ministry of Health

Hadiza Djibo	Nutritionist
Hassane Toukon	Ophthalmic Nurse
Aichatou Kiari	Interviewer

Helen Keller International

Anne Paxton, MPH	Public Health Specialist
Omofolasade Kosoko, MD, MPH	Ophthalmologist
Nancy Sloan, Dr.P.H.	Epidemiologist

APPENDIX II

LIST OF SITES BY PROVINCE

BURKINA FASO

Province	Village	Number of Children
Yatenga	Toubiengo-Silmi-Mossi	207
	Zom	216
	Koungo	211
	Youba	199
	Soubo	206
Passore	Gonsin	192
	Boura	201
	Yako	199
Sourou	Lerry	200
	Touaga	203

LIST OF SITES BY PROVINCE

CHAD

Province	Village	Number of Children
Chari Baguirme	N'Djamena (Blabine)	103
	Seita	83
	Bodero	147
	Karnak	216
	Doum-Doumou	145
Batha	Guella	142
	Sarya	38
	Sigho	70
	Abgougka	80
	Al-Midjelit	55
	Azaef	18
	Babah	182
	Dopdop	215
Ouaddai	Aboudoura	217

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LIST OF SITES BY PROVINCE

MALI

Province	Village	Number of Children
Tomboctou	Iloua	133
	Bokiatt	75
	Puits Kaddi	27
	Goundam (displaced persons)	286
	Tondigame	195
	Ebangue	166
	San Fatou	118
	Teriquen	21
	Puits Badi	14
	Puits Oulad Ich	42
	Dar Elboida	67
	Agouni	119
	Nibkitt	88
:gou	Mierou	175
	Wani	239
	Macina Ville (displaced persons)	19

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