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LOWER SHIRE VALLEY

OCULAR DISEASE SURVEY

Final Report

Ministry of Health
Government of Malawi

Preface

The Lower Shire Valley Ocular Disease Survey was conducted as the first phase of an integrated program for the prevention of blindness in this area of Malawi. Its primary objective was to provide baseline data on the magnitude of the problem, the principle causes of blindness and their geographic distribution within the valley. These data now serve as a reference for the design and ultimate evaluation of a series of both short-term and long-term interventions designed to reduce the toll of the three major blinding conditions: cataract, xerophthalmia, and trachoma.

Acknowledgments

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Introduction

The Lower Shire River Valley is well-known in Malawi as an area where blindness is endemic. The prevention of blindness has been designated a major health priority by the government of Malawi. As a start to addressing this major problem, the government of Malawi requested the assistance of a number of public health organizations in planning and designing a blindness prevention program for the Lower Shire Valley.

The long range goal of this program is to reduce the prevalence of avoidable blindness in the population to a point where it is no longer a major impediment to social and economic development. Intermediate to this long range goal are objectives such as:

1) Training of medical and health personnel in the detection and prevention of blinding eye disease.

2) Education and motivation of public in the prevention of blindness.

3) Deployment of necessary manpower and resources to areas most at risk of eye disease and avoidable blindness.

4) Planning, implementation and evaluation of a regional intervention program to reduce the prevalence of blinding eye disease based on results of a baseline prevalence survey.

Due to the recognized need to quantify the extent and distribution of blinding eye disorders in the Lower Shire Valley, for program planning and to serve as a baseline against which the effectiveness of intervention activities will be evaluated, a prevalence survey of ocular diseases was undertaken. The following were the specific objectives of this baseline survey:

1) To estimate the prevalence of defined stages of xerophthalmia among under-six year old children in the Lower Shire Valley.

2) To determine nutritional, infectious, and other environmental risk factors which are associated with the development of corneal and non-corneal xerophthalmia.

3) To identify resources at the community household level which provide targets for specific intervention strategies to prevent the development of xerophthalmia.

4) To identify and estimate the prevalence of the major causes of blindness across all age groups.

5) To determine hygienic and other household characteristics associated with active inflammatory trachoma in children.

The comprehensive approach embodied in the goals and objectives served as a regional demonstration project in Southern Africa with representatives from Botswana, Lesotho, Swaziland, Tanzania, Zambia, and Zimbabwe participating in the baseline survey.

Study Design

The general design of the study was a cross-sectional prevalence survey of 5,436 children under six years of age in 71 villages in the Lower Shire Valley. In addition, 1,664 individuals six years of age and older were also sampled in a subsample of ten villages. The survey was conducted in October and November of 1983 during the dry season. Data collected during the survey included:

1) An Ophthalmic and Physical Examination

An ocular examination of all children which stressed diagnosis of xerophthalmia, trachoma and other anterior segment lesions was done. In addition, these children were examined for signs of pedal edema and measles rash. For those six years of age and older, a visual acuity was taken and then an examination was conducted. For those with non-refractive visual loss, a dilated exam was conducted to determine the cause of this decreased acuity.

2) A Nutritional Assessment Examination

For children, a random sample and all cases of xerophthalmia and their controls had their height and weight measured. A Dietary Interview was also conducted with the mothers of these children that focused on the availability of vitamin A and beta-carotene containing food in the area, their seasonality and use by families and children. In addition, the availability of potentially fortifiable foods was investigated. For those six years of age and older no nutritional assessment was conducted.

3) Other Socioeconomic and Environmental Data were also collected as a means for planning future intervention programs for xerophthalmia and trachoma. In particular, data concerning levels of crowding, availability of water and its uses, particularly for washing, shared sleeping facilities, ownership of animals and other data were collected.

The field work for this survey was conducted by three survey teams consisting of an ophthalmologist-team leader, approximately four household enumerators, two clinical assistants and advance visit field officers, and a nurse anthropometrist. The total field work took approximately six weeks. Specific information regarding field team composition, training, and survey procedures can be found in the Manual of Operations.

RESULTS

Blindness

Bilateral blindness is the most serious sequelae of ocular disease and imposes significant economic and social burdens on affected individuals and communities. The overall blindness prevalence among those six years of age and older in the Lower Shire Valley was 1.27%. Table 1 shows the increasing rate of bilateral blindness (defined as a visual acuity of less than 3/60 in the better eye) with age from less than 1% under age 50 to over 10% in those 70 years of age and older. The prevalence for those 50 years and older was 4.79%. Tables 2 and 2A show blindness prevalence by cause and give a short description of the clinical findings for each case. Cataract accounted for 40% of the blindness with corneal-related events accounting for 30%. None of the corneal blindness was caused by trichiasis. This does not necessarily mean that trachoma is an unimportant cause of bilateral blindness in this population. Both inflammatory and cicitricial trachoma can act synergistically with other infectious processes to cause severe corneal scarring.

Monocular blindness was more than twice as common as binocular blindness with an overall prevalence of 2.7% in those six years of age and older.. Table 3 shows prevalence by age. Rates increased dramatically with age up to 14.3% in the 70+ years old age group. Cornea-related pathology dominated this group accounting for 57% of all monocular blindness (Table 4). Cataract was the second most common cause accounting for 21%. Table 5 presents the distribution of visual acuity in the better eye among those who are monocularly blind. These data show that 7.1% of those who are already blind in one eye are nearly blind (6/60-3/60) in their better eye. Fortunately, the vast majority of monocularly blind persons have good vision in their other eye.

Table 1

Prevalence of Bilateral Blindness in Persons 6 Years of Age and Older, Lower Shire Valley, Malawi, 1983

n = 1664

Age	Number Blind	Total	Prevalence	95% CI*(1)
6 - 29 yrs.	1	844	0.12%	(0.01, 0.66)
30 - 49 yrs.	4	417	0.96%	(0.24, 2.45)
50 - 59 yrs.	2	141	1.42%	(0.14, 5.11)
60 - 69 yrs.	7	116	6.03%	(1.70, 10.40)
70 yrs. +	6	56	10.71%	(2.61, 18.82)
Total	20	1574(2)	1.27%	(0.76, 1.96)

(1)* 95% Confidence Interval

(2) 90 subjects were missing data on visual acuity.

Table 2

Prevalence of Bilateral Blindness in Persons 6 Years of Age and Older by Cause, Lower Shire Valley, Malawi, 1983

Cause	Number Blind	Prevalence	95% C.I.
Cataract	8	0.51%	(0.22, 1.09)
Cornea-Related	6	0.38%	(0.14, 0.83)
Glaucoma	3	0.19%	(0.04, 0.56)
Retinal Disease	1	0.06%	(0.01, 0.36)
Unknown Cause	2	0.13%	(0.01, 0.46)
Total	20	1.27%	(0.76, 1.96)

Table 2A

Summary of Bilaterally Blind Subjects
6 Years of Age and Older, Lower Shire Valley,
Malawi, 1983

Bilateral Cause	Right Eye	Left Eye
Lens	Leukoma (leprosy) ectropian vascularized scar	Lens (nuclear immature cataract)
Lens	Lens (mature, cortical cataracts)	Lens (mature cortical cataracts)
Lens	Lens (mature cataract)	Lens (mature cataract)
Lens	Lens (nuclear, immature cataract)	Lens (nuclear, immature cataract)
Lens	Lens (nuclear, immature cataract)	Lens (nuclear, immature cataract)
Lens	Lens (mature cortical cataract)	Lens (mature cortical cataract)
Lens	Mature cataract, leukoma (infection)	leukoma (infection)
Lens	Dislocated lens	Aphakia, glaucoma?
Corneal	Adherent leukoma (smallpox)	Phthisis (smallpox)
Corneal	Phthisis (smallpox)	Phthisis (smallpox)
Corneal	Adherent leukoma (infection) secondary glaucoma	Adherent leukoma (infection) secondary glaucoma
Corneal	Dense leukoma (smallpox)	Phthisis (smallpox)
Corneal	Phthisis (diarrhea, fever)	Phthisis (diarrhea, fever)
Corneal	Phthisis (infection)	Phthisis (infection)
Glaucoma	Glaucoma nebulae, immature nuclear cataract	Phthisis (no history) mature cataract
Glaucoma	Glaucoma, mature cataract	Glaucoma, mature cataract
Glaucoma	Phthisis (no history)	Glaucoma, PSC immature cataract totally excavated disc
Retinal	Optic nerve (atrophy)	Optic nerve (atrophy)
?	Missing	Missing
?	Missing	Missing

Table 3

Prevalence of Monocular Blindness by Age
Among Persons 6 Years of Age and Older,
Lower Shire Valley, Malawi, 1983

n = 1664

Age	Total n	Number Monocularly Blind	Prevalence	95% CI
6 - 29	844	10	1.2%	(0.6, 2.2)
30 - 49	417	10	2.4%	(0.9, 3.9)
50 - 59	141	5	3.5%	(0.5, 6.6)
60 - 69	116	9	7.8%	(2.9, 12.6)
70+	56	8	14.3%	(5.1, 23.5)
Total	1574(1)	42	2.7%	(1.9, 3.5)

(1) 90 subjects were missing data on visual acuity.

Table 4

Prevalence of Monocular Blindness by Cause
Among Persons 6 Years of Age and Older,
Lower Shire Valley, Malawi, 1983

Cause	Number Monocularly Blind	Prevalence	95% CI
Cornea-related[1]	24	1.5%	(1.0, 2.3)
Cataract	9	0.6%	(0.3, 1.1)
Amblyopia	4	0.3%	(0.06, 0.65)
Retinal Disease	3	0.2%	(0.04, 0.56)
Congenital	1	0.06%	(0.006, 0.36)
Unknown Cause	1	0.06%	(0.006, 0.36)
Total	42	2.7%	(1.9, 3.5)

(1) Includes 8 phthisical eyes

Table 5

Visual Acuity of Fellow Eye in Those Who Are Monocularly Blind Among Persons 6 Years of Age and Older, Lower Shire Valley, Malawi, 1983

Visual Acuity in Fellow Eye	Number Monocularly Blind	Percent
6/18 or better	36	85.8%
<6/18 - 6/60	3	7.1%
<6/60 - 3/60	3	7.1%
Total	42	100%

The prevalence of best corrected (pinhole) visual acuity (in the better eye) among all survey subjects examined is presented in Table 6. Forty-seven subjects (3.0%) showed a non-blinding loss of vision greater than 6/18. The rate of visual impairment (<6/18 to 3/60) also increased with age resulting in 12.5% of those age 50 or older affected. Combining visual impairment and blindness rates shows that almost 1 person in 20 among those 6 years of age and older in the Lower Shire Valley have a non-refractive loss of vision below 6/18.

Visual loss among children under six years of age is reported in Table 7. Visual acuities were not measured on these young children and the presence of visual loss was based upon the ophthalmologists' clinical judgement. Corneal pathology was responsible for 71% of all visual loss among these children and six of these corneal cases were considered bilaterally blind. Table 8 presents the prevalence by age of these bilaterally blind children. All six of these cases were classified as probably resulting from xerophthalmia. Among those with only unilateral loss of vision, cornea-related pathology accounted for 65.6% amblyopia/strabismus for 18.8% with the remaining 15.6% distributed between cataracts, optic atrophy, and congenital conditions.

Xerophthalmia

It was suspected from previous work by Chirambo and Benezra that xerophthalmia and measles were major causes of corneal blindness among young children in the Lower Shire Valley. Results for active xerophthalmia among children under six years of age are represented in Tables 9, 10, and 11. The overall prevalence of active signs or symptoms of vitamin A deficiency was approximately 4%. There was very little difference between the sexes except for a higher rate of X1B (Bitot's spots) among males similar to that found in Asian cultures. The three to five year age group showed the highest rates for all clinical signs and symptoms. In both sexes the rates of nightblindness and Bitot's spots, both signs of mild vitamin A deficiency, increased with age. This too is similar to the situation found in Asia.

Table 12 shows the prevalence and cause of corneal scarring among children. Cause was determined by consensus opinion after review of clinical parameters such as location and density of the scar, whether scarring was unilateral or bilateral, and a review of the history of events immediately proceeding the development of the scar. All corneal scars were ranked on a scale ranging from classical xerophthalmia to definitely not xerophthalmia. Only those judged to be either classic presentations of xerophthalmic scarring or those with a high likelihood of being due to xerophthalmia were defined as

Table 6

Best Corrected Visual Acuity Among Persons 6 Years and Older by Age, Lower Shire Valley, Malawi, 1983

n = 1664

Visual Acuity	Total n		Age in Years 6 - 14 yrs.		15 - 29 yrs.		30 - 49 yrs.		>=50 yrs.	
6/18 or better	1507	(95.7)	424	(99.5)	416	(99.5)	408	(97.8)	259	(82.7)
<6/18 - 6/60 (2)	30	(1.9)	2	(0.5)	1	(0.2)	3	(0.7)	24	(7.7)
<6/60 - 3/60 (2)	17	(1.1)	0	--	0	--	2	(0.5)	15	(4.8)
Less than 3/60 (3)	20	(1.3)	0	--	1	(0.2)	4	(1.0)	15	(4.8)
Total	1574 (1)	(100%)	426	(100%)	418	(100%)	417	(100%)	313	(100%)

(1) 90 subjects were missing data on visual acuity.

(2) Visual impairment, by WHO criteria

(3) Blindness, by WHO criteria

Table 7

Prevalence of Visual Loss by Cause
Among Children Less Than 6 Years
of Age, Lower Shire Valley,
Malawi, 1983

Cause	Number with Visual Loss	Prevalence	95% C.I.
Bilateral			
Cornea-related	6	0.11%	(0.04, 0.24)
Unilateral			
Cornea-related	21	0.39%	(0.24, 0.59)
Amblyopia/Strabismus	6	0.11%	(0.04, 0.24)
Cataract	2	0.04%	(0.004, 0.13)
Optic Atrophy	1	0.02%	(0.002, 0.10)
Congenital Conditions	2	0.04%	(0.004, 0.13)
Total	38	0.70%	(0.49, 0.96)

Table 8

Prevalence of Bilateral Blindness Due to Corneal Scarring in Children Less Than 6 Years of Age, Lower Shire Valley, Malawi, 1983

Age	Number Blind	Total	Prevalence	95% C.I.
0-1 yrs.	2	2025	0.10%	(0.01, 0.36)
2-3 yrs.	2	1929	0.10%	(0.01, 0.37)
4-5 yrs.	2	1482	0.14%	(0.01, 0.49)
Total	6	5436	0.11%	(0.04, 0.24)

Table 9

Prevalence Rates of Active Xerophthalmia in Children Less Than 6 Years of Age, Lower Shire Valley, Malawi, 1983

n = 5436(1)

Xerophthalmia Grade	n	Prevalence rate/1,000	95% C.I.
XN	184	33.94	(29.46, 39.15)
X1A	5	0.92	(0.30, 2.16)
X1B	18	3.32	(1.97, 5.24)
X2 + X3(2)	3	0.55	(0.11, 1.62)
Total	210	38.73	(33.94, 44.26)

(1) 14 subjects' examination results for xerophthalmia were left blank.

(2) 2 subjects originally called X2 - X3 on the examination forms were subsequently excluded based on a review of clinical findings.

Table 10

Prevalence Rates of Active Xerophthalmia
in Children Less Than 6 Years Old,
by Sex, Lower Shire Valley, Malawi, 1983
n = 5436(1)

Xerophthalmia Grade	Male (n = 2597)(2)			Female (n = 2818)(2)		
	n	rate/1,000	95% CI	n	rate/1,000	95% CI
XN	89	34.13	(27.16, 41.09)	96	34.07	(27.37, 40.76)
X1A	2	0.77	(0.08, 2.76)	3	1.07	(0.21, 3.14)
X1B	12	4.62	(2.39, 8.09)	6	2.13	(0.78, 4.65)
X2 + X3	1	0.38	(0.04, 2.15)	2	0.71	(0.07, 2.57)
Total	104	40.05	(32.51, 47.59)	107	37.97	(30.91, 45.03)

(1) 14 subjects were missing ocular examination results for active xerophthalmia.

(2) 21 subjects were missing sex, including one case of XN.

Table 11

Prevalence Rates of Active Xerophthalmia
in Children Less Than 6 Years of Age,
by Age, Lower Shire Valley, Malawi, 1983

n = 5436(1)

	XEROPHTHALMIA GRADE							
	XN		X1A		X1B		X2 - X3	
Age	n	rate/1,000	n	rate/1,000	n	rate/1,000	n	rate/1,000
< 1 yr.(2)	--	--	0	0	0	0	0	0
1 yr.(2)	--	--	0	0	1	1.04	1	1.04
2 yrs.	33	35.03	0	0	2	2.12	0	0
3 yrs.	45	45.59	2	2.03	4	4.06	1	1.01
4-5 yrs.	106	71.52	3	2.02	11	7.42	1	0.67
Total	184	33.94	5	0.92	18	3.31	3	0.55

(1) 14 subjects were missing ocular examination results for active xerophthalmia.

(2) Nightblindness was not ascertained for children under 2 years of age.

Table 12

Prevalence Rates of Corneal Scars
in Children Less Than 6 Years of Age
by Cause, Lower Shire Valley, Malawi, 1983

n = 5436(1)

Cause	n	rate/10,000	95% CI
Xerophthalmia(2)	32	59.02	(40.21, 83.18)
Suspected Xerophthalmia(3)	8	14.75	(6.27, 29.14)
Trauma	3	5.53	(1.11, 16.23)
Others(4)	33	60.86	(41.87, 85.39)
Total	76	140.17	(108.70, 171.30)

(1) 14 subjects were missing results of ocular examinations.

(2) Includes corneal scars with clinical presentation and history consistent with xerophthalmia.

(3) Includes corneal scars with clinical presentation and history which could be consistent with xerophthalmia.

(4) Includes 18 cases for whom there was insufficient information to establish a cause.

xerophthalmia scars. Eighteen cases or 23.7% had insufficient data to determine cause. Among those for whom there were sufficient data to judge the cause, 32 of 58 (55.2%) were thought due to xerophthalmia. There was little difference by age in the rates of xerophthalmia scarring (see Table 13). Even if there were no additional xerophthalmia-related corneal scars among those cases with unknown cause, the prevalence of 59 per 10,000 is 11.8 times the WHO criteria for defining a problem of public health significance. Table 14 also shows that active disease rates are higher in Malawi for night blindness and for corneal disease (XN and X2-X3) than the WHO criteria. Bitot's spots (X1B) are the only exception and even for this sign the confidence interval includes the WHO criterion. It may be that conditions such as measles and diarrhea acutely stress already marginal vitamin A reserves resulting in direct progression to corneal disease without passing through the "milder" stages of vitamin A deficiency.

Measles also plays an important role in corneal damage among young children and has been closely associated with xerophthalmia in a number of countries. Table 15 presents data on the association of a past history of measles and corneal scarring. Over 50% of these cases defined as xerophthalmic scars had a history of measles in the month prior to the development of the scar. It is possible that some of this measles-associated blindness occured through mechanisms other than exacerbation of vitamin A deficiency.

Trachoma

The climate and environmental conditions in the Lower Shire Valley are typical of areas with endemic trachoma. The valley is hot and dry much of the year and few villages have adequate water supply or waste disposal capabilities. The prevalence of inflammatory trachoma reflects these environmental conditions. Table 16 presents data on the severity of inflammatory trachoma for this population. The total prevalence of all signs of trachoma was almost 40% in children less than 6 years of age. The highest rates occurred in the one to three year olds, but even among those less than twelve months of age, 20% had evidence of active disease. Severe inflammatory trachoma peaked in the one year olds with 11.2% being affected by this potentially blinding condition. The prevalence of inflammatory trachoma decreases markedly with increasing age in the adult population, although 3% of those 50 years of age and older still shows signs of inflammatory trachoma. Table 17 shows essentially no difference in rates between males and females among the young children. However in adults, there is a 3.75 fold excess of severe inflammatory disease in women compared with men (Table 18). This excess of severe disease in adult women is also shown in the data on trachoma scarring (Table 19) where there is an 8 fold difference between men and women in the

Table 13

Prevalence of Corneal Scars in Children Less Than 6 Years of Age by Cause and Age, Lower Shire Valley, Malawi, 1983

Age at Time of Survey	Xero.		Xero. Susp.		Trauma		Other		Total	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
< 1 year	0	0.0	1	0.09%	0	0.0	2	0.19%	3	0.28%
1 year	6	0.63%	1	0.10%	1	0.10%	6	0.63%	14	1.46%
2 years	6	0.64%	1	0.11%	0	0.0	1	0.11%	8	0.85%
3 years	7	0.71%	1	0.10%	0	0.0	7	0.71%	15	1.52%
4-5 years	13	0.88%	4	0.27%	2	0.13%	17	1.15%	36	2.43%
Total	32	0.59%	8	0.15%	3	0.06%	33	0.61%	76	1.40%

Table 14

Comparison of Prevalence Rates of Xerophthalmia in Malawi with WHO Criteria for Public Health Significance

Xerophthalmia Grade	Malawi	WHO Criteria
XN	3.39%	1.0%
X1B	0.33%	0.5%
X2-X3	5.5/10,000	1/10,000
XS	59/10,000	5/10,000

Table 15

Percentage of Children Less Than 6 Years of Age with Corneal Scars Reporting a History of Measles in the Month Prior to Onset by Cause, Lower Shire Valley, Malawi, 1983

Cause	Measles History		Total
	Positive	Negative	
Xerophthalmia (XS)	18 (56.3%)	14 (43.7%)	32 (100%)
Suspected Xerophthalmia	3 (37.5%)	5 (62.5%)	8 (100%)
Trauma	0 (0%)	3 (100%)	3 (100%)
Other(1)	2 (6.1%)	31 (93.9%)	33 (100%)
Total	23 (30.3%)	53 (69.7%)	76 (100%)

(1) 18 cases have missing data on preceeding events so only 13 cases in this category were truly negative for a history of measles.

Table 16

Prevalence of Inflammatory Trachoma,
Lower Shire Valley, Malawi, 1983

n = 7100(1)

Age	n	Severity of Inflammation: Mild %	Mild 95% C.I.	Moderate %	Moderate 95% C.I.	Severe %	Severe 95% C.I.	Total %	Total 95% C.I.
<1 yr.	1065	7.8	(6.2, 9.4)	5.8	(4.4, 7.2)	8.2	(6.6, 9.8)	21.8	(19.3, 24.3)
1 yr.	958	21.7	(19.1, 24.3)	18.2	(15.6, 20.6)	11.2	(9.2, 13.2)	51.0	(47.8, 54.2)
2 yr.	941	20.1	(17.5, 22.6)	18.4	(15.9, 20.9)	7.9	(6.2, 9.6)	46.3	(43.1, 49.5)
3 yr.	982	18.1	(15.7, 20.5)	19.5	(17.0, 22.0)	6.7	(5.1, 8.3)	44.3	(41.2, 47.4)
4 yr.	906	14.9	(12.6, 17.2)	17.5	(15.0, 20.0)	6.6	(5.0, 8.2)	39.1	(35.9, 42.3)
5 yr.	572	15.4	(12.4, 18.3)	13.6	(10.8, 16.4)	4.2	(2.6, 5.8)	33.2	(29.3, 37.1)
6-14 yrs.	474	7.6	(5.2, 10.0)	6.8	(4.5, 9.0)	2.3	(1.0, 3.7)	16.7	(13.3, 20.0)
15-29 yrs.	436	3.2	(1.5, 4.9)	0.5	(0.05, 1.7)	0.9	(0.2, 2.3)	4.6	(2.6, 6.6)
30-49 yrs.	429	2.1	(0.9, 4.0)	0.2	(0.02, 1.3)	1.6	(0.7, 3.4)	4.0	(2.1, 5.8)
50 + yrs.	313	2.9	(1.3, 5.5)	0	--	0	--	2.9	(1.3, 5.5)

(1) 24 subjects are missing ocular examination results for inflammatory trachoma.

Table 17

Prevalence of Inflammatory Trachoma in Children
Less Than 6 Years of Age, by Sex, Lower Shire Valley,
Malawi, 1983

n = 5436(1)

		Severity of Inflammatory Trachoma							
		Mild		Moderate		Severe		Total	
Sex	n	%	95% C.I.	%	95% C.I.	%	95% C.I.	%	95% C.I.
Male	2591	16.4	(15.0, 17.8)	15.5	(14.1, 16.9)	7.3	(6.3, 8.3)	39.2	(37.3, 41.1)
Female	3812	16.0	(14.8, 17.2)	15.4	(14.3, 16.5)	8.0	(7.1, 8.9)	39.4	(37.9, 41.0)
Total	5403	16.2	(15.2, 17.2)	15.4	(14.4, 16.4)	7.7	(7.0, 8.4)	39.3	(38.0, 40.6)

(1) 12 subjects are missing ocular examination results for inflammatory trachoma and 21 are missing data on sex.

Table 18

Prevalence of Inflammatory Trachoma in Person 6 Years and Older By Sex, Lower Shire Valley, Malawi, 1983

n = 1664(1)

Sex	Total n	Severity of Inflammation: Mild %	Mild 95% C.I.	Moderate %	Moderate 95% C.I.	Severe %	Severe 95% C.I.	Total %	Total 95% C.I.
Male	668	3.0	(1.7, 4.3)	2.8	(1.6, 4.1)	0.4	(0.1, 1.3)	6.3	(4.4, 8.1)
Female	984	4.9	(3.5, 6.2)	1.6	(1.0, 2.6)	1.9	(1.2, 3.0)	8.4	(6.7, 10.2)
Total	1652	4.1	(3.2, 5.1)	2.1	(1.4, 2.8)	1.3	(0.8, 1.9)	7.6	(6.3, 8.9)

(1) 12 subjects are missing ocular exam results for inflammatory trachoma.

Table 19

Prevalence of Cicitricial Trachoma in Persons 6 Years and Older By Sex, Lower Shire Valley, Malawi, 1983

n = 1664(1)

Sex	Total n	Severity of Scarring: Mild %	Mild 95% C.I.	Moderate %	Moderate 95% C.I.	Severe %	Severe 95% C.I.	Total %	Total 95% C.I.
Male	667	17.1	(14.2, 19.9)	3.0	(1.7, 4.3)	0.15	(0.01, 0.84)	20.2	(17.2, 23.3)
Female	982	20.3	(17.8, 22.8)	5.6	(4.2, 7.0)	1.22	(0.63, 2.14)	27.1	(21.7, 32.4)
Total	1649	19.0	(17.1, 20.9)	4.5	(3.5, 5.5)	0.79	(0.42, 1.35)	24.3	(22.2, 26.3)

(1) 15 subjects are missing ocular exam results for trachoma scarring.

prevalence of severe scarring (trichiasis). This excess risk among adult women is consistent with data reported from other countries.

Trachomatous conjunctival scarring is well-known to be associated with age. This association is also seen in the Lower Shire Valley (Table 20). Rates for mild scarring rise from less than 1% in infants to almost 30% in those 50 and older. A similar rise occurs for moderate scarring with a peak of approximately 10% in the oldest age group. In spite of high rates of inflammatory disease among children, the rates of trichiasis in the adult population were unexpectedly low. Among those 50 years of age and older only 1.9% had this form of severe scarring. The discrepancy between the rate of acute disease and subsequent trichiasis may indicate that there has been a recent increase in endemic severe inflammatory disease in the Lower Shire Valley.

The prevalence of inflammatory trachoma also varied geographically as shown in Table 21. The most important geographic determinant of risk was distance of village to the river. Table 22 shows that rates of moderate to severe inflammatory disease in children increased significantly as one went further west from the river. The same was true for rates of all inflammatory trachoma. Villages on the east side of the river had rates similar to those of the villages closest to the river on the west side. This east-west difference was expected because the escarpment is much closer to the river on the east side than it is on the west.

A number of social factors and hygiene parameters were examined for their effects on rates of inflammatory trachoma. Results are preliminary and may be affected by confounding variables.

Two indices of crowding were used, total household size and number of persons sleeping with the child. Tables 23 and 24 show prevalence rates of total and moderate-severe inflammatory trachoma for these two measures of crowding. The expected pattern of increased risk with increased crowding does not hold true in this population. It can be assumed then, that household-level crowding is not likely to be a major determinant of infection load and transmission in the Lower Shire Valley.

Recent data from Mexico suggests that a major factor in risk of inflammatory trachoma in young children may be their face washing habits. Table 25 shows prevalence of inflammatory disease for different levels of weekly face washing stratified by the prevalence of trachoma at the traditional area level. There is generally a consistent trend towards lower rates among those who wash their faces more often. The differences however, are small.

Table 20

Prevalence of Cicitricial Trachoma,
Lower Shire Valley,
Malawi, 1983

n = 7100(1)

Age	n	Severity of Scarring: Mild %	Mild 95% C.I.	Moderate %	Moderate 95% C.I.	Severe %	Severe 95% C.I.	Total %	Total 95% C.I.
< 1 yr.	1065	0.4	(0.1, 1.0)	0	-	0	-	0.4	(0.1, 1.0)
1 yr.	956	2.5	(1.6, 3.7)	0.1	(0.01, 0.6)	0.2	(0.02, 0.7)	2.8	(1.9, 4.1)
2 yrs.	940	5.7	(4.2, 7.2)	0.1	(0.01, 0.6)	0	-	5.9	(4.4, 7.4)
3 yrs.	980	10.6	(8.7, 12.5)	0.4	(0.1, 1.0)	0	-	11.0	(9.0, 13.0)
4 yrs.	905	12.6	(10.4, 14.8)	0.8	(0.3, 1.6)	0	-	13.4	(11.2, 15.6)
5 yrs.	573	14.7	(11.8, 17.6)	0.5	(0.1, 1.5)	0	-	15.2	(12.3, 18.1)
6-14 yrs.	494	10.7	(8.0, 13.5)	0.6	(0.1, 1.8)	0	-	11.3	(8.5, 14.1)
15-29 yrs.	422	16.6	(13.0, 20.1)	3.3	(1.6, 5.0)	0.2	(0.02, 1.3)	20.1	(16.3, 24.0)
30-49 yrs.	420	23.3	(19.3, 27.4)	6.2	(3.9, 8.5)	1.4	(0.5, 3.1)	31.0	(26.5, 35.4)
50 + yrs.	313	29.4	(24.3, 34.4)	10.2	(6.9, 13.6)	1.9	(0.7, 4.2)	41.5	(36.1, 47.0)

(1) 32 subjects are missing ocular exam results for cicitricial trachoma.

Table 21

Prevalence of Inflammatory Trachoma
in Children Less Than 6 Years of Age
by Traditional Area, Lower Shire Valley,
Malawi, 1983

	Number with Trachoma	Prevalence of Moderate-Severe Inflammation	Prevalence of All Trachomatous Inflammation
Chickwawa District			
Ngabu T.A.	1269	32.0%	48.5%
Chapanarga T.A.	571	18.6%	35.9%
Massea T.A.	152	20.4%	46.1%
Katunga T.A.	356	19.9%	35.7%
Kasisi T.A.	251	11.2%	21.1%
Makhuwira T.A.	488	13.1%	29.1%
Nsanje District			
Ndamera T.A.	227	37.4%	50.7%
Chimombo T.A.	192	32.8%	49.0%
Nyachikadza T.A.	162	17.3%	34.0%
Mlolo T.A.	727	19.7%	37.6%
Tengani T.A.	455	17.1%	31.6%
Mbenje T.A.	508	25.4%	43.5%
Malenia T.A.	66	21.2%	33.3%

Table 22

Prevalence of Moderate-Severe Inflammatory Trachoma in Children Less Than 6 Years of Age by Distance to the Shire River, Lower Shire Valley, Malawi, 1983

n = 5436(1)

Location of Village	Total N	Number Affected	Prevalence		95% C.I.
East of River	1498	247	16.5%		(14.6, 18.4)
West, <= 1 km	1003	178	17.7%	(2)	(15.4, 20.1)
West, 2-4 km	476	107	22.5%	(2)	(18.7, 26.2)
West, >= 5 km	2447	719	29.4%	(2)	(27.6, 31.2)
Total	5424	1251	23.1%		(21.9, 24.2)

(1) 12 subjects are missing ocular exam results for inflammatory trachoma.

(2) Test for trend among those on west side of river $Z = 7.28$, $p<.01$

Table 23

Prevalence of Trachoma in Persons Less Than 6 Years of Age by Household Size, Lower Shire Valley, Malawi, 1983

Number of persons in household	Total n	Prevalence	
		Moderate Severe	All Trachoma
2	35	14.3	28.6
3	420	22.1	37.4
4-5	1685	23.7	39.3
6-7	1590	22.3	38.7
≥ 8	1694	24.5	40.8

Table 24

Prevalence of Trachoma in Persons Less Than 6 Years of Age by Number of Persons sleeping with Index Child, Lower Shire Valley, Malawi, 1983

Number of Persons sleeping with child	Total n	Prevalence	
		Moderate - Severe	All Trachoma
0, 1 person	234	18.4	31.6
2 persons	1257	23.3	38.7
3 persons	2038	24.6	58.6
4 persons	1219	23.4	41.0
≥ 5 persons	676	19.7	34.5

Table 25

Prevalence of Inflammatory Trachoma in Persons Less Than 6 Years of Age by Number of Times Face is Washed Per Week by Level of Endemicity in Traditional Areas Lower Shire Valley, Malawi, 1983

Prevalence of all Inflammatory trachoma at traditional area level	Facewashings per week	Total n(1)	Prevalence Moderate - Severe	Prevalence All Trachoma
< 30%	0 - 7	265	15.1	29.8
	8 - 14	344	11.0	25.3
	> = 15	116	11.2	22.4
30 - 39%	0 - 7	1121	21.1	38.5
	8 - 14	776	19.1	32.9
	> = 15	402	14.7	31.3
> 40%	0 - 7	1089	30.8	47.5
	8 - 14	842	31.8	50.5
	> = 15	405	26.4	41.0

(1) 64 subjects were missing data on the frequency of fashwashing.

Nose blowing techniques were also examined as presented in Table 26. Those using rags or clothing to blow their nose had a lower rate of trachoma than those only blowing into the air. This is opposite to that which would be expected if contaminated clothing served as a source of reinfection.

Table 26

Prevalence of Trachoma in Persons Less Than 6 Years of Age by Method of Nose Blowing, Lower Shire Valley, Malawi, 1983

Method of nose blowing	Total n	Prevalence	
		Moderate/ Severe	All Trachoma
rag or air	2188	19.0	35.0
mother or child's clothes	662	17.7	32.8
air only	2574	28.0	45.0

DIETARY ASSESSMENT STUDY

Procedures

Adult respondents from households with cases of xerophthalmia, matched controls, and an approximate 10% sub-sample of all surveyed children were administered a dietary frequency questionnaire concerning the individual child's usual intake of selected foods high in vitamin A, fat, and protein. In addition, the usual frequency with which children consumed bananas was asked. Current breastfeeding status of the child was also ascertained.

Results

Table 27 describes the breastfeeding status of sample children by age and case status. Nearly all children under one year of age were breastfeeding. The proportion decreased to approximately 90% during the second year of life (one year of age) and 30% during the third year of life. No differences in breastfeeding status were observed between cases of xerophthalmia and non-cases.

Tables 28 - 31 indicate the frequency with which children consumed dark green leafy vegetables (both fresh and dried) and mangos or pawpaws by age and case status. Notably, the frequency with which fresh dark green leafy vegetables (DGLV) are reported consumed is surprisingly high and increased with age with approximately 50% to 90% of the children reporting consumption of DGLV at least once a week. In contrast, dried DGLV are apparently consumed infrequently during this season of the year (end of the dry season). The proportion of children who reported mango or pawpaw intake at least once a week increased from 27% to approximately 40% from less than one year to 3-5 years of age, respectively. The distributions of reported DGLV intake were similar between cases and non-cases across all age groups. However, children with night blindness consistently reported consuming mangos or pawpaws with less frequency than non-cases.

Tables 32 - 35 indicate the reported usual frequencies with which children consume eggs and small fish, both fresh and dried, by age and case status. A notable increase in the frequency of egg consumption was noted between children less than and more than two years of age, with a maximum of 22% of children two years of age reporting weekly consumption. The frequency of fresh and dried small fish intake was similar at each age. The proportion of children who consumed fish on a weekly basis increased from approximately 25% of children less than 12 months of age to more than 40% among children 3 - 5 years of age. While children with night blindness reported consuming eggs and fish with a frequency similar to that of

Table 27

Current Breastfeeding Status by Age by Case Status Among Children Less Than 6 Years of Age, Lower Shire Valley, Malawi, 1983.

Age (years)	Case status	Total Number	Breastfeeding n	Breastfeeding %	Not breastfeeding n	Not breastfeeding %
< 1	X2/X3	2	2	100.0	0	0
	Non-case[1]	89	88	98.9	1	1.1
1	X2/X3	1	0	0	1	100.0
	X1B	1	0	0	1	100.0
	Non-case[1]	110	98	89.1	12	10.9
2	X1B	2	0	0	2	100.0
	XN	23	7	30.4	16	69.6
	Non-case[1]	112	32	28.6	80	71.4
3 - 5	X2/X3	2	0	0	2	100.0
	X1B	13	0	0	13	100.0
	XN	105	2	1.9	103	98.1
	Non-case[1]	366	15	4.1	351	95.9

1 Includes children with corneal scars attributable to any cause.

Table 28

Frequency of Usual Intake of Vegetable and Fruit Sources of Vitamin A by Case Status Among Children Less Than 12 Months of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake					
			≥1x/week		1-3x/month		<1x/month	
			n	%	n	%	n	%
Fresh DGLV	X2/X3	2	2	100.0	0	0	0	0
	Non-case[1]	60	31	51.7	1	1.7	28	46.7
Dried DGLV	X2/X3	2	0	0	0	0	2	100.0
	Non-case[1]	60	5	8.3	2	3.3	53	88.3
Mango/pawpaw	X2/X3	1	1	100.0	0	0	0	0
	Non-case[1]	59	16	27.1	4	6.8	40	67.8

1 Includes children with corneal scars attributable to any cause.

Table 29

Frequency of Usual Intake of Vegetable and Fruit Sources of Vitamin A by Case Status Among Children 1 Year of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	%	1-3x/month n	%	<1x/month n	%
Fresh DGLV	X2/X3	1	0	0	1	100.0	0	0
	X1B[1]	1	1	100.0	0	0	0	0
	Non-case	110	93	84.5	11	10.0	6	5.5
Dried DGLV	X2/X3	1	0	0	0	0	1	100.0
	X1B[1]	1	0	0	0	0	1	100.0
	Non-case	109	3	2.8	2	2.8	104	95.4
Mango/pawpaw	X2/X3	1	0	0	0	0	1	100.0
	X1B[1]	1	0	0	0	0	1	100.0
	Non-case	110	39	35.5	5	4.5	14	12.7

1 Includes children with corneal scars attributable to any cause.

Table 30

Frequency of Usual Intake of Vegetable and Fruit Sources of Vitamin A by Case Status Among Children 2 Years of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	≥1x/week %	1-3x/month n	1-3x/month %	<1x/month n	<1x/month %
Fresh DGLV	X1B	2	2	100.0	0	0	0	0
	XN	23	22	95.7	1	4.3	0	0
	Non-case[1]	111	97	87.4	9	8.1	5	4.5
Dried DGLV	X1B	2	0	0	0	0	2	100.0
	XN	23	3	13.0	0	0	20	87.0
	Non-case[1]	112	5	4.5	3	2.7	104	92.9
Mango/pawpaw	X1B	2	0	0	1	50.0	1	50.0
	XN	23	6	26.1	1	4.3	16	69.6
	Non-case[1]	112	49	43.8	5	4.5	58	51.8

1 Includes children with corneal scars attributable to any cause.

Table 31

Frequency of Usual Intake of Vegetable and Fruit Sources of Vitamin A by Case Status Among Children 3 to 5 Years of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	%	1-3x/month n	%	<1x/month n	%
Fresh DGLV	X2/X3	2	2	100.0	0	0	0	0
	X1B	13	12	92.3	1	7.7	0	0
	XN	105	96	91.4	7	6.7	2	1.9
	Non-case[1]	368	333	90.5	26	7.1	9	2.4
Dried DGLV	X2/X3	2	0	0	0	0	2	100.0
	X1B	13	1	7.7	1	7.7	11	84.6
	XN	104	8	7.7	2	1.9	94	90.4
	Non-case[1]	369	27	7.3	12	3.2	330	89.4
Mango/pawpaw	X2/X3	2	0	0	0	0	2	100.0
	X1B	13	5	38.5	1	7.7	7	53.8
	XN	105	30	28.6	2	1.9	73	69.2[2]
	Non-case[1]	368	147	40.0	21	5.7	200	54.3

1 Includes corneal scars attributable to any cause.

2 Comparison between XN and non-case: Odds ratios= 1.94(1.22,3.08); x^2(2df)= 8.99, $p<0.01$.

Table 32

Frequency of Usual Intake of Animal Food Sources of Vitamin A by Case Status Among Children Less Than 12 Months of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake					
			≥1x/week		1-3x/month		<1x/month	
			n	%	n	%	n	%
Eggs	X2/X3	2	0	0	0	0	2	100.0
	Non-case[1]	60	5	8.3	4	6.7	53	88.3
Fresh small fish	X2/X3	2	0	0	0	0	2	100.0
	Non-case[1]	60	15	25.0	5	8.3	40	66.7
Dried small fish	X2/X3	2	0	0	0	0	2	100.0
	Non-case[1]	60	16	26.7	6	10.0	38	63.3

1 Includes children with corneal scars attributable to any cause.

Table 33

Frequency of Usual Intake of Animal Food Sources of Vitamin A by Case Status Among Children 1 Year of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	≥1x/week %	1-3x/month n	1-3x/month %	<1x/month n	<1x/month %
Eggs	X2/X3	1	0	0	0	0	1	100.0
	X1B	1	0	0	0	0	1	100.0
	Non-case[1]	110	6	5.5	10	9.1	94	85.4
Fresh small fish	X2/X3	1	1	100.0	0	0	0	0
	X1B	1	1	100.0	0	0	0	0
	Non-case[1]	110	34	30.9	16	14.5	60	54.5
Dried small fish	X2/X3	1	0	0	1	100.0	0	0
	X1B	1	0	0	0	0	1	100.0
	Non-case[1]	109	34	31.2	19	17.4	56	51.4

1 Includes children with corneal scars attributable to any cause.

Table 34

Frequency of Usual Intake of Animal Food Sources of Vitamin A by Case Status Among Children 2 Years of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	%	1-3x/month n	%	<1x/month n	%
Eggs	XIB	2	0	0	0	0	2	100.0
	XN[1]	23	5	21.7	3	13.0	15	65.2
	Non-case	111	24	21.6	15	13.5	72	64.9
Fresh small fish	XIB	2	0	0	0	0	2	100.0
	XN[1]	23	12	52.2	2	8.7	9	39.1
	Non-case	112	52	46.4	19	17.0	41	36.6
Dried small fish	XIB	2	1	50.0	0	0	1	50.0
	XN[1]	23	10	43.5	4	17.4	9	39.1
	Non-case	112	55	49.1	12	10.7	45	40.2

1 Includes children with corneal scars attributable to any cause.

Table 35

Frequency of Usual Intake of Animal Food Sources of Vitamin A by Case Status Among Children 3 to 5 Years of Age, Lower Shire Valley, Malawi, 1983

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	≥1x/week %	1-3x/month n	1-3x/month %	<1x/month n	<1x/month %
Eggs	X2/X3	2	1	50.0	0	0	1	50.0
	X1B	13	0	0	2	15.4	11	84.6
	XN	105	11	10.5	9	8.6	85	80.9
	Non-case[1]	364	51	14.0	51	14.0	262	72.0
Fresh small fish	X2/X3	2	1	50.0	0	0	1	50.0
	X1B	13	4	30.8	2	15.4	7	53.8
	XN	104	46	43.3	18	17.3	40	38.5
	Non-case[1]	369	155	42.0	56	15.2	158	42.8
Dried small fish	X2/X3	2	1	50.0	0	0	1	50.0
	X1B	13	6	46.2	1	7.7	6	46.2
	XN	105	57	54.3	11	10.5	37	35.2
	Non-case[1]	369	173	46.9	56	15.2	140	37.9

1 Includes corneal scars attributable to any cause.

non-cases, there was a tendency for children with Bitot's spots (X1B) to consume eggs and fresh fish less frequently than children with nightblindness or non-cases.

Tables 36 - 39 indicate the frequency of usual consumption of groundnuts and bananas by age and case status. The frequency of consumption of groundnuts increased with age up to two years (i.e., during the weaning years), and decreased slightly among older children. Children with night blindness exhibited a similar frequency of intake as non-cases; however, among children 3 - 5 years of age with Bitot's spots, groundnuts were consumed significantly more than either night blind or non-xerophthalmic children. No immediate explanation can be offered for this difference. The frequency with which bananas were consumed increased with age from 25% among infants to approximately 50% of children two years of age or older consuming bananas on a weekly basis. The distribution of frequencies among children with night blindness was similar to the non-cases, while children with Bitot's spots show a tendency to consume less of this fruit.

Table 36

Frequency of Usual Intake of Groundnuts and Bananas by Case Status Among Children Less Than 12 Months of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	≥1x/week %	1-3x/month n	1-3x/month %	<1x/month n	<1x/month %
Groundnuts	X2/X3	2	0	0	0	0	2	100.0
	Non-case[1]	60	2	3.3	1	1.7	57	95.0
Banana	X2/X3	2	0	0	1	50.0	1	50.0
	Non-case[1]	59	15	25.4	10	17.0	34	57.6

1 Includes children with corneal scars attributable to any cause.

Table 37

Frequency of Usual Intake of Groundnuts and Bananas by Case Status Among Children 1 Year of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	≥1x/week %	1-3x/month n	1-3x/month %	<1x/month n	<1x/month %
Groundnuts	X2/X3	1	0	0	0	0	1	100.0
	X1B	1	0	0	0	0	1	100.0
	Non-case[1]	110	8	7.3	3	2.7	99	90.0
Banana	X2/X3	1	1	100.0	0	0	0	0
	X1B	1	0	0	1	100.0	0	0
	Non-case[1]	110	44	40.0	34	30.9	32	29.1

1 Includes children with corneal scars attributable to any cause.

Table 38

Frequency of Usual Intake of Groundnuts and Bananas by Case Status Among Children 2 Years of Age, Lower Shire Valley, Malawi, 1983.

Food	Status	Total Number	Frequency of intake ≥1x/week n	≥1x/week %	1-3x/month n	1-3x/month %	<1x/month n	<1x/month %
Groundnuts	X1B	2	0	0	0	0	2	100.0
	XN	23	1	4.3	1	4.3	21	91.3
	Non-case[1]	112	16	14.3	3	2.7	93	83.0
Bananas	X1B	2	0	0	0	0	2	100.0
	XN	23	12	52.2	7	30.4	4	17.4
	Non-case[1]	111	59	53.2	26	23.4	26	23.4

1 Includes children with corneal scars attributable to any cause.

Table 39

Frequency of Usual Intake of Groundnuts and Bananas by Case Status Among Children 3 to 5 Years of Age, Lower Shire Valley, Malawi, 1983.

Food	Case Status	Total Number	Frequency of intake ≥1x/week n	≥1x/week %	1-3x/month n	1-3x/month %	<1x/month n	<1x/month %
Groundnuts	X2/X3	2	0	0	0	0	2	100.0
	X1B	13	4	30.8[2]	0	0	9	69.2
	XN	105	7	6.7	3	2.9	95	90.5
	Non-case[1]	369	28	7.6	15	4.1	326	88.3
Bananas	X2/X3	2	1	50.0	0	0	1	50.0
	X1B	13	4	30.8	2	15.4	7	53.8[3]
	XN	105	48	45.7	30	28.6	27	25.7
	Non-case[1]	368	173	47.0	105	28.5	90	24.5

1 Includes children with corneal scars attributable to any cause.

2 Comparison between X1B and non-case: odds ratio = 0.16 (.05,.54); x^2(2df)= 9.92; $p<0.01$.

3 Comparison between X1B and non-case: odds ratio = 3.50(1.19,10.27); x^2(2df)= 5.60, $0.05 < p<0.10$.

STUDY OF POTENTIALLY FORTIFIABLE FOODS: USAGE BY HOUSEHOLDS

Introduction

In an attempt to investigate the degree to which potentially fortifiable foods are used by households in the Lower Shire Valley, a systematic subsample of all households, households with cases of xerophthalmia and their controls were queried about their purchasing habits of five types of food: white processed sugar, white salt, vegetable oil, commercial biscuits, and Blantyre-ground maize flour. Those technically fortifiable foods were identified as being present in the local markets during a preliminary visit to the study area in February, 1983.

Procedures

Questions concerning frequency of purchase of these food items as well as a write-in question concerning the amount of money spent on salt and sugar each week were incorporated into the anthropometric and dietary assessment form (Form 5). Responsible adults from a 10% sub-sample of systematically selected households were asked these questions by the team public health nurse as were responsible adults from households with xerophthalmic children, and households with children matched for age, sex, and village.

To supplement the frequency data specifically addressing the use of white salt, five markets throughout the valley were visited by either a public health nurse or an ICEPO nutrition consultant in order to identify the supply sources for white salt and to purchase varying quantities of the locally available product. Amounts purchased ranged from five tambala to sixteen tambala worth of white salt using common, local measures. These "measures" usually consisted of caps of varying sizes from jars or very small pottery bowls. Purchased samples were placed into clear plastic bags, sealed, and taken to the survey headquarters where they were weighed to the nearest 5 grams using a small, hanging spring scale.

Results

The frequencies with which households usually purchase the five commercially prepared food products are described in Table 40. Approximately 830 responses were available for analysis, while data were missing from three to five households for each listed food. A striking finding was that more than 90% of those households questioned reported purchasing white salt at least once per week. The next most frequently purchased food item was sugar, with more than 1/3 of the households purchasing this product at least on a monthly basis. Approximately 15% of the

Table 40

Distribution of the Frequency of Purchase of Selected, Potentially Fortifiable Foods by Sampled Households, Lower Shire Valley, Malawi, 1983.

		Distribution of frequency of purchase							
		1x/week		1-3x/month		<1/month		Never	
Food	No. of households[1]	n	%	n	%	n	%	n	%
Sugar	830	117	14.1	184	22.2	120	14.5	409	49.3
White Salt	828	762	92.0	16	1.9	12	1.5	38	4.6
Vegetable Oil	820	5	0.6	49	5.9	61	7.4	714	86.1
Biscuits	829	68	8.2	55	6.6	91	11.0	615	74.2
Maize Flour	830	2	0.2	2	0.2	5	0.6	821	98.9

(1) Data from 3 to 5 households are missing for each listed food.

households reported purchasing biscuits on a monthly basis and, while small bottles (e.g., 100 ml) of commercial vegetable oil and packets of commercially ground maize flour from Blantyre were available in limited quantities, they were rarely purchased. Thus, white salt and, to a much lesser extent, white processed sugar appear to be potential food vehicles for vitamin A fortification. Sugar is both grown and processed in the Lower Shire Valley, but its less frequent purchase and known importance in making alcohol coupled with widespread observations during the survey of local alcohol production, renders sugar a less suitable food vehicle for fortification at the present time. The remaining discussions will focus on further analyses of salt usage.

Table 41 clearly shows that the frequency with which white salt was purchased by households with children with active xerophthalmia (XN-X2/X3) is indistinguishable from that of the larger population. However, frequency data alone do not permit quantitative comparisons.

In order to estimate quantities of salt used, respondents were asked about the usual weekly expenditure on white salt, and these data were related to the amounts of white salt which could be purchased at different prices in local markets. Table 42 presents the data for 16 weighed samples of white salt from five different markets in the Lower Shire Valley during the month of October, 1983. Virtually every sample of salt originated from the Blantyre Salt Packaging Company, being shipped primarily by rail from Blantyre to major retail markets throughout the valley. Figure 3 depicts the relationship between the amount of salt purchased in grams and the price paid for the sixteen samples of salt. While the data may be better fit by a curvilinear line, given the haphazard sampling technique and relative inprecision of estimates, a simple linear regression equation has been computed to estimate the average amount of salt available to a household at a given price. The amount of salt purchased (Y) is approximately equal to 1.44 + 15.05 tambala spent ($r=0.86$). This equation was used to estimate the average amounts of salt purchased per week by a household, based on the reported weekly expenditures on salt.

The mean and median weekly expenditure on white salt is 10 tambala among households which reported using this product (92%), for which approximately 150$\pm$83g of salt could purchased. Two-thirds of all interviewed households, purchased between 75 to 225g of white salt each week (5 to 15 tambala). However, a difference existed in the usual amounts purchased each week between households with children presenting active xerophthalmia and households with no xerophthalmia (Table 43). Households with cases of xerophthalmia tended to purchase slightly less salt per week, with 46% reported spending 1 to 7 tambala versus 35% of households without xerophthalmia ($p<.025$). On the

Table 41

Distribution of the Frequency of Purchase of White, Processed Salt Among Households with and without Xerophthalmic Children, Lower Shire Valley, Malawi, 1983.

Household status	No. of households	Distribution of frequency of purchase: 1x/week (1) n	%	1-3x/month n	%	<1/month n	%	Never n	%
Xerophthalmia	155 (2)	142	91.6	3	1.9	2	1.3	8	5.2
No xerophthalmia	673 (3)	620	92.1	13	1.9	10	1.5	30	4.5

(1) Excludes 5 households with missing data.
(2) Includes cases of XN, X1A, X1B, X2, X3.
(3) Includes children with corneal scars attributable to any cause.

Table 42

Data from the Market Survey of the Prices of White, Processed Salt, Distributed From the Blantyre Salt Packaging Company, Lower Shire Valley, Malawi, October, 1983.

Market place	Price (tb)	Sample 1* weight (grams)	Sample 2* weight (grams)
Ngabu	5	75	75
	7	140	150
	10	200	175
Malchanga	5	50	75
	8	100	125
	10	140	-
	16	250	240
Gooke	10	90	-
Juwaki RR	10	105	-
Nchacha	10	170	-

* Two samples costing the same amount were selected from different vendors in the same market on the same or different days in Ngabu and Malchanga markets.

Figure 3: Least Squares Linear Regression of the Weight (grams) of White, Processed Blantyre Salt by Price (tambala) at Local Markets, Lower Shire Valley, Malawi.
October, 1983

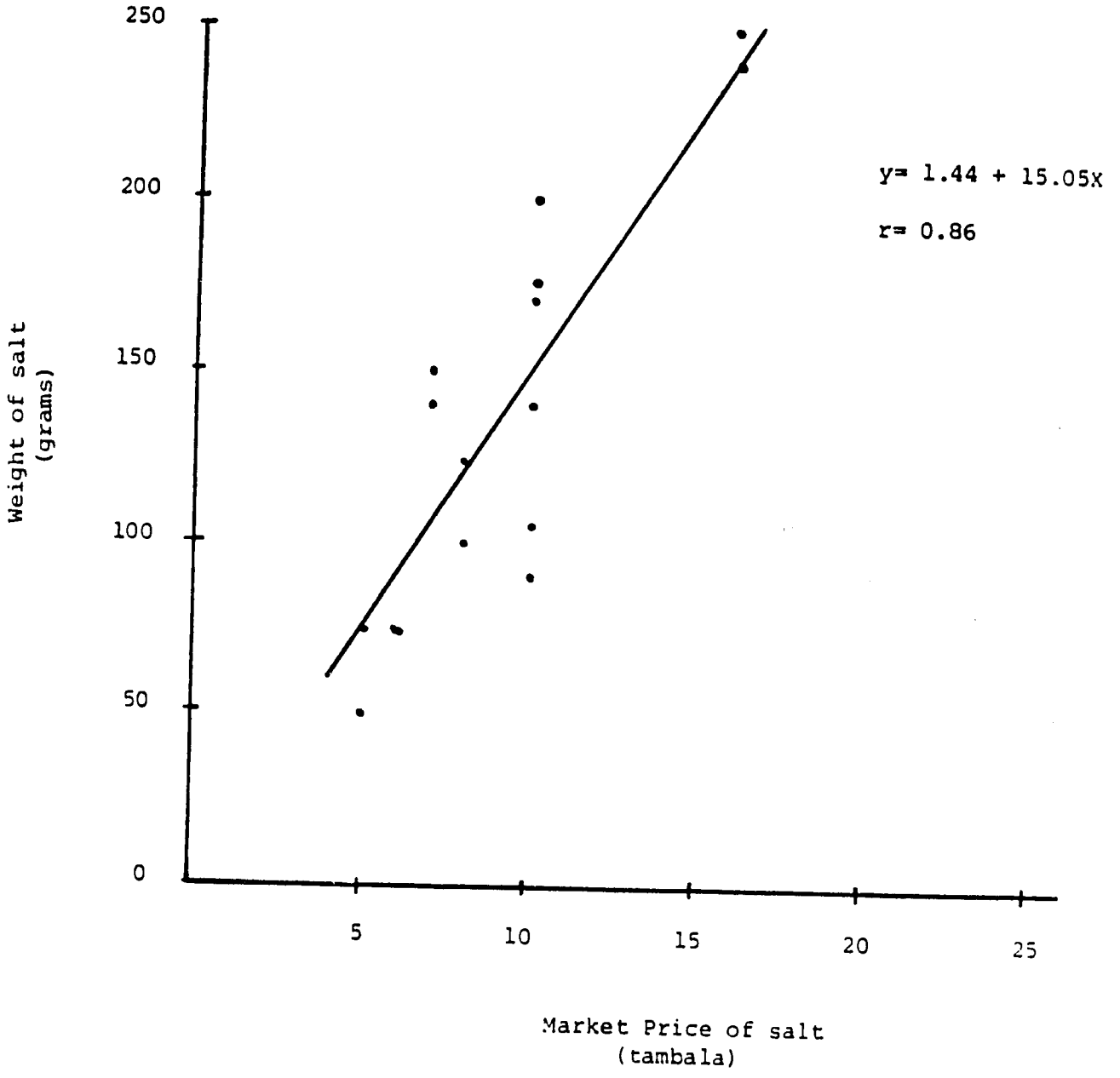

Table 43

Comparison of Usual Amount (tambala) Spent Per Week on White Salt Among Households with and without an Under 6 Year Old Child with Xerophthalmia, Lower Shire Valley, Malawi, 1983

Child status	No. of households[1]	Usual amount spent on white salt: 1-7tb/week n	%	8-12tb/week n	%	13-21tb/week n	%	>22tb/week n	%
Xerophthalmia	146[2]	67	45.9	63	43.2	15	10.3	1	0.7
No xerophthalmia	633[3]	220	34.8	283	44.7	115	18.1	15	2.4

$x^2 = 10.01$, 3d.f., $p<.025$

(1) Excludes 38 households which report never purchasing white salt, and 40 households with missing data.

(2) Includes cases of XN, X1A, X1B, X2, and X3.

(3) Includes children with corneal scars attributable to any cause.

average, households with cases of xerophthalmia spent about 8.5 tambala or 130±66 grams versus 10.2 tambala for 155±86 grams of white salt per week among other households (Table 44). This difference was not explained by differences in household size between those with and without xerophthalmic children.

Table 44

Comparison of Average (mean ±SE) Weekly Purchases of White Salt in Grams and Expenditure in Tambala Among households with and without Children with Xerophthalmia, Lower Shire Valley, Malawi, 1983.

Child status	No. of households (1)	Amount salt purchased (gms)	Expenditure on salt (tb)
Xerophthalmia	146 (2)	130±66	8.5 ± 4.4
No xerophthalmia	633 (3)	155±86	10.2 ± 5.7

(1) Excludes 38 households which report never purchasing white salt, and 13 households with missing data.

(2) Includes cases of XN, X1A, X1B, X2 and X3.

(3) Includes children with corneal scars attributable to any cause.

Discussion

Initial anecdotal impressions that preventable blinding conditions such as xerophthalmia, trachoma and cataract are important public health problems in the Lower Shire Valley have been confirmed by this baseline survey. There is a clear cut need for programmatic intervention to reduce this burden of avoidable blinding disease.

Cataract was the leading cause of blindness accounting for 40% of those who are bilaterally blind. Given an estimated population of approximately 340,000 in the valley, there are over 1200 persons currently blind from cataract who could be restored to good visual functioning with appropriate surgical intervention. The provision of these surgical services requires a system of identifying and referring appropriate surgical candidates. The Ophthalmic Medical Assistant program currently operating in the Lower Shire Valley could be supported in this area by the regular scheduling of ophthalmic surgeon visits to district hospitals in Chickwawa and Nsanje. Surgical availability is, however, not usually the most important determinant of reducing the cataract backlog in a population. The adequacy of the referral coverage and the motivation of patients to make use of available surgical services are often the most critical components of a program. Often the best advertisement for cataract surgery is a satisfied patient who has received successful cataract surgery. Clearly, more work needs to be done in this area to identify methods, in addition to providing adequate access to surgery, that will increase the volume of cataract surgery in the Lower Shire Valley and reduce the prevalence of this blinding condition.

Corneal disease accounted for the majority of the remaining blindness (30%). Most of this was probably due to a combination of xerophthalmia, measles, secondary infections and trachoma. Addressing the determinants of xerophthalmia, measles and trachoma could significantly reduce new cases of corneal blindness. While trachomatous scarring alone was not found to be the cause of any case of adult blindness, it is well-known that chronic inflammatory trachoma increases the susceptibility of the eye to secondary infection. In addition, the disparity between the high rates of inflammatory trachoma in young children and low rates of severe scarring in adults suggests that the ecology of trachoma in this area may have changed in the recent past. With the current high infection load in the community, the prevalence of severe scarring in adults is likely to increase as the cohort of children with severe inflammatory disease ages. The prevalence of inflammatory trachoma exceeds the criteria set by the WHO for a problem of public health significance. Clearly a program that can reduce the rates and severity of inflammatory trachoma in children is urgently needed in this area. Villages that are at an especially high risk are those at the base of the western escarpment.

Xerophthalmia is a major nutritional disease in the Lower Shire Valley and requires urgent consideration of practical and effective interventions to improve the vitamin A status of the population. The prevalence of xerophthalmia in the Lower Shire Valley is well above the WHO criteria for a problem of public health significance. A particularly worrisome aspect is the high rate of corneal or blinding xerophthalmia. These high rates occured despite the fact that beta carotene containing foods were eaten with a similar frequency by cases and their matched controls. This apparent discrepancy may be explained by differential amounts consumed by the two groups which we were unable to ascertain.

Three broad strategies for preventing vitamin A deficiency have been employed to varying degrees in countries where vitamin A deficiency is a public health problem. These are periodic distribution of a large oral dose of vitamin A to children through either standing clinics or specially designed intervention programs, fortification of a processed food "vehicle" which is routinely consumed by the population, and increasing the availability and child consumption of food sources of vitamin A through horticultural, marketing, and nutritional education approaches. The magnitude and severity of vitamin A deficiency and the resources available for preventing the disease will determine which combinations of strategies are most appropriate.

During the survey, data were collected on household level purchase of several potentially fortifiable foods. Although sugar is grown and produced locally, it's relatively infrequent purchasing pattern makes it a less attractive vehicle for fortification at the present time. However, the survey data indicate that more than 90% of households routinely purchase varying quantities of coarsely processed white salt each week. This pattern of frequent purchase is practically identical between households with and without xerophthalmic children. However, for as yet unknown reasons, households with xerophthalmic children appear to purchase smaller quantities, spending an average of nearly 2 tambala less on salt per week. Individual salt consumption was not investigated during the survey. Limited, careful dietary studies are urgently needed to determine the range of salt consumption among individuals, particularly young children, to determine a suitable level for fortification. Given the typical food consumption pattern whereby members of the household eat nsima from a single pot, it may be that young children consume salt in proportion to the amount of nsima consumed. Alternatively, the pattern of salting nsima and relish eaten by children may be different than that for older household members.

The coarse white salt being used is centrally distributed from the Blantyre Salt Packaging Company, although no processing

occurs at that point. At various times during the year, the salt is supplied from countries such as Mocambique, Namibia and the United Kingdom. Based on preliminary discussions at the IVACG meeting in Geneva, the current lack of processing in Blantyre may not pose a major obstacle to fortifying the salt with vitamin-A. Plans have already been made in collaboration with the Ministry of Health, Government of Malawi and the United States Department of Agriculture to conduct preliminary tests on samples of Blantyre salt concerning the feasibility of vitamin A fortification.

Recommendations

The size of the blinding eye disease problem in the Lower Shire Valley necessitates that immediate action be taken while longer term programmatic activities are planned and implemented.

1. Provide an adequate supply of vitamin A capsules to every hospital, clinic, and health post in the Lower Shire Valley. All children presenting at the Maternal and Child Health clinics should be dosed with 200,000 IU every six months. Further distribution at the village level could be carried out by the Health Surveillance Assistants assigned to those villages. The goal should be to dose every child under six years of age on a six monthly basis.

2. Provide an adequate supply of tetracycline eye ointment to every hospital, clinic, and health post in the Lower Shire Valley. All children presenting to Maternal and Child Health clinics with red, crusty eyes should be treated with tetracycline eye ointment. Further treatment at the village level could be carried out by the Health Surveillance Assistants assigned to those villages. Village level treatment should include all children in the village to reduce the pool of infection. Areas with especially high risk should be targeted for mass treatment on a priority basis. The traditional areas with the highest rates of inflammatory disease are Ngabu and Massea in Chickwawa District and Ndamera, Chimombo and Mbenje in Nsanje District.

3. Provide regularly scheduled ophthalmic surgical services for cataract extraction at the two district hospitals in Chickwawa and Nsanje. Referral for surgery from the Ophthalmic Medical Assistants in the Lower Shire Valley should be coordinated with the ophthalmologists' schedule.

The long-term strategy for the Malawi Blindness Prevention Program should be: focused on the Lower Shire Valley, comprehensive in addressing the three major blinding conditions; cataract, xerophthalmia, and trachoma, and integrated within the framework of the primary health care system that the Ministry of Health is currently implementing. Recommendations for this long-term intervention program include:

Cataract

1. Train Primary Health Care Workers, Medical Assistants, Nurses, and Clinical Officers in the recognition of blinding cataract and the appropriate referral process.

2. Improve the Ophthalmic Medical Assistant coverage to increase referrals to surgery of those who are visually disabled from cataract.

3. Closely examine and test methods of increasing the acceptability of cataract surgery by the general population.

Xerophthalmia

1. Train Primary Health Care Workers, Medical Assistants, Nurses, and Clinical Officers in the recognition and treatment of xerophthalmia and in the short-term strategy of capsule distribution to all children under six years of age on a twice yearly basis.

2. Consider the fortification of salt with vitamin A as a potentially effective strategy for improving vitamin A status in preventing xerophthalmia in the Lower Shire Valley.

   a. Continue preliminary laboratory investigations on the technical feasibility of fortifying course white salt with vitamin A.

   b. Closely examine salt intake by young children within households in order to determine an optimal level of fortification.

3. Since measles is associated with half of all xerophthalmic corneal scarring, increase coverage and effectiveness of the measles immunization activities through the primary health care system.

Trachoma

1. Train Primary Health Care Workers, Medical Assistants, Nurses, and Clinical Officers in the recognition and treatment of inflammatory trachoma in young children.

2. Provide adequate supplies of topical tetracycline eye ointment to all hospitals, clinics, and health posts to treat and institute long-term prophylaxis among individuals with moderate to severe inflammatory trachoma.

3. Provide mass treatment at the village level in high risk areas.

4. Conduct further studies to identify appropriate intervention strategies to reduce the prevalence and severity of inflammatory trachoma in young children through cost-effective environmental manipulation. This type of community-based investigation should be conducted in a number of villages with different intervention tools in order to assess the most cost-effective method of reducing the infection load in the community.