

The Epidemiology of Trachoma in the Lower Shire valley of Southern Malawi

Abstract

Background

Trachoma, a neglected infectious tropical disease has been historically known to be endemic in some parts of Malawi. The objectives of the study were to determine the prevalence of trachoma and associated risk factors in the Lower Shire valley of southern Malawi.

Methodology

A population based survey conducted in Nsanje district (population 238,041), and Mwanza district (population 86,314). Children aged 1-9 years and adults aged 15 and above were assessed for clinical signs of trachoma.

Results

The prevalence of trachoma follicular (TF) among children aged 1-9 years in Nsanje is 18.5% (CI 16.4-20.8), while the prevalence of TF in Mwanza is 7.8% (CI 6.6-9.2). The prevalence of Trachoma Trichiasis (TT) in adults aged 15 and above in Nsanje is 0.5% (CI 0.2-1.2) while in Mwanza it is 0.2% (CI 0.02-0.6).

Conclusion:

The prevalence rates of active trachoma infections is not uniform among districts in the Lower Shire Valley, with rates much higher than the WHO cutoff point (TF >10%) in Nsanje district, suggesting that trachoma is a disease of public health importance and full **SAFE** (Surgery, Antibiotics, Face Washing and Environmental) control strategy should be undertaken. For Mwanza district, it is recommended to focus on S, F and E components of the SAFE, at the same time identifying and treating focal areas with high TF prevalence.

Key words: Trachoma, prevalence, risk factors, blindness, trichiasis, follicles, Malawi, Lower Shire, epidemiology, mapping

Introduction

Trachoma, the oldest reported endemic infectious eye disease is caused by serotypes A, B, Ba and C of the bacterium *Chlamydia trachomatis* [1, 2]. Repeated infections can eventually lead to eyelids thickening and developing scars resulting in the eyelashes turning inwards and rubbing on the cornea [3, 4], causing abrasions and ulceration, eventually leading to visual loss and blindness. According to the World Health Organization (WHO), using the WHO simplified grading system [5, 6] there are five stages that categorize the clinical features of trachoma: Trachomatous inflammation follicular (TF), Trachomatous inflammation intense (TI), Trachoma Scarring (TS), Trachomatous Trichiasis (TT) and Corneal Opacity (CO).

Trachoma remains one of the leading causes of preventable blindness in sub-Saharan Africa especially in countries that have poor environmental sanitation, inadequate water supply and poor socio-economic status [7, 8]. The presence of flies (*Musca sorbens*) play an important role in trachoma transmission [9-11]. There is an excess burden for trachoma in women than men [12]. Worldwide, despite many global initiatives such as the WHO global elimination of blinding trachoma (GET2020), International Trachoma Initiatives (ITI), International Coalition against Trachoma Control (ICTC) and many others that have been addressing trachoma over the recent years, there are still about 8.2 million people with trachoma trichiasis and many more millions with active disease [7, 13]. The good news is that there is now even a strong renewed commitment by donors and partners to complete trachoma mapping and implement control activities in countries suspected endemic within the next few years so that the goal of eliminating trachoma by the year 2020 is achieved. Blinding trachoma remains a problem where living conditions facilitate continuous transmission of *Chlamydia trachomatis* among family members [14]. It is argued that trachoma together with the many other neglected tropical diseases (NTD's) that are associated with poverty produce a disease burden almost as huge as that associated with human immune deficiency virus/AIDS, tuberculosis, or malaria [15].

The strategy recommended for control of trachoma is known as SAFE, an acronym standing for Surgery for Trichiasis, Antibiotic for active disease, Facial cleanliness promotion to reduce transmission from person to person by flies and Environmental improvement which reduces transmission of the infection. The effectiveness of each intervention has been documented [16]. The WHO aims to achieve Global Elimination of Blinding Trachoma by the year 2020 (GET2020) through implementation of the SAFE strategy [17]. District level mapping is required before the SAFE strategy is implemented. Currently, a lack of district level prevalence data exists in many other countries suspected of having endemic trachoma [18], and this leads to incorrect country information displayed on the global trachoma atlas [19]. Malawi is no such exception with the lower shire valley (comprising of 3 districts) in Southern Malawi suspected of being the most highly endemic region, with information obtained from studies dating to over 20 years ago [20] and some new studies [21-23]. Until two years ago, none of the districts in the lower shire have had a mass drug administration with Azithromycin antibiotic. A study done in one of the districts (Chikwawa) suggested that prevalence of trachoma had been reduced over a period of time due to some components of the SAFE strategy (mainly F& E) having been implemented [23]. Following this, recently a trachoma prevalence study using the WHO recommended mapping methodology was conducted in the same district, and found out that Trachoma is still a disease of public health importance in that district [21]. This raised concern regarding the unknown situation of trachoma in the remaining two districts (Nsanje and Mwanza) that are part of the lower shire valley, especially that none of them had been surveyed before. Also all the 3 districts within the lower shire valley share boundaries with Mozambique, and knowing the prevalence of trachoma here is likely to give a clue of what the prevalence of the side of Mozambique should be. The whole Lower shire valley is also known to be co-endemic for other neglected tropical diseases (Lymphatic Filariasis, Schistosomiasis, Onchocerciasis, and Soil Transmitted Helminths), and mass drug treatment is being implemented for some of these. It is therefore important to know the prevalence of Trachoma in the region since the integration of trachoma control strategies with other neglected tropical diseases (NTD's) may be beneficial in Sub-Saharan Africa [24].

We sought to determine the prevalence of trachoma in two districts of the lower shire valley of southern Malawi suspected of having trachoma but with no previous prevalence data.

Methods

Ethical approval was obtained from the National Health Sciences Research Committee (NHSRC), and separate approval was obtained from each of the district health administrative offices (DHO) for Nsanje and Mwanza Districts, in Malawi. Upon explanation of the purpose of the study, written informed consent was obtained from all subjects who participated in the study. Where the participant was a minor, written informed consent was obtained from the guardian.

The study districts in the lower shire were Nsanje (population 238,041) and Mwanza district (Population 86,314) and both these have had previous trachoma.

Figure 1 shows map of Malawi and the districts where the study was done.

Both Nsanje and Mwanza districts have referral district hospitals with Ophthalmic clinical officer who are based and regularly conducts eye clinics at the district hospital and also conducts outreach eye clinics at various health centres located within the community. The clinical officers are trained to do trichiasis surgeries within the district hospitals using the WHO recommended bilamellar tarsal plate rotation (BTPR). However the number of trichiasis surgeries done in both districts is very low, with less than 30 cases done per year in each district. There are several factors that contribute to this low productivity, some attributable to lack of surgical equipment while others relate to complexities in getting patients. However, health promotion on primary eye care including hygiene and environmental control is regularly done by community health workers (Health Surveillance assistants) who have been trained and are fully based in the community. Both district hospitals have environmental departments which focus on safe water and other hygienic programs as part of their health promotion activities.

The study was a cross-sectional population based household survey designed to obtain district level prevalence estimates for trachoma TF in children aged 1-9 years; and trichiasis (TT) in adult men and women aged 15 years and above, and to assess the predisposing risk factors for trachoma infection. The study was conducted between July and October 2012.

Sample size

The size of the sample was been chosen to allow determination of the prevalence of TF/TI in children aged 1-9-years old with an acceptable degree of certainty to achieve narrow confidence intervals. This age group was chosen because the prevalence of TF/TI is highest in the 1-9 years group. To determine the required sample size for each district we used the following parameters:

a) Size of the population in each of the districts (i.e. the number of 1-9 years old children in the district).

b) Expected prevalence of 20% of TF/TI in 1–9-year-old children (based on estimates of the results of the previous survey).
c) Desired precision of the estimate of 0.04 (taken as 20% of the expected prevalence).
d) Required alpha risk (risk of the true prevalence being outside the confidence interval; usually 5%), expressed as the Z score for the alpha risk: for an alpha risk of 5%, the Z score is 1.96.
e) Expected design effect (usually 4 for the clustering effect).
Using these parameters the sample size required as given in the WHO guide manual for trachoma program managers [25] is

$$= e \times d^2 \times b \times (1-b)/C^2 = 4 \times (1.96)^2 \times 0.20 \times 0.80 / (0.04)^2$$

$$= 1537 \text{ children aged 1-9 years}$$

For trichiasis a similar calculation was done as follows: assuming an expected prevalence of 2% with a desired precision of 1%. The usual design effect for trichiasis is about 1.5. So the required sample size is $1.5 \times (1.96)^2 \times (0.02) \times (0.98) / (0.01)^2 = 1152$ adults over 14 years. With an average of two adults aged 15 and above in each household, the same households where the 1537 children were sampled also provided an adequate sample size to estimate the prevalence of trichiasis.

Selection of clusters and households for survey

With an average of 1.4 children aged 1-9 years per household in Malawi this translates to 1080 households needed. Hence a total of 24 clusters with 45 households (HH) per cluster for Nsanje and 20 clusters with 54 HH per cluster for Mwanza were selected with using probability proportional to size sampling (PPS). In each cluster eligible households were listed and the required number was selected from the list at random. All members of the selected households were examined.

Training:

A total of 12 ophthalmic clinical officers (6 paired teams) from the Ministry of Health were selected for training and underwent a 3day refresher training course in grading trachoma conducted by KK and IS in Nsanje District. Graders were trained and certified using eyelid photographs derived from the Partnership for Rapid Elimination of Trachoma (PRET) study [26, 27]. The training included field work where residents from one selected village were examined to practice their grading. The graders were taught how to safely examine children and adults for evidence of TF, TI, TT or corneal opacity (CO); and recognize and refer other priority diseases. Upon completion of training an inter-observer agreement exercise using kappa score was conducted to ensure that trainees can successfully grade trachoma. The highest and lowest kappa scores were 0.85 and 0.72 respectively. Training and field work were externally observed by a Sight Savers Epidemiologist (LS) from UK.

Field Methods

Three generic questionnaires (attached as appendices) were used in this survey: viz:

- a) Village headman questionnaire: This questionnaire will collect (village) level information in terms of availability of health services and barriers to their uptake, water sources and sources of health education.
- b) Household questionnaire: collecting data on household member characteristics, and household level risk factors, such as assets, water sources, water availability and sanitation services.
- c) Ocular examination questionnaire: collecting data on demographics of survey subjects, individual risk factors for trachoma, signs and symptoms, and history of previous trachoma treatment.

All the information was recorded using paper questionnaire forms (copies attached in appendices).

The selected clusters were visited a few days in advance by community health workers from Ministry of Health (known as Health Surveillance Assistants) who are responsible for disease surveillance and implementing health promotion. They briefed the village chiefs and the community members and organize the selected cluster (village) household list that was used for random HH selection by the survey team. During the actual survey days the Ophthalmic team assigned to the cluster obtained the list and only chose the random numbers of HHs that have been preselected using a computer. All the 6 teams were supervised by a team leader (KK) and the 3 supervisors who checked forms at end of each day.

Clinical examination

Each eye was everted and examined for presence of trachoma using a 2.5 x magnifying loupe (Binomag plastic, Zabby's, India) and graded according to the WHO simplified system [28] and any incidental ocular conditions noted. Subjects complaining of visual difficulty had their visual acuity tested using Snellen E charts and were referred or advised as appropriate. Other data collected included the environmental factors such as availability of functional latrines, presence of solid waste or animal pens, distance to water source and hygienic condition of children faces (clean/unclean). As in other surveys, a clean face was defined as absence of obvious ocular and nasal discharge.

Quality control of trachoma observations

Every night there was a meeting where the investigators, observer, supervisors and enumerators discussed challenges faced and suggested solutions for improvement. Recommendations were implemented in the following days.

Data management, analysis and reporting

Survey questionnaires were collected from the field and sent to a central location (at BICO Lions Sight First Eye Hospital) for double data entry. The data entry programs were developed in Epidata version 3.1. The data entry programs have in-built range checks, consistency checks and controls for skip patterns to minimize data entry errors. However, this was also complemented with data validation techniques in Epidata and detailed data range and consistency checks programs written in STATA 11, which also facilitated in listing all the outstanding errors for cleaning. Data was analysed in STATA version 11 by a Biostatistician from the Malawi Liverpool welcome trust (MM). Univariate analysis using frequencies and other descriptive statistics and bivariate analysis were done to examine relationships using the Yates' corrected Chi-squared test for 2 by 2 tables.

We report the district level prevalence of the WHO indicators TF in 1-9 year olds and TT in those aged 15 and over. Individual and household risk factors associated with TF and TT and the strength of their association and joint effects have also been reported.

Results

A total of 911 and 985 households resulting in a total of 2,286 (99.9% of which were examined) and 2,933 persons (99.8% of which were examined) for Nsanje and Mwanza respectively were enumerated.

Table 1 shows the baseline characteristics (sex and age range) of the study participants and Table 2 shows availability of household characteristics that were studied in the two districts.

The prevalence rates of Trachoma Follicular (TF) and Trachoma Intense (TI) in children aged 1-9 years and Trachoma Scarring (TS), Trachoma Trichiasis (TT) and Cornea Opacity (CO) in adults aged 15 years and above in Nsanje and Mwanza respectively are shown in Table 3.

The prevalence of TF among children aged 1-9 years was found to be 18.5 % (95% CI 16.4-20.8) in Nsanje and 7.8 (95% CI 6.6-9.2) in Mwanza districts respectively. The prevalence of trachoma follicular (TF) among children aged 1-9 years by age group is shown in Table 4.

In both districts trachoma follicles tended to pick in children between 2 and 4 years of age.

The prevalence of Trachoma trichiasis (TT) in adults aged 15 and above (Table 4) was 0.5%(0.2-1.1) and 0.2(0.02-0.6) in Nsanje and Mwanza districts respectively. Table 5 shows the prevalence of Trachoma Trichiasis (TT) by sex among adults aged 15 years and above in Nsanje and Mwanza districts respectively.

Taking into consideration that adults aged 15 and above contributed to 45% of total population in both districts (Nsanje population 238041 and Mwanza population 86314), prevalence rates of Trichiasis obtained (Table 5) translate to a total of 536 cases in Nsanje and only 78 cases in Mwanza districts as the backlog with Trichiasis needing surgery.

The main positive risk factors for Trachoma follicular (TF) obtained through univariate logistical regression after accounting for clustering in households in both district was the presence a dirty face. In regard to sources of water, after accounting for clustering in the households, the main source of water for Mwanza and for Nsanje district was a borehole ((Table 2). Water sources were reported to be near (less than 15 minutes walking distance) in more than half the population in both districts.

Discussion

This study was conducted to determine the epidemiology of trachoma in the Lower shire Valley (Mwanza, Chikwawa and Nsanje districts), commonly known as the Trachoma belt of Malawi, in particularly the prevalence of trachoma infections (TF/TI) among children aged 1-9 years, and the prevalence of trachoma trichiasis (TT) among adult men and women aged 15 years and above. The study also aimed to determine the risk factors associated with trachoma in Nsanje and Mwanza districts. . This information is necessary to decide if a district is endemic and needs a full “SAFE” control strategy which includes mass treatment with Azithromycin antibiotic. Chikwawa districts was already surveyed and found to be endemic [21], with information on trachoma prevalence required in the remaining two districts, surveyed here. According to the WHO guidelines, and based on findings of this study, trachoma is a disease of public health importance in Nsanje District (TF > 10%), but not in Mwanza districts (TF < 10%), Table 3. Nsanje is therefore eligible for a full “SAFE strategy and should be prepared to do so” after applying for Azithromycin donation from International Trachoma Initiative (ITI). Since the prevalence rate is less than 30%, the mass drug administration would have to be conducted for a period of 3 years, which will be followed by further surveillance to determine the impact of the interventions. However, to effectively control trachoma, it is important to ensure that facial cleanliness and environmental changes (F and E components of SAFE) are not overlooked. In regards to Mwanza district, the prevalence of TF is below 10%, and even if TI is added to determine the prevalence of active infections (TF/TI), it is still below but closer to 10% (Table 3). Even though the WHO guidelines are very clear for prevalence rates of over 10% (recommends to start mass drug treatment) and for rates less than 5% (does not recommend mass drug treatment), the guidelines are not very clear for districts which have prevalence between 5 and 10% such as Mwanza. Whereas it is said that in such cases sub districts (focal areas with greater than 10% prevalence) should be identified and have targeted treatment, most researchers argue that this information can often not be obtained from the existing district data that uses 20-30 clusters as the study is not designed for such analysis, and that additional surveys designed and powered at sub district level need to be conducted to accurately determine which sub-districts need treatment. Resurveying can be expensive, and the tendency is that districts with prevalence between 5 and 10% have just been left. There is need to clarify among the trachoma research community, how these cases should be handled and have clear policy documents in place.

The prevalence of trichiasis (TT) observed in adults aged 15 years and above in Nsanje is twice as much as in Mwanza (Table 3). Both these values are higher than WHO cut off point of threshold for elimination of trichiasis (TT) as a public health problem (0.1 %) and indicate that surgical intervention for trichiasis should be implemented in the two districts. However the observed TT prevalence only translates to a few cases (78) needing surgery in Mwanza as the population of Mwanza is small. For Nsanje there are more but manageable cases of TT (536 in total) so with the SAFE strategy it should be possible to address these cases. It is important to note that not all cases of trachomatous trichiasis progress to cornea opacity, and that some of the cornea opacities seen in the community are not caused by trachoma; but may be caused by other cornea infections and concurrent use of traditional herbal medicines for treatment. Moreover the observed cases may be old prevalent cases but we do not have means to verify this. Even though the advice would be to organize TT surgery for all the cases in Mwanza, it is therefore likely that only a few cases in Mwanza among these TT cases will progress to CO. As is the prevalence of cornea opacity in both districts was small, though the prevalence was twice as much in Nsanje compared to Mwanza (Table 3).

It is also important to remember, that to effectively control trachoma, it is important to ensure that facial cleanliness and environmental changes (F and E components of SAFE) are not overlooked. In regards to risk factors, only the presence of a dirty face was associated with trachoma follicular (TF) in Nsanje and Mwanza districts and there has been some discussion over the usefulness of this indicator, due to the complexities of defining a dirty face and the timing of the assessment of the indicator i.e at what time of day the interviewer sees the child [29]. Along distance to a water source was not a major factor in the transmission of trachoma in both districts. Even though majority (85%) of population had access to a water source of a distance of less than 30 minutes of walking (Table 2), it may be the time it takes to bring the water back that matters more as sometimes women have to wait for a long time at the source of water. Hoechsmann et.al [14] found that trachoma follicular was associated with a longer distance to the primary water source in Chikwawa district, which shares boundaries between both Nsanje and Mwanza. Of importance note is the large proportion of people who use borehole in Nsanje and Mwanza (82.7 & 78.4% respectively, Table 2).

It should be noted however that since the Hoechsmann study, many boreholes were drilled in the lower shire valley by Non Governmental organizations (NGOs) in the “WASH” sector such as World Vision, Goal Malawi, Water Aid resulting in most residents accessing water within a walking distance of 30 minutes. These NGOs are not addressing Trachoma per se, but rather reacting to addressing the millennium developmental goals (MDGs) [30] which have to be achieved by 2015. Among these goals is the need halve the proportion of the population without sustainable access to safe drinking water and basic sanitation by 2015 (MDG 7).

The hypothesis that reduction in trachoma follicular (TF) can be related to environmental improvement in absence of antibiotic treatment is indeed supported by the readily availability of water in these districts and not the antibiotic. Currently both districts have

access to only limited amounts of tetracycline eye ointment as an available drug and only use it for treating severe eye infections. While as Nsanje will need the MDA, if only Mwanza districts continues to address the environmental hygiene and conducts the TT surgeries, within a few years we one should expect not see any blinding trachoma in Mwanza.

Conclusion

In summary, the Lower shire should be considered a trachoma endemic region with evidence of active trachoma infection in both districts surveyed. However, there is only evidence that trachoma is of public health importance in Nsanje district only, which requires the full implementation of the SAFE strategy. It is important to note that certain activities of the SAFE strategy (antibiotic distribution) may be integrated with control of other diseases and some studies have reported success [31]. There is currently no justification for Mwanza districts to have an MDA. Addressing the S, F and E and treating hot spots should further reduce the prevalence of Trachoma in Mwanza.

Authors' contributions

KK: Conceived the study, designed the study, interpreted the data, drafted the manuscript, critically revised the manuscript for intellectual content, read and approved the final version & paper guarantor

IS: Conceived the study, designed the study, analysed the data, interpreted the data, critically revised the manuscript for intellectual content, read and approved the final version

MM: Analysed the data, interpreted the data, drafted the manuscript, critically revised the manuscript for intellectual content, read and approved the final version

LS: Interpreted the data, critically revised the manuscript for intellectual content, read and approved the final version

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Ethical approval: National Health Sciences Research Committee (NHSRC) in Malawi.

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Table 1: Baseline characteristics of the study participants

Variable	Nsanje district		Mwanza district	
Sex	No.	%	No.	
Male	934	40.9	1,108	37.8
Female	1,352	59.1	1,825	62.2
Total	2286	100	2933	100
Age Group (years)				
1-9	1,280	56.0	1,677	57.2
10-14	11	0.5	4	0.1
15+	995	43.5	1252	42.7
ALL	2286	100	2933	100

Table 2: Availability of household characteristics in Nsanje and Mwanza districts				
Nsanje		Mwanza		
	No.	%	No.	%
Type of Toilet				
Traditional pit-latrine	416	45.7	584	60.5
Improved pit-latrine	37	4.1	23	2.4
Shared pit-latrine	100	11.0	123	12.7
Flushed toilet at the residence	1	0.11	1	0.1
None	356	39.1	235	24.3
Feces around 15 m of the house				
Yes	13	1.4	15	1.5
No	894	98.6	958	98.5
Loose garbage around the house				
Yes	201	22.2	155	15.9
No	706	77.8	818	84.1
Water source				
Tap water	19	2.1	25	2.6
Rain Water Harvest	3	0.3	7	0.7
Protected Well	4	0.4	2	0.2
Unprotected Well	9	1.0	41	4.2
Borehole	753	82.7	767	78.4
Dam	1	0.1	1	0.1
River/Stream	122	13.4	134	13.7
Water all year round				
Yes	749	82.3	778	79.8
No	161	17.1	197	20.2
Distance to main water source				
<15 minutes	578	63.5	584	59.7
16-30 minutes	210	23.1	294	30.0
31-60 minutes	106	11.6	76	7.8
>60 minutes	17	1.9	25	2.6

Table 3: Prevalence rates for Trachoma* in Nsanje and Mwanza districts

Children aged 1-9 years						
		CI*		CI		
Nsanje		16.4-20.8		3.6-4.8		
Mwanza		6.6-9.2		0.5-1.3		
Adults aged 15 and above						
		CI*		CI		CI
Nsanje		2.5-4.9		0.2-1.1		0.02-0.7
Mwanza		0.2-1.1		0.02-0.6		

*Trachoma Follicles (TF), Trachoma Intense (TI), in children aged 1-9 years; Trachoma scarring (TS), Trachoma Trichiasis (TT) and Cornea Opacity (CO) in adults aged 15 years and above.
** 95% confidence Intervals

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Table 4: Prevalence of Trachoma follicular (TF) by age in Nsanje and Mwanza districts

Age(years)	With TF		With TF	
	Nsanje		Mwanza	
	No.	%	No.	%
1	24	10.1	11	8.4
2	33	13.9	19	14.5
3	44	18.6	18	13.7
4	30	12.7	25	19.1
5	27	11.4	10	7.6
6	25	10.6	19	14.5
7	24	10.4	12	9.2
8	13	5.5	6	4.6
9	17)	7.2	11	8.4
Total	237	100	131	100

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Table 5: Prevalence of Trachoma Trichiasis (TT) by sex in Nsanje and Mwanza districts

Nsanje	No examined	%	No with TT	%	P value
Males	305	30.7	1	0.3	0.6
Females	690	69.3	5	0.7	
Total	995	100	6	0.6	
Mwanza	No examined		No with TT		P value
Males	307	24.5	0	0.0	0.4
Females	945	75.5	2	0.2	
Total	1252	100	2	0.2	

* 95% confidence Intervals

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Figure 1: Map of Malawi showing survey sites*
*Mwanza, Chikwawa and Nsanje districts comprising Lower Shire Valley, Southern Malawi



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