PREVALENCE AND RISK FACTORS FOR TRACHOMA IN RWANDA

Ruberanziza E[1], Mupfasoni D[1], Nizeyimana V[2], Karibushi B[1], Kabera M[1], Kaberuka T[1], Kabanda G[2], Sebeza J[2] Kramer MH[2], Ruxin J[1,3], Fenwick A[4], and Kalua K[5,6]

Abstract

Objective: Trachoma is the oldest blinding ocular infection that has well known predisposing risk factors for its transmission. The prevalence of trachoma in Rwanda has been unknown as no trachoma population-based survey had ever been undertaken. The aim of this study was to determine the prevalence of Trachoma and assess associated risk factors for its transmission.

Methods: A population-based cross-sectional study of children aged 1 to 9 years and adult women aged 15 and above. Study setting was Gatsibo (Eastern Province) and Nyaruguru (Southern Province) Districts, Rwanda. Clusters were selected through probability proportion-to-size sampling and eligible persons were sampled using a systematic random sampling method. Data were collected using three generic survey questionnaires (village, household and individual level) as recommended by the World Health Organization (WHO).

Results: 3,451 children and 1,841 adult women underwent ocular examination for trachoma assessment. The prevalence of trachomatous inflammation-follicular (TF) among children was 1.32 % [95% CI, 0.77-1.86] in Gatsibo and 0.73% [95% CI, 0.33-1.13] in Nyaruguru Districts, respectively; with both districts having a prevalence below the WHO/International Trachoma Initiative (ITI) cut-off point of 10% for trachoma to be taken as disease of public health importance. There was no case of blinding trachomatous trichiasis and corneal opacity in both districts. Risk factors present for trachoma transmission were minimal.

Conclusion: Trachoma is not a disease of public health importance in Gatsibo and Nyaruguru Districts in Rwanda

Keywords: Prevalence and risk factors, trachoma, trachomatous trichiasis (TT), trachomatous inflammation-follicular (TF), trachomatous inflammation-intense (TI)

Introduction

Trachoma is one of the five Vision 2020 (global initiative for elimination of avoidable blindness, launched jointly by WHO and International Agency for Prevention of Blindness (IAPB)) priority ocular areas , the other four being cataract, childhood blindness, Onchocerciasis, and refractive errors and low vision. The “Vision 2020 Right to Sight”, is a global initiative to eliminate avoidable blindness by the year 2020 (1,2,3).

To achieve the goal of eliminating blinding trachoma by the year 2020, an initiative known as GET 2020 (Global Elimination of blinding Trachoma by 2020) has been developed by WHO (4). This initiative works through a strategy known as “SAFE”, the acronym SAFE meaning: S=Surgery; A=Antibiotics; F=Face washing; E=Environment to eliminate trachoma.

Rwanda is still listed by WHO as one of the suspected trachoma endemic countries (5), with an estimated overall prevalence of blindness of 1.0 % (6), but the contribution of trachoma as a cause of blindness is not known. The recommended SAFE strategy for elimination of blinding trachoma is not currently being implemented in Rwanda due to lack of reliable prevalence data. The Rwandan Neglected Tropical Disease (NTD) Control program which is implemented by the Ministry of Health’s Center for Treatment and Research on AIDS, Malaria, Tuberculosis and Other Epidemics (TRAC *Plus*, Ministry of Health) in partnership with Columbia University’s Access Project chose to conduct research on trachoma in line with the VISION 2020 priorities. Through this initiative, a baseline trachoma prevalence survey was conducted in two districts with the aim of estimating the prevalence of trachoma and assessing its predisposing factors. The study results were intended to give guidance on whether an intervention using the SAFE strategy was warranted in the selected districts.

Correspondence: Dr. Eugene Ruberanziza; E-mail: eugener@theaccessproject.com

[1].Access Project, Kigali Rwanda, [2] TRAC Plus - Centre for Treatment and Research on AIDS, Malaria, Tuberculosis and Other Epidemics, Kigali, Rwanda; [3]The Earth Institute, Columbia University, New York City, USA, [4]Imperial College London, UK, [5] Dept of Ophthalmology, College of Medicine, Malawi, [6]London School of Hygiene and Tropical Medicine, UK

Methods

Study setting

The study was implemented in two districts in Rwanda from early to late December 2008: Gatsibo District in the Eastern Province and Nyaruguru District in the Southern Province. The selection of the districts was based on the results of the earlier Trachoma Rapid Assessment (TRA) survey that showed a prevalence of active trachoma (trachomatous inflammation-follicular (TF)/trachomatous inflammation-intense (TI)) greater than 10% in both districts. .

Study design

This was a cross-sectional household-based survey designed to obtain district-level prevalence estimates for trachoma and its risk factors. This involved determining the magnitude, pattern and distribution of trachoma in the selected districts. The study was carried out among village residents by TRAC *Plus* in collaboration with Access Project and the district administrations.

Inclusion criteria

Children aged 1 to 9 years, and adult women aged 15 years and above were examined for evidence of trachoma. A resident by definition was considered as a person who had lived in the village for at least 6 months.

Exclusion criteria

People living in the village for less than 6 months and those children and adults who were medically unfit to complete the eye examination were excluded. Children aged between 10 and 15 and men aged 15 and above were also not included in the study.

Sampling procedure

Sample size

The primary disease of interest in this survey was active trachoma (TF/TI) in children 1 - 9 years, and trachomatous trichiasis (TT) and corneal opacity (CO) in women aged 15 years and above. Hence, the sample sizes in the survey aimed to achieve adequate numbers of children and women in each district to estimate trachoma prevalence in each category. The sample size was calculated using the following recommended WHO formula for conducting trachoma prevalence surveys (7):

Sample size required $= e \times d^2 \times b \times (1-b) / c^2$; *where:*

b = the expected prevalence of TF in 1–9-year-old children,
c = the desired precision of the estimate,
d= the required alpha risk (5%), and
e = the expected design effect.

For children 1-9 years, the minimum sample size per district was determined using the assumption that the prevalence estimate of TF/TI in the district was greater than 20%. The expected number of children aged from 1-9 years was 117,920 for Gatsibo and 86,439 for Nyaruguru, while the expected number of women aged 15 years and above was 102,461 for Gatsibo and 75,107 for Nyaruguru. The following parameters were used to calculate the sample size: an assumed prevalence of TF/TI of 20% for Gatsibo and Nyaruguru, with the lowest expected rate being 16% (precision of 4%), a significance level of 5%, and a design effect of 4 to account for clustering of members in the household. Using the formula above the required number of children per district for this study was 1,537. Assuming an average of 1.6 children aged 1-9 years per household there was a need to sample 896 households for each district. This required 32 clusters of 28 households each. Probability proportional to size (PPS) 32 was used to select clusters (villages) for each of the two districts. In women aged 15 years and above, the prevalence of TT was assumed much lower (<1%) and using the same parameters as for the children, a much higher sample would have been needed to obtain an estimate with narrow confident intervals. Since the two sub-populations were studied concurrently, the number of women aged 15 years and above obtained from the total households where the children were sampled was taken as the sample size. Assuming one female aged 15 years and above per household, it was anticipated that at least 960 women would be sampled and examined for TT and CO. The 28 households were sampled using a systematic random sampling technique.

Sampling frame

The sampling frame was a list of selected clusters (villages) in each of the 2 districts, from which the 28 households were randomly selected. The sampling frame included the name of each village, the cell, sector and district in which each village was located, the identification code of each village, and the household list of residents from each selected village.

The clusters were selected through probability proportionate to size sampling (PPS), using updated data from the 2008 district census as the sampling frame. A list of the enumeration areas (or sectors, villages usually corresponding to a defined settlement in the rural areas or urban suburb) and their respective population size of children aged 1-9 years was produced. A column was created with the cumulative population across the enumeration areas. The total population was divided by the number of clusters required to derive the sampling interval. The first cluster was selected by multiplying the sampling interval with a random number between 0 and 1, the resulting number then was traced in the cumulative population column, and the first cluster was chosen from the corresponding enumeration area. The consecutive clusters were identified by adding the sampling interval to the previous number. The second stage of selecting 28 households within the cluster used a random formula where 28 households were randomly selected.

Adaptation of survey questionnaires

Three generic questionnaires were used: village questionnaire, household questionnaire and ocular examination questionnaire. The questionnaires were translated in the local language (Kinyarwanda).

Survey teams and training

The team leader in collaboration with the Survey Technical Working Group selected six survey teams. Each team had a supervisor and two ophthalmic clinical officers. The teams attended a 1-week training workshop covering survey methodology, client ocular examination and administration of questionnaires. A team leader who is a public health ophthalmologist, works in an area of high endemic trachoma, and had recently supervised a similar trachoma study in another country, conducted the training for the grading of trachoma. WHO slides for trachoma and other sets of slides were used for training. At the end of the training an inter-observer agreement exercise involving a gold reference (the examiner as a standard) was conducted, and each member attained at least a kappa value of 0.7.

Pre-testing

The questionnaires were pre-tested in a district that was not among the selected districts. Each ophthalmic clinical officer examined and administered at least two of each questionnaire under observation of the team leader and the supervisors. After pre-testing, further discussions were conducted as part of the training session and the questionnaires were finalised and uploaded electronically onto a Personal Digital Assistant (PDA).

Data collection

Thirteen ophthalmic clinical officers and three supervisors were involved in the data collection that took place from early to end December 2008. Data collection in the field started in Gatsibo District followed by Nyaruguru District. Each of the six teams was assigned one village for every day. Data was collected using the three modified standard WHO forms for trachoma survey. The village questionnaire was used for collecting cell information in terms of availability of health services, water sources; the household questionnaire for data on household member characteristics, assets, household water sources and sanitation; and the ocular examination questionnaire for data on demographics of survey subjects, trachoma risk factors, signs and symptoms, and history of previous trachoma treatment.

The ocular examination for presence of trachoma was conducted using a loupe 2.5 magnification and each eye was examined separately. Other data collected included environmental factors such as availability of functional latrines, presence of solid waste or animal pens, distance to water source and unclean children's faces.

Ethical considerations

The protocol together with all the tools for the survey was submitted to the Rwandan National Ethics Committee which gave approval for the study. All participants/legal guardians were given information about the research and asked to give free and informed consent before taking part in the research.

Data management and analysis

Survey questionnaires were entered using electronic PDAs and information was transferred from the PDAs straight into personal computers. Data were cleaned and analysed in STATA/MP.10.0. Univariate analysis using frequencies and other descriptive statistics and bivariate analysis were done to examine relationships, using the Pearson Chi-squared test for 2 by 2 tables. In cases of expected frequencies being less than 5, Fisher's exact test and two-tailed probability was reported. The cut-off point for statistical significance was set at 5% level.

Results

General characteristics of study participants

A total of 812 households in Gatsibo district and 821 households in Nyaruguru district out of 896 households in each district were enumerated for the study, giving a response rate of 91% and 92 % respectively. A total of 1,671 children and 1,780 children aged ≤ 9 years were recruited for the study from Gatsibo and Nyaruguru Districts, respectively, versus 1,537 children who were planned from each district; and a total of 910 and 931 women from Gatsibo and Nyaruguru, respectively, were recruited for the study versus 960 women planned.
Table 1 shows the detailed distribution by age of the participants who were recruited in the study for both districts.

Table 1: Distribution by age and sex for Gatsibo and Nyaruguru Districts

Variables	**Districts**					
	Gatsibo			**Nyaruguru**		
Age	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
	No (%)	**No (%)**		**No (%)**	**No (%)**	
Children ≤ 9 years	810 (100.0)	861 (48.6)	1,671	794 (100.0)	986 (51.4)	1,780
Adults > 15 years	----	910 (51.4)	930	----	931 (48.6)	942
Total	810 (100.0)	1,771 (100.0)	2,581	794 (100.0)	1,917 (100.0)	2,711

Ocular examination findings

Clean faces

All children aged 1-9 years were inspected and noted whether they had clean faces or not, and the information obtained from the two districts is shown in table 2. A clean face was defined as absence of obvious ocular and nasal discharge.

Table 2: Presence of clean faces

	Districts	
Clean faces	Gatsibo	Nyaruguru
Yes	1,287 (78.6%)	1,418 (79.9%)
No	351 (21.4%)	357 (20.1%)
Total	1,638 (100.0%)	1,775 (100.0%)

Table 3: Prevalence of active trachoma (TF/TI) in children aged 1-9 years

Trachoma type	**Gatsibo (n=1,667)**		**Nyaruguru (n=1,776)**	
	No (%)	95% CI	No (%)	95% CI
TF	22 (1.32)	0.77- 1.86	13 (0.73)	0.33-1.13
TI	5 (0.30)	0.037-0.56	0 (0.0)	0

There was no case of TT or CO found in women aged 15 years and above in the two districts.

Environmental factors associated with trachoma

Regarding water sources, more than 50% of residents in both districts had access to a water source reachable within a distance of less than 30 minutes, the common source being an unprotected well in both districts. Regarding latrines, garbage disposal and presence of animal waste, the majority (>75%) of the residents were using improved pit latrines, no evidence of animal waste was found, but loose garbage in 41.4% and 38.7% of all resident homes in Gatsibo and Nyaruguru Districts, respectively.

Discussion

This study was conducted to determine the prevalence of active trachomatous infections (TF/TI), the sequelae of the infections (TT and CO), and the environmental factors associated with trachoma in Gatsibo and Nyaruguru districts in Rwanda. The study was meant to give baseline data on the current status of trachoma in the two districts. To our knowledge, this is the first trachoma population-based survey undertaken in Rwanda. Two previous trachoma surveys reported were the TRA (unpublished data), which was done in 2007 in 9 districts, and the Rapid Assessment of Avoidable Blindness survey (RAAB) study conducted in Western Province (8).

The TRA showed that the prevalence of active trachoma (TF/TI) in children aged 1-9 years was highest in Gatsibo (15.3%) and Nyaruguru (12.6%) districts and prompted the conduction of a population-based survey in the two districts to verify the findings. It is worth noting that the number of children examined in Gatsibo and Nyaruguru districts during the TRA were only 150 and 151 respectively, selected from the suspected areas and therefore, prone to bias due to small sample size; this is in contrast to the present survey where the clusters and households were randomly selected and the sample size was large. In the present study, a total of 3,443 children aged 1-9 years and 1,841 women aged 15 years and above were examined for evidence of trachoma according to WHO simplified classification of trachoma. The RAAB study carried out in western Rwanda reported the presence of trachoma in that province, but could not determine the actual prevalence of trachoma.

Prevalence of active trachoma

The prevalence of TF and TI in children was less than 1.5% and 0.5%, respectively, with narrow CIs. This is much lower than the WHO/ITI cut-off point of 10% for trachoma to be taken as disease of public health importance. Hence overall active trachoma is not a problem in the two districts and therefore does warrant neither the whole "SAFE" strategy nor massive antibiotic administration. Although these findings indicate that trachoma is not a disease of public health importance in Rwanda, mechanisms for constant surveillance and routine reporting of active trachoma cases to be put in place to track the progress of trachoma in the two districts should be considered.

There were no case of TT and CO in the two districts; and this observation is similar to what was found during the TRA in the same districts, where no case of trichiasis was found in Gatsibo and only one case in Nyaruguru. Development of trachoma scarring and trichiasis is related to the intensity of the active infection and the frequency of infections (9,10,11), and so it is possible that the active trachoma infections in these districts are not severe and frequent and therefore heal without further sequelae, which can lead to blindness. Rwanda is also composed of mainly a younger age population (majority of people aged < 40 years). If the current active infections are indeed going to be persistent and recurrent, one would expect to have cases of trichiasis in future.

Environmental and other risk factors associated with trachoma

There is running water in the two districts, and generally accessible water from the many rivers and dams enables the short time it takes to bring water home. Rwanda has two rainy seasons every year, and accessibility vary substantially among the country's 30 districts. Trachoma is associated with scarcity of water (9,10,12,13) and the relative abundance of water in these two districts may partly explain why trachomatous infections are not a major problem there.

Lack of proper environmental and personal hygiene is the other factor that is associated with the increased transmission of trachomatous infections (14). Garbage disposal in the surrounding area and presence of cattle feces are associated with presence of *Musca sorbens*, the flies responsible for the transmission of trachoma (15). The presence of flies on children's faces and dirty faces appeared to be strongly associated (16). The presence of flies may be a marker of socio-economic status and is probably linked with other trachoma risk factors (17). Flies are also more likely to increase in the absence of a proper pit latrine/toilet and where the faces of children are not regularly cleaned. In this study more than 75% of all households had a functioning toilet. In regard to facial cleanliness, almost three quarters of all children examined had clean faces. The absence of factors that promote the transmission of active trachoma in the two districts may explain the low prevalence of trachoma infections.

In conclusion the low prevalence of active trachomatous infections and the absence of blinding trachoma in the two districts show that trachoma is not a disease of high public health importance in Gatsibo and Nyaruguru districts, and may well carry a low burden in the rest of the country. However it should be noted that the two districts were selected based on the earlier results from the TRA study, and therefore the results of this study can not be extrapolated and generalized to the other districts.

If the current situation of trachoma found in Gatsibo and Nyaruguru districts is indeed the same in other parts of the country, then blinding trachoma is not a problem and it is likely that the WHO goal of eliminating blinding trachoma will be achieved by the year 2020 in Rwanda.

Acknowledgements

The study received financial support from Legatum, Geneva Global (GG), Global Network for Neglected Tropical Disease Control (GNNTDC), Schistosomiasis Control Initiative (SCI), Sabin Vaccine Institute (SVI) and The Earth Institute (EI)/Columbia University.

References

1. Pizzarello L, Abiose A, Ffytche T, et al. VISION 2020: The Right to Sight: a global initiative to eliminate avoidable blindness. Arch Ophthalmol 2004;122(4):615-620.
2. Resnikoff S, Kocur I, Etya'ale DE, Ukety TO. Vision 2020 - the right to sight. Ann Trop Med Parasitol 2008;102 Suppl 1:3-5.
3. http://www.V2020.org.
4. Mariotti SP, Pararajasegaram R, Resnikoff S. Trachoma: looking forward to Global Elimination of Trachoma by 2020 (GET 2020). Am J Trop Med Hyg 2003;69(5 Suppl):33-35.
5. Polack S, Brooker S, Kuper H, et al. Mapping the global distribution of trachoma. Bull World Health Organ 2005;83(12):913-919.

6. Resnikoff S, Pascolini D, Etya'ale D, et al. Global data on visual impairment in the year 2002. Bull World Health Organ 2004;82(11):844-851.
7. WHO. Trachoma Control: A guide for programme managers. Published jointly by the World Health Organization, the London School of Hygiene and Tropical Medicine, and the International Trachoma Initiative. Geneva. WHO Library Cataloguing-in-Publication Data, 2006.
8. Mathenge W, Nkurikiye J, Limburg H, Kuper H. Rapid assessment of avoidable blindness in Western Rwanda: blindness in a postconflict setting. PLoS Med 2007;4(7):e217.
9. West SK, Munoz B, Lynch M, et al. Risk factors for constant, severe trachoma among preschool children in Kongwa, Tanzania. Am J Epidemiol 1996;143(1):73-
10. Ngondi J, Matthews F, Reacher M, et al. Prevalence of risk factors and severity of active trachoma in southern Sudan: an ordinal analysis. Am J Trop Med Hyg 2007;77(1):126-132.
11. Stark A, Sherman MD. Re: "Risk factors for constant, severe trachoma among preschool children in Kongwa, Tanzania". Am J Epidemiol 1997;146(3):285.
12. Polack S, Kuper H, Solomon AW, et al. The relationship between prevalence of active trachoma, water availability and its use in a Tanzanian village. Trans R Soc Trop Med Hyg 2006;100(11):1075-1083.
13. Baggaley RF, Solomon AW, Kuper H, et al. Distance to water source and altitude in relation to active trachoma in Rombo district, Tanzania. Trop Med Int Health 2006;11(2):220-227.
14. Burton MJ. Trachoma: an overview. Br Med Bull 2007;84:99-116.
15. Sahlu T, Larson C. The prevalence and environmental risk factors for moderate and severe trachoma in southern Ethiopia. J Trop Med Hyg 1992;95(1):36-41.
16. Schemann JF, Guinot C, Ilboudo L, et al. Trachoma, flies and environmental factors in Burkina Faso. Trans R Soc Trop Med Hyg 2003;97(1):63-68.
17. Edwards T, Harding-Esch EM, Hailu G, et al. Risk factors for active trachoma and Chlamydia trachomatis infection in rural Ethiopia after mass treatment with azithromycin. Trop Med Int Health 2008;13(4):556-565.