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Completing Baseline Mapping of Trachoma in Nepal: Results of 27 Population-Based Prevalence Surveys Conducted in 2013 and 2014

Shekhar Sharma[a], Jeremiah M. Ngondi[b], Sailesh Mishra[a,c], Raman D. Prasad[d], Kathryn Crowley[e], Delali Bonuedi[e], Lisa A. Rotondo[e], Lionel Nizigama[e], Aryc Mosher[f], Rob Henry[f], Rebecca Willis[g] and Anthony W. Solomon[h,i], for the Global Trachoma Mapping Project*

[a]Nepal Netra Jyoti Sangh, Kathmandu, Nepal; [b]RTI International, Dar es Salaam, Tanzania; [c]Ministry of Health and Population, Kathmandu, Nepal; [d]RTI International, Kathmandu, Nepal; [e]RTI International, Washington, DC, USA; [f]United States Agency for International Development, Washington, DC, USA; [g]Task Force for Global Health, Decatur, GA, USA; [h]Clinical Research Department, London School of Hygiene & Tropical Medicine, London, UK; [i]London Centre for Neglected Tropical Disease Research, London, UK

ABSTRACT

Purpose: Trachoma is endemic in parts of Nepal; implementation of the surgery, antibiotics, facial cleanliness, environmental improvement (SAFE) strategy started in 2002. Some suspected-endemic districts had not previously been mapped. We aimed to estimate the prevalences of trachomatous inflammation—follicular (TF) and trichiasis in those districts.

Methods: Population-based prevalence surveys were undertaken in 27 districts. In each of those districts, two-stage cluster sampling was used to select a sample of 2000 children aged 1–9 years and 4000 adults aged ≥15 years from a total of 40 wards (clusters), drawn evenly from two subdistricts. Consenting eligible participants were examined for trachoma by Global Trachoma Mapping Project (GTMP)-certified graders, using the World Health Organization simplified grading system. Data were analyzed at district level using GTMP methods.

Results: A total of 43,200 households were surveyed, and 162,094 people were examined for trachoma. District-level TF prevalence in 1–9-year-olds ranged from 0% to 4.3% (95% confidence interval [CI] 2.4–6.2). Among adults aged ≥15 years, trichiasis prevalence ranged from 0% to 0.33% (95% CI 0.08–0.65).

Conclusion: TF was not a public health problem in any of the 27 districts surveyed; thus, antibiotic mass drug administration is not needed. In two districts (Dhanusa and Gorkha), trichiasis prevalence in adults aged ≥15 years was ≥0.2%; thus, further trichiasis surgery interventions at public health level are warranted to achieve elimination. These findings will facilitate planning for elimination of trachoma as a public health problem in Nepal.

Background

Trachoma, a neglected tropical disease, remains a preventable cause of blindness. Its elimination as a public health problem (through the surgery, antibiotics, facial cleanliness, and environmental improvement: "SAFE" strategy) is a global target that was endorsed by the World Health Assembly in 1998.[1,2] The World Health Organization (WHO) estimates that by 2016 a total of 190.2 million people worldwide required A, F, and E for trachoma elimination purposes, in 42 countries.[3] It has been estimated that 1.9 million people are blind or visually impaired from it; 3.2 million people need surgery to avoid trachomatous blindness.[4] Prior to SAFE implementation, baseline surveys of trachoma prevalence are recommended to guide programs to deliver appropriate interventions.[5]

Three decades ago, trachoma was considered the most widespread potentially blinding disease in Nepal, affecting 6.5% of the population and accounting for 2.4% of bilateral blindness nationally.[6] Trachoma was characterized as hyperendemic in the western districts, and there were thought to be over 58,000 people with trichiasis.[6] The National Trachoma Program (NTP), in collaboration with partners, started implementation of the SAFE strategy in 2002. The first step involved undertaking trachoma rapid assessments (TRAs).[7] In districts where TRA results showed that ≥10% of 1–9 year-olds examined had trachomatous inflammation—follicular (TF), population-based prevalence surveys (PBPSs) were subsequently undertaken.[8]

The Ministry of Health and Population in Nepal initially set itself the goal to eliminate trachoma as a

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public health problem by the year 2017. By 2012, Nepal had done PBPSs of trachoma in 27 out of 75 districts, of which 20 districts were under implementation of the SAFE strategy.[9] However, eight districts that had not been mapped previously were suspected to be endemic for trachoma. Additionally, districts that previously had TRAs (14) and PBPSs (five) were felt to need further PBPSs because initial findings had indicated the percentage of children having TF in the 5–9.9% range. In the series of surveys described here, we aimed to estimate the prevalence of TF and trichiasis in 27 districts, where trachoma was still suspected to be endemic, and in which trachoma-specific interventions had not previously been undertaken.

Materials and methods

Study settings

Figure 1 shows the location of the 27 districts where surveys were conducted in 2013 (14 districts) and 2014 (13 districts). Among the 27 districts, 8 districts had not been surveyed, while 19 had previously been evaluated with either a TRA or a PBPS (between 1996 and 2012) and found to have a TF proportion or prevalence of 5–9.9%.

Survey design and sampling

These surveys were designed prior to the start of the Global Trachoma Mapping Project (GTMP), and their methodology therefore differs from the GTMP template[10] in several ways, notably: (1) the sample for each district was fixed as 2000 children aged 1–9 years and 4000 adults aged ≥15 years, instead of a fixed sample of households; (2) the water and sanitation fields in the household questionnaire were not the

GTMP standardized questions (so these data have not been included in this analysis); and (3) data were collected using paper-based questionnaires instead of the GTMP's Android smartphone-based system.

Surveys were powered to estimate a district-level TF prevalence of 4% in 1–9-year-olds, aiming to have 95% confidence of estimating that prevalence with absolute precision of ± 2% and a (conservative) design effect of 5, which resulted in a sample size estimate of 1844 children aged 1–9 years; we rounded this up to 2000. In addition, the sample size for adults aged ≥15 years was powered to estimate a trichiasis prevalence of 1.0% with an absolute precision of 0.5% and a design effect of 2.6, which resulted in a sample of 3926 (rounded up to 4000). The smallest administrative area (the ward) was defined as a cluster. To obtain the desired sample, each district was stratified into two subdistricts and 40 wards (20 per subdistrict) were systematically selected with probability proportional to population size, using census data from 2011 to generate the sampling frame. In each cluster, households were sampled using the random walk method[5] to obtain a fixed sample of 50 children aged 1–9 years and 100 adults aged ≥15 years.

Trachoma grading

Graders participating in the surveys had obtained a kappa for diagnosing TF of ≥0.7 based on an intergrader agreement test, compared to a GTMP-certified grader trainer as the gold standard.[11] The eyelid and tarsal conjunctiva of each eye were examined for the trachoma signs TF and trichiasis, using the definitions of the WHO simplified grading system[12], a 2.5 × magnifying loupe, and torch or sunlight.
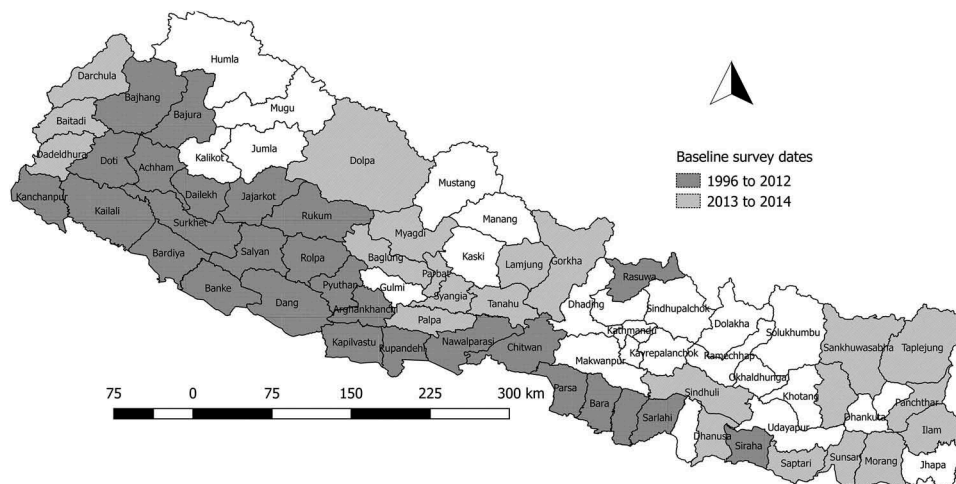

Figure 1. Map of Nepal showing districts previously surveyed (in 1996–2012) and districts surveyed in 2013–2014.

Data collection

Survey teams composed of four people (a grader, an enumerator, a community health volunteer, and a helper) undertook the fieldwork, covering, on average, one cluster per day. After obtaining verbal consent, household members were enumerated and examined for trachoma signs.

Data management and analysis

Data collection was done using paper-based questionnaires, after which data were double entered and validated for accuracy. Descriptive statistics were used to examine sample characteristics. Prevalence estimates and 95% confidence intervals for TF and trichiasis were generated using GTMP methods in R (R Foundation for Statistical Computing, Vienna, Austria) and structured query language. For each cluster, the proportion of 1–9-year-olds with TF was adjusted for age, using data from the most recent census. Similarly, for each cluster, the proportion of ≥15-year-olds with trichiasis was adjusted for gender and age in 5-year age bands.[10] District-level prevalences of TF and trichiasis were calculated as the means of the adjusted cluster-level proportions, and confidence intervals for each of these prevalence estimates were calculated by bootstrapping, with replacement, over 10,000 replications.

Ethics statement

The survey was carried out by the NTP. Ethical clearance was obtained from the Institutional Review Board of Nepal Netra Jyoti Sangh and Nepal Health Research Council. Verbal informed consent was sought from parents/guardians for children aged 1–9 years, and from each participant aged ≥15 years. Children with TF were treated with 1% tetracycline ointment, with tubes being given to carers to apply twice daily for 6 weeks. Individuals with trichiasis were counseled and referred to hospitals, where trichiasis surgery was offered free of charge.

Results

Characteristic of the sample

Table 1 shows the demographic characteristics of the sample in 27 districts surveyed. A total of 43,200 households were visited and 162,094 people were examined for trachoma. Examinees included 54,041 children aged 1–9 years and 108,053 adults aged ≥15 years. The proportion of female participants was 47.4% among children aged 1–9 years and 53.2% among those aged ≥15 years. The mean (standard deviation) age was 5.5 (2.6) and 36.2 (16.7) years among children aged 1–9 years and adults aged ≥15 years, respectively.

Table 1. Characteristics of survey population, population-based trachoma surveys, Nepal, 2013–2014.

Region	District	Survey year	Children aged 1–9 years		Adults aged ≥15 years	
			Number examined	Proportion female (%)	Number examined	Proportion female (%)
Central	Dhanusha	2013	2,000	44.2	4,000	48.5
Central	Sindhuli	2013	2,000	47.2	4,000	56.5
East	Bohjpur	2013	2,000	46.8	4,000	52.5
East	Ilam	2013	2,000	48.7	4,000	50.5
East	Morang	2013	2,000	55.5	4,000	53.9
East	Panchthar	2013	2,000	47	4,000	50.6
East	Saptari	2014	2,000	47.4	4,000	58.9
East	Shankhuwasava	2013	1,997	43.8	4,000	49.17
East	Sunsari	2013	2,000	43.4	4,000	48.5
East	Taplejung	2013	2,000	48.6	4,000	50.8
Far west	Baitadi	2013	1,999	39.7	3,999	50.8
Far west	Bajhang	2014	2,050	49	4,100	55.6
Far west	Dadeldhura	2014	2,004	46.5	3,993	55
Far west	Darchula	2014	2,002	47.8	3,993	50.1
Midwest	Dolpa	2014	2,000	46.5	3,999	47.7
Midwest	Pyuthan	2013	2,002	51.3	3,993	50.8
Midwest	Salyan	2013	2,000	48.4	3,999	57.1
West	Arghakhanchi	2013	2,000	47.1	3,985	49.8
West	Baglung	2013	2,000	48.1	3,998	57.7
West	Gorkha	2014	2,000	47.1	3,994	54.8
West	Lamjung	2014	2,000	49.2	3,958	52.8
West	Myagdi	2014	2,000	47.4	3,999	54.6
West	Palpa	2014	2,000	48.9	3,995	51.2
West	Parbat	2014	2,007	48.2	3,991	55.6
West	Rupandehi	2014	2,000	48.5	3,995	50.5
West	Syanja	2014	2,005	45.8	3,994	58.2
West	Tanahun	2014	1,975	46.9	4,068	63.1
Total			54,041	47.4	108,053	53.2

Table 2. Prevalence of TF among children aged 1–9 years and trichiasis among adults aged ≥15 years, Nepal, 2013–2014.

Region	District	Prevalence of TF % in children 1–9 years (95% CI)[a]	Prevalence of trichiasis % in adults ≥15 years (95% CI)[b]
Central	Dhanusha	0	0.21 (0.02–0.48)
Central	Sindhuli	0.2 (0.0–0.3)	0.02 (0.0–0.04)
East	Bhojpur	0.1 (0.0–0.2)	0.03 (0.0–0.06)
East	Ilam	0	0
East	Morang	0.3 (0.1–0.5)	0.09 (0.01–0.19)
East	Panchthar	0	0
East	Saptari	0.1 (0.0–0.1)	0
East	Shankhuwasava	0.2 (0.0–0.3)	0
East	Sunsari	0.5 (0.0–1.2)	0.02 (0.0–0.04)
East	Taplejung	0.3 (0.0–0.6)	0
Far west	Baitadi	4.5 (1.4–9.4)	0
Far west	Bajhang	0	0.05 (0.0–0.09)
Far west	Dadeldhura	0.4 (0.0–0.8)	0.11 (0.01–0.27)
Far west	Darchula	0.2 (0.0–0.4)	0.11 (0.01–0.22)
Midwest	Dolpa	0.1 (0.0–0.1)	0
Midwest	Pyuthan	0	0
Midwest	Salyan	4.3 (2.4–6.2)	0.12 (0.04–0.21)
West	Arghakhanchi	0	0
West	Baglung	0.2 (0.0–0.4)	0
West	Gorkha	0.7 (0.1–1.1)	0.33 (0.08–0.65)
West	Lamjung	0.6 (0.0–1.5)	0.05 (0.0–0.13)
West	Myagdi	0.1 (0.0–0.2)	0.01 (0.0–0.01)
West	Palpa	0	0
West	Parbat	0.3 (0.0–0.6)	0
West	Rupandehi	0	0
West	Syanja	0.2 (0.0–0.4)	0.01 (0.0–0.03)
West	Tanahun	0.1 (0.0–0.2)	0.07 (0.0–0.17)

[a]Adjusted for age in 1-year age bands (see text).
[b]Adjusted for gender and age in 5-year age bands (see text).
CI, confidence interval.

Prevalence of trachoma signs

Table 2 summarizes the prevalence of TF and trichiasis by district. Prevalence of TF in children aged 1–9 years ranged (by district) from 0% to 4.3% (95% confidence interval [CI] 2.4–6.2), while trichiasis prevalence in adults aged ≥15 years ranged from 0% to 0.33% (95% CI 0.08–0.65). Trichiasis prevalence was ≥0.2% in two districts. Prevalence categories are shown in Figure 2, alongside those generated at baseline in districts of Nepal that were surveyed prior to this tranche of work.

Discussion

Baseline trachoma surveys are essential for planning implementation of the SAFE strategy and setting targets for elimination. This set of surveys completes baseline mapping of suspected-endemic districts in Nepal, and showed that trachoma was not a public health problem in 25 of 27 districts for which we generated data. The prevalence of TF among children aged 1–9 years was < 5% in all districts, and only two districts (Dhanusha and Gorkha) had trichiasis prevalence of ≥0.2% in adults aged ≥15 years, indicating a requirement for public health-level trichiasis surgery programs to achieve the trichiasis elimination target.[13] Following

intervention, further prevalence surveys of trichiasis will be needed to document attainment of elimination.[14]

Our survey design's major strength was the oversampling compared to the most recent sample sizes recommended by the WHO for both TF (1019 children aged 1–9 years)[10] and trichiasis (2818 adults aged ≥15 years)[15], which thus provided power for very precise prevalence estimates at district level. However, there are a number of potential limitations. First, the use of a fixed sample of 50 children and 100 adults per cluster is a potential source of (albeit minor) bias, since examinees were recruited by selecting households, not individuals, and it is unlikely that the group of households chosen in every cluster yielded exactly the desired number of examinees in each age group. Second, sampling of households was done using the random walk method; this is not optimally rigorous from an epidemiological perspective. Third, we did not check to see whether cases of trichiasis were associated with trachomatous scar of the conjunctiva, which was a recommendation made in 2015,[16] well after these surveys were completed. Finally, the water and sanitation data that we collected were not translatable to WHO/UNICEF Joint Monitoring Program definitions for improved and unimproved water sources and sanitation facilities (https://www.wssinfo.org/definitions-
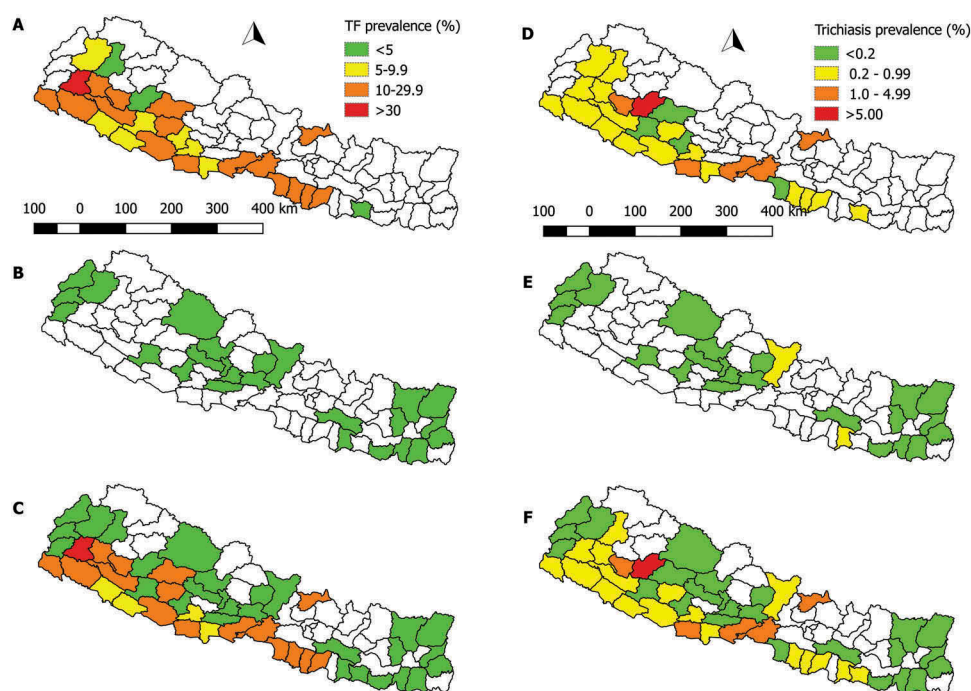
Figure 2. Baseline prevalence of TF in children aged 1–9 years and trichiasis in adults aged ≥15 years, Nepal, 1996–2014. (a) TF prevalence from districts mapped in 1996–2012; (b) TF prevalence from districts mapped in 2013–2014; (c) TF prevalence combining data from all surveys conducted in 1996–2014; (d) Trichiasis prevalence from districts mapped in 1996–2012; (e) Trichiasis prevalence from districts mapped in 2013–2014; (f) Trichiasis prevalence combining data from all data surveys conducted in 1996–2014.

methods/watsan-categories/), and we have therefore not presented them here. We do not believe that this weakens our conclusions: any comparison of TF and access to water and sanitation would be moot, given that TF prevalence was < 5% in each district.

The findings from these surveys suggest that TF was not a public health problem in any of 27 districts, so antibiotic mass drug administration will not be needed for trachoma elimination. However, two districts need to undertake public-health-level trichiasis surgery interventions to attain elimination of trachoma. The data suggest that with intensive effort and a small number of further prevalence surveys, Nepal may soon be able to eliminate trachoma and demonstrate that this has been achieved.

Conflict of interest

None of the following authors have any proprietary interests or conflicts of interest related to this submission:

Shekhar Sharma, Jeremiah M. Ngondi, Sailesh Mishra, Raman D. Prasad, Kathryn Crowley, Delali Bonuedi, Lisa A. Rotondo, Lionel Nizigama, Aryc Mosher, Rob Henry, Rebecca Willis, and Anthony W. Solomon.

Funding

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Appendix

The GTMP investigators are as follows: Agatha Aboe (1,11), Liknaw Adamu (4), Wondu Alemayehu (4,5), Menbere Alemu (4), Neal D. E. Alexander (9), Ana Bakhtiari (2,9), Berhanu Bero 245 (4), Sarah Bovill (8), Simon J. Brooker (1,6), Simon Bush (7,8), Brian K. Chu (2,9), Paul Courtright (1,3,4,7,11), Michael Dejene (3), Paul M. Emerson (1,6,7), Rebecca M. Flueckiger (2), Allen Foster (1,7), Solomon Gadisa (4), Katherine Gass (6,9), Teshome Gebre (4), Zelalem Habtamu (4), Danny Haddad 250 (1,6,7,8), Erik Harvey (1,6,10), Dominic Haslam (8), Khumbo Kalua (5), Amir B. Kello (4,5), Jonathan D. King (6,10,11), Richard Le Mesurier (4,7), Susan Lewallen (4,11), Thomas M. Lietman (10), Chad MacArthur (6,11), Colin Macleod (3,9), Silvio P. Mariotti (7,11), Anna Massey (8), Els Mathieu (6,11), Siobhain McCullagh (8), Addis Mekasha (4), Tom Millar (4,8), 255 Caleb Mpyet (3,5), Beatriz Muñoz (6,9), Jeremiah Ngondi (1,3,6,11), Stephanie Ogden (6), Alex Pavluck (2,4,10), Joseph Pearce (10), Serge Resnikoff (1), Virginia Sarah (4), Boubacar Sarr (5), Alemayehu Sisay (4), Jennifer L. Smith (11), Anthony W. Solomon (1,2,3,4,5,6,7,8,9,10,11), Jo Thomson (4), Sheila K. 260 West (1,10,11), and Rebecca Willis (2,9).

Key: (1) Advisory Committee, (2) Information Technology, Geographical Information Systems, and Data Processing, (3) Epidemiological Support, (4) Ethiopia Pilot Team, (5) Master Grader Trainers, (6) Methodologies Working Group, (7) Prioritisation Working Group, (8) Proposal Development, Finances and Logistics, (9) Statistics and Data Analysis, (10) Tools Working Group, (11) Training Working Group.