

Trachoma Impact Survey Results from 31 Woredas in Tigray Region, Ethiopia

Gemechis Teferi, Harnet Adane, Evini Cyrille, Aynalem Tefera, Solomon Gadisa, Adugna Amin, Mebratu Tsehaye, Yonas Mitku, Haftamu Assefa, Sharone Backers, Addisu Alemayehu, Belete Mengistu, Fikreab Kebede, Fentahun Tadesse, Nebiyu Negussu, Robert Butcher, Ana Bakhtiari, Rebecca Willis, Sarah Boyd, Cristina Jimenez, Michael Dejene, Anthony W. Solomon, Meheret Deyassa, Mohammed Shafi, Tezera Kifle, Asfaw Tegen, Berihu Mesfin, Tsegay Berihu, Teklay Mariam, Hagos Godefay, Emma M. Harding-Esch, Amanuel Kidane & Ephrem Fisseha

To cite this article: Gemechis Teferi, Harnet Adane, Evini Cyrille, Aynalem Tefera, Solomon Gadisa, Adugna Amin, Mebratu Tsehaye, Yonas Mitku, Haftamu Assefa, Sharone Backers, Addisu Alemayehu, Belete Mengistu, Fikreab Kebede, Fentahun Tadesse, Nebiyu Negussu, Robert Butcher, Ana Bakhtiari, Rebecca Willis, Sarah Boyd, Cristina Jimenez, Michael Dejene, Anthony W. Solomon, Meheret Deyassa, Mohammed Shafi, Tezera Kifle, Asfaw Tegen, Berihu Mesfin, Tsegay Berihu, Teklay Mariam, Hagos Godefay, Emma M. Harding-Esch, Amanuel Kidane & Ephrem Fisseha (2024) Trachoma Impact Survey Results from 31 Woredas in Tigray Region, Ethiopia, *Ophthalmic Epidemiology*, 31:6, 597-604, DOI: [10.1080/09286586.2024.2317823](https://doi.org/10.1080/09286586.2024.2317823)

To link to this article: <https://doi.org/10.1080/09286586.2024.2317823>



© 2024 The Author(s). Published with license by Taylor & Francis Group, LLC.



[View supplementary material](#)



Published online: 27 Dec 2024.



[Submit your article to this journal](#)



Article views: 237



[View related articles](#)



[View Crossmark data](#)

Trachoma Impact Survey Results from 31 Woredas in Tigray Region, Ethiopia

Gemechis Teferi^a, Harnet Adane^b, Evini Cyrille^a, Aynalem Tefera^a, Solomon Gadisa^a, Adugna Amin^a, Mebratu Tsehaye^a, Yonas Mitku^c, Haftamu Assefa^c, Sharone Backers^d, Addisu Alemayehu^d, Belete Mengistu^d, Fikreab Kebede^e, Fentahun Tadesse^{e,f}, Nebiyu Negussu^e, Robert Butcher^g, Ana Bakhtiari^h, Rebecca Willis^h, Sarah Boyd^h, Cristina Jimenezⁱ, Michael Dejene^j, Anthony W. Solomon^k, Meheret Deyassa^l, Mohammed Shañi^m, Tezera Kifleⁿ, Asfaw Tegen^o, Berihu Mesfin^b, Tsegay Berihu^b, Teklay Mariam^b, Hagos Godefay^b, Emma M. Harding-Esch^g, Amanuel Kidane^a, and Ephrem Fisseha^a

^aLight for the World, Addis Ababa, Ethiopia; ^bTigray Regional Health Bureau, Mekele, Tigray, Ethiopia; ^cQuha Hospital, Tigray, Ethiopia; ^dAct to End NTDs East, RTI International, Addis Ababa, Ethiopia; ^eMinistry of Health, Addis Ababa, Ethiopia; ^fCrown Agents, Addis Ababa, Ethiopia; ^gClinical Research Department, London School of Hygiene & Tropical Medicine, London, UK; ^hInternational Trachoma Initiative, Task Force for Global Health, etc., Decatur, Georgia, USA; ⁱSightsavers, Haywards Heath, UK; ^jSightsavers, Addis Ababa, Ethiopia; ^kDepartment of Control of Neglected Tropical Diseases, World Health Organization, Geneva, Switzerland; ^lAmbo Hospital, Ambo, Oromia, Ethiopia; ^mAdama Hospital Medical College, Adama, Oromia, Ethiopia; ⁿOrbis International, Addis Ababa, Ethiopia; ^oEyen Consulting PLC, Addis Ababa, Ethiopia

ABSTRACT

Purpose: Baseline surveys were conducted in Tigray region, Ethiopia, in 2013. Since then, rounds of azithromycin mass drug administration (MDA) have been delivered in-line with international guidance. The purpose of these surveys was to assess trachomatous inflammation—follicular (TF) prevalence following those treatments to enable the region to plan the next steps towards elimination of trachoma.

Methods: All surveys followed WHO recommendations for community-based cross-sectional survey design. Thirty-one woredas in six zones of Tigray region were surveyed. There were two survey series: all 31 woredas were surveyed in the first series, and 11 woredas were resurveyed in the second, due to having a TF prevalence between 5% and 9.9% in the first series.

Results: In the first series of 31 surveys, one woreda had an adjusted TF prevalence in 1–9-year-olds of <5.0%, 13 had a prevalence of 5.0–9.9% and 17 had a prevalence of 10.0–29.9%. In the second series of 11 surveys, the prevalence of TF was <5.0% in seven woredas and 5.0–9.9% in four woredas. The most recent adjusted prevalence of trachomatous trichiasis (TT) unknown to the health system in ≥15-year-olds was ≥2% in 27 EUs. One-third of households visited had access to an improved drinking water source within a 30-minute return journey of their house, and 11% had an improved latrine.

Conclusion: Eight woredas met the criteria to stop MDA for 2 years before the re-survey. However, further rounds of MDA, additional efforts to improve water and sanitation access and ongoing strengthening of surgical services for TT are needed across Tigray.

ARTICLE HISTORY

Received 18 November 2022

Revised 2 January 2024

Accepted 6 February 2024

KEYWORDS

Ethiopia; neglected tropical disease; Tigray; trachoma; trachoma impact survey



Introduction


Trachoma, caused by repeated rounds of infection with *Chlamydia trachomatis*, is the leading infectious cause of blindness worldwide.¹ Trachoma can be eliminated as a public health problem using the World Health Organization's (WHO)-recommended SAFE (trichiasis surgery, mass drug administration [MDA] of antibiotics, facial cleanliness, and environmental improvement) strategy.^{2,3} Elimination of trachoma as a public health problem is defined as follows: (i) prevalence of trachomatous trichiasis (TT) unknown to the health system of <2% among people aged ≥15 years in each formerly endemic district, (ii) prevalence of trachomatous inflammation—follicular (TF) of <5% among children aged 1–9

years in each formerly endemic district, plus (iii) evidence that the health system can continue to identify and manage incident cases of TT.⁴

In some parts of Ethiopia, large-scale trachoma elimination efforts have been underway since at least 2001.⁵ Pre-intervention (baseline) surveys, conducted both before and as part of the Global Trachoma Mapping Project,^{6,7} confirmed that trachoma was hyperendemic throughout much of the country,^{8–14} and stimulated stakeholders at all levels to take action.¹⁵ In the Tigray region, trachoma was endemic in all 11 evaluation units (EUs) in 2013,^{16,17} with disease prevalence exceeding the respective elimination thresholds in each EU.¹⁰

Tigray Regional Health Bureau (RHB) launched projects to eliminate trachoma as a public health problem in

CONTACT Gemechis Teferi  g.teferi@light-for-the-world.org  Light for the World, Bole Road, Bedesta Building 5th Floor, Addis Ababa, Ethiopia

 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/09286586.2024.2317823>.

© 2024 The Author(s). Published with license by Taylor & Francis Group, LLC.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

2015. By 2018, 31 of the 34 trachoma-endemic woredas had completed the required number of rounds of antibiotic MDA and more than 38,000 TT surgeries had been performed. No trachoma-targeted facial cleanliness or environmental interventions were conducted during that period.

WHO recommends that trachoma impact surveys be undertaken 6–12 months after the last round of annual antibiotic MDA, to determine whether treatment should be continued or stopped.¹⁸ The primary aim of the surveys reported here was to re-estimate TF prevalence among children aged 1–9 years after interventions in the Tigray Region, Ethiopia, to guide future interventions. The prevalence of TT and water, sanitation, and hygiene (WaSH) infrastructure coverage was also assessed.

Methods

Survey overview

At the end of 2019, Tropical Data protocols were updated from version 2¹⁹ to version 3.²⁰ Version 2 was used for the 2018–19 surveys, and version 3 for the 2020 surveys. Methodological differences are noted in the relevant sections below.

All 31 woredas were surveyed in the first series of surveys, and 11 woredas were resurveyed in the second. The first series of surveys in these woredas involved 22 surveys in 2018–2019 (using the Tropical Data version 2 methodology)¹⁹ and nine surveys in 2020 (using the Tropical Data version 3 methodology).²⁰ Out of the 22 surveys conducted in 2018–2019, 21 were above the 5% WHO threshold. Out of these 21, 12 had a TF prevalence between 5.0% and 9.9% and therefore only required a single extra round of MDA, and were therefore available for a second series of impact surveys by 2020. The second series however consisted of surveys in only 11 of these woredas, which had completed planned MDA treatment as per WHO guidelines (all using the Tropical Data version 3 methodology),²⁰ as repeat impact surveys in one woreda, Tsegede, were put on hold due to insecurity in the area. In total, 20 woredas were surveyed once and 11 woredas were surveyed twice.

Survey design

All surveys followed contemporary WHO recommendations for community-based cross-sectional survey design.^{6,21} Each woreda was surveyed as an independent EU, in-line with WHO definitions of an EU for trachoma elimination purposes.¹⁶ Within each woreda, two-stage cluster sampling was employed. The primary sampling unit was the kushat, selected using random

sampling with probability proportional to size. The secondary sampling unit was the household, selected using compact segment sampling. All residents aged ≥ 1 year in selected households were eligible to take part.

To estimate a prevalence of TF in 1–9-year-olds of 4% with a precision of $\pm 2\%$ (at the 95% confidence level, assuming a design effect of 2.63²² and assuming a 20% non-response rate), 1,164 children aged 1–9 years were needed.²¹ Based on recent trachoma surveys in Ethiopia, an average of 1.5 children aged 1–9 years was expected per household, so 776 households would be needed to meet the sample size target. Based on sampling 30 households (the number which could comfortably be visited by one field team in a single day) per kushat, 26 kushats would need to be included. The secondary objectives of the survey (estimation of TT prevalence and WaSH coverage) would be assessed in the households selected to recruit children for TF assessment.

Training and team composition

All graders and recorders were trained in a standardised manner using the Tropical Data training system.^{19,20} All had to pass a standard qualifying examination before they could join a survey team. Graders were required to pass both slide and field intergrader agreement tests by scoring kappas of $\geq .7$ compared to a certified grader trainer, and recorders were required to score $\geq 90\%$ in a standard recorder test.^{19,20}

Thirteen teams, each consisting of a trachoma grader, a data recorder, a village guide, and a driver, were assembled to conduct the fieldwork. A supervisor oversaw the work of graders and recorders and assisted them technically, as well as coordinating and leading the overall survey.

Clinical data collection

Field teams moved from house-to-house to collect the data. All residents aged ≥ 1 year living in selected households were invited to be examined. Children aged < 1 year and individuals not resident in selected households (including institutionalised and homeless) were excluded.

Each consenting individual was examined by a certified grader for the signs TT, TF, and trichomatous inflammation—intense (TI),²³ using 2.5 \times magnifying binocular loupes, and sunlight or a torch for illumination. In 2020, follicle size guides were used to support TF diagnosis.²⁴ When trichiasis was recorded as being present in an eye, the presence or absence of trichomatous scarring (TS)²³ was also checked, and the examinee was asked if they had ever been offered management of the trichiasis in that eye by a health-care

worker at a primary, secondary, or tertiary level. All data were captured electronically using a purpose-built Open Data Kit-based Android smartphone application (www.tropicaldata.org).

TT was graded differently in the 2018–19 and 2020 surveys, due to an amendment to the simplified grading system.^{25,26} In 2018–19, TT was graded according to the 1987 definition: at least one eyelash touching the eyeball or evidence of recent removal of in-turned eyelashes arising from either eyelid.²³ In 2020, the eyelid (upper or lower) that a deviated eyelash originated from was recorded and TT was only assigned if the deviated eyelash originated from the upper eyelid, in-line with contemporary recommendations.^{25,26}

Household data collection

The GPS coordinates of participating households were recorded and the household head or their nominee was asked questions about household WaSH access. Questions were adapted for trachoma surveys from the United Nations Children's Fund (UNICEF)/WHO Joint Monitoring Programme (JMP) household questionnaire.^{6,27,28} Latrines and handwashing facilities were directly observed.

Handwash station assessment differed between 2018–19 and 2020. In 2018–19, only handwash stations within 15 m of the household latrine were recorded.^{6,19,27} Where there was no latrine, no handwash station data were recorded. In 2020, householders were asked whether there was a handwash station on the household premises, regardless of the presence or absence of a latrine.^{20,28}

In households in which one or more resident 1–9-year-olds were missing at the time of the survey team's first visit, a second visit was made, where possible, before the end of the day.

Data analysis

Woreda-level prevalence estimates and confidence intervals were calculated using the methods used by the Global Trachoma Mapping Project.^{6,29} TF prevalence in children aged 1–9 years was adjusted for age in 1-year age-bands. TT (according to the definition at the time of the survey) unknown to the health system prevalence in those aged ≥ 15 years was adjusted for age and gender in 5-year age-bands.

Survey ethics

Approval for the survey was obtained from the Tigray Regional Health Research Institution Ethics Committee. Tropical Data support for trachoma surveys was

approved by the London School of Hygiene & Tropical Medicine Observational Ethics Committee (16105). Informed verbal consent was obtained from all individuals (or their parent/guardian for children aged < 18 years) who participated in the survey and recorded in the data collection app. All participants found to have active trachoma were provided with 1% tetracycline eye ointment for 6 weeks free-of-charge and those with trichiasis were referred for appropriate management.

Results

Population surveyed

A total of 1,099 kushats, 32,989 households, and 135,758 individuals were enumerated across the 42 surveys (Supplementary Table 1). Of 135,758 people enumerated, 130,872 (96%) were examined by survey teams; 4,730 (3%) were absent and 154 (.1%) refused. Ninety-nine percent of enumerated 1–9-year-olds were examined and 94% of enumerated adults aged ≥ 15 years were examined. Of those examined, 72,902 (56%) were female.

Active trachoma

Of 54,796 children aged 1–9 years examined across all 42 surveys, 5,156 (10%) had TF in one or both eyes (Supplementary Table 2).

In the first wave of the 31 surveys, the prevalence of TF in 1–9-year-olds ranged from 3.1% (95% confidence interval [CI]: 1.7–5.0%) in Tahtay Adiabo to 24.5% (95% CI: 19.9–29.0%) in Ofla. There were 1, 13, and 17 woredas with a TF prevalence of $< 5.0\%$, 5.0–9.9%, and 10.0–29.9%, respectively.

Eleven of the 13 woredas with a TF prevalence 5.0–9.9% in the first series of surveys received one round of MDA and were re-surveyed in a second series of surveys. The prevalence of TF in 1–9-year-olds in this series ranged from 1.5% (95% CI: .7–2.4%) in Asgede Tsimbla to 7.2% (95% CI: 4.4–10.2%) in Tahtay Koraro. There were 7 and 4 woredas with a TF prevalence of $< 5.0\%$ and 5.0–9.9%, respectively. [Figure 1a](#) shows the most recent estimates of TF prevalence from each woreda. Indicative changes in TF prevalence since baseline surveys are shown in [Figure 2](#); it should be noted that, because the EU boundary has changed between pre-MDA and post-MDA surveys, these are for illustrative purposes only and not for formal comparisons.

Trachomatous trichiasis

A total of 63,648 people aged ≥ 15 years were examined during all 42 surveys (Supplementary Table 3). During

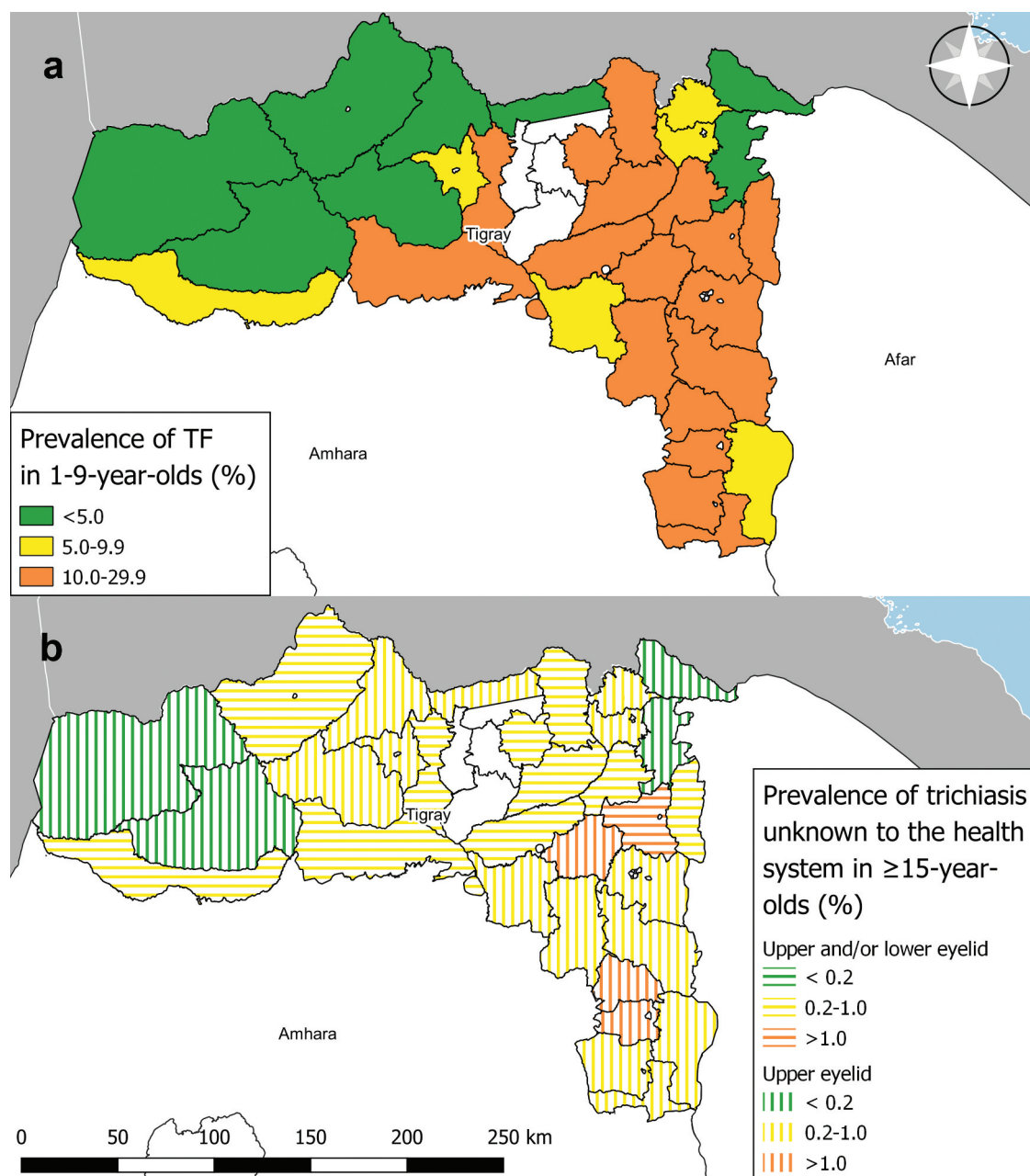


Figure 1. Trachoma impact survey results from most recent survey in 31 woredas of Tigray region, Ethiopia, 2018–2020. (a) age-adjusted prevalence of trachomatous inflammation—follicular (TF) in 1–9-year-olds. (b) age- and gender-adjusted prevalence of trachomatous trichiasis (TT) unknown to the health system in ≥15-year-olds, according to contemporary definitions at the time of the survey. The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the authors, or the institutions with which they are affiliated, concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

the first wave of surveys (22 surveys using the 2018–9 methodology surveys and 9 surveys using the 2020 methodology), 48228 ≥15-year-olds were examined. Eight hundred and ninety-one cases (621 [70%] unknown to the health system) of trichiasis (upper and/or lower eyelid) and 380 cases (261 [69%] unknown to the health system) of trichiasis (upper eyelid only) were identified. The prevalence of TT (upper and/or

lower eyelid) unknown to the health system in ≥15-year-olds in the 2018–9 surveys in the first series ranged from .25% (95% CI: .04–.54%) in Tsegede to 1.15% (95% CI: .5–2.02%) in Kilde Awlaelo. The prevalence of TT (upper eyelid) unknown to the health system in ≥15-year-olds in the 2020 surveys in the first series ranged from .50% (95% CI: .26–.71%) in Enderta to 1.18% (95% CI: .78–1.61%) in Degua Temben. The prevalence of TT

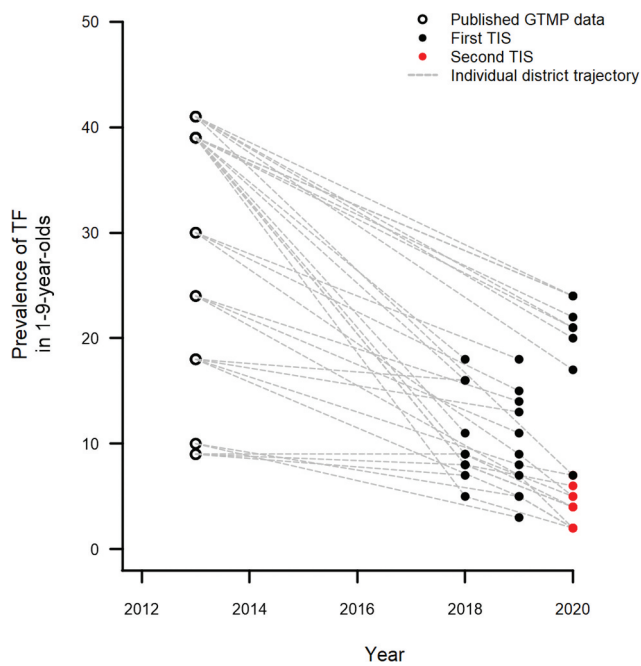


Figure 2. Prevalence of trichomatous inflammation—follicular (TF) before and after mass drug administration (MDA) in 31 woredas of Tigray region, Ethiopia. Pre-MDA prevalence estimates have been published previously.¹⁰ Confidence intervals are not presented to avoid overcomplicating the figure. This figure is for descriptive purposes only: because the pre- and post-MDA woreda boundaries are different, formal pre- and post-MDA estimate comparisons are not appropriate. GTMP: Global Trachoma Mapping Project; TIS: Trachoma Impact Survey.

unknown to the health system was $\geq .2\%$ in all 31 surveys. During the second series of surveys (11 surveys), 222 cases of TT (upper eyelid only) were identified, of which 127 [57%] were unknown to the health system. The prevalence of TT (upper eyelid only) unknown to the health system in ≥ 15 -year-olds ranged from .12% (95% CI: .03 – .26%) in Erob to .55% (95% CI: .21 – 1.00%) in Tahtay Koraro. The prevalence was $\geq .2\%$ in 7/11 surveys. **Figure 1b** shows the most recent prevalence estimates of TT unknown to the health system, according to contemporary definitions at the time of the survey, in each woreda.

Water, sanitation, and hygiene access

Overall, WaSH access was low (Supplementary Table 4). Of the 32,989 households surveyed in 1,099 kushats in 42 surveys, 9,949 (30%) had access to an improved drinking water source within a 30-minute return journey of the house and 3,632 (11%) had an improved latrine. There were 588/32,989 (2%) households with a handwashing facility across all 42 surveys. For the 22 surveys that used version 2 methodology, 300/17,431 households had a latrine with a handwashing station within 15 m of the

latrine. For the 20 surveys that used the version 3 methodology, 288/15,558 had a handwashing station in the yard/plot/premises.

Discussion

Following several years of MDA, a general decrease in TF prevalence has been observed as compared to pre-intervention estimates in Tigray, Ethiopia. However, WHO targets for elimination of trachoma as a public health problem were not met in 23 surveyed woredas, and ongoing interventions are required. Of these, 23 woredas that require further rounds of antibiotic MDA, six will need one round and 17 will need three rounds before resurvey. In eight woredas, the target TF prevalence has been reached. No further rounds of MDA should be delivered for 24 months before a trachoma surveillance survey is conducted. Four woredas, namely Erob, Saesi-Tsaedamba, Kafta-humera and Welkayit, met both TF and TT elimination criteria.

The decline in TF prevalence over the course of the programme has been slower than expected. While this is perhaps unsurprising given similar findings from neighbouring regions of Ethiopia,^{5,30} operational research to explore the fidelity of program implementation could help identify areas that could be improved to make MDA more locally effective. Additionally, antibiotic MDA alone will not break the cycle of *C. trachomatis* transmission: adequate WaSH infrastructure and behaviour change interventions are likely to be essential, alongside MDA, to achieving sustained elimination of trachoma.^{31–33} Sustained and extensive health education is required to promote and maintain behavioural changes in personal and environmental hygiene.^{32,34} Potential routes for intervention could be through integration with school health curricula and through health worker training packages. To facilitate behaviour change, WaSH infrastructure must be improved. There is a need for increased intersectoral collaboration between the neglected tropical disease and WaSH sectors, as well as increased financial resources for WaSH interventions in the context of trachoma elimination.^{33,35} Collection of WaSH access data within trachoma surveys enables planning of district-specific environmental improvement activities and advocacy for support from partner organisations. Furthermore, improvements in WaSH infrastructure will contribute to the achievement of wider national and international targets to reduce inequality.³⁶

The prevalence of TT remains high in Tigray and above the elimination target in 27 woredas. The majority of TT cases identified in these surveys were previously unknown to the health system, indicating that

significant improvements in case-finding and surgical service accessibility are needed. The link between TT and female gender is well established³⁷; it is important to design surgical programmes to ensure women have equitable access to services. Improvements to surgical services should not just aim to increase coverage but also maintain and enhance surgical quality, and sustainably identify incident cases, to meet the WHO elimination criteria.⁴ Mechanisms to detect postoperative TT should be developed, and for patients who are not operated on at first diagnosis of TT^{38,39} but subsequently wish to have surgery,⁴⁰ it should be readily available. The number, geographical distribution and motivation of surgeons, and their access to appropriate equipment, should be reviewed to identify areas for service improvement. Programmes should also work to increase awareness and uptake of TT surgery in affected communities.

We found that one-third of households had access to an improved drinking water source within a 30-minute return journey of the house. This is consistent with previous findings from Ethiopia. The UNICEF/WHO JMP, for example, estimated that in 2015, 30% of rural Ethiopian households had access to an improved drinking water source within a 30-minute return journey.⁴¹ However, our findings suggest that Tigray has lower WaSH access than other regions of Ethiopia due to failure to mobilise resources for construction of WaSH facilities. The 2016 Ethiopian Demographic and Health Survey estimated that 57% of households in rural areas had access to basic drinking water.⁴² Despite regional and national recommendations for householders to invest in solid covers for their own sanitation facilities, the majority of households that we visited (89%) did not have access to improved latrines. Of the eight woredas with a TF prevalence below the 5% threshold, the WaSH ratios were not observed to be higher than those that had not reached elimination.

These surveys were technically strong. The adherence to internationally standardised survey protocols and the apparently high examination coverage of residents in selected households suggest that the data are robust and comparable to trachoma data from elsewhere. There were also some weaknesses in our approach. First, the surveys were designed to estimate TF prevalence and may be under-powered to precisely estimate TT prevalence: the number of adults examined was below the 2,818 sample size recommended by WHO⁴³ in all 42 surveys. We have ensured confidence intervals around TT prevalence estimates are presented clearly alongside point estimates. Second, the EU boundaries of the baseline surveys do not match those used here. It is therefore not possible to make formal comparisons between pre- and post-MDA data and any comparisons, such as those we have drawn in [Figure 2](#), are for indicative purposes only. The primary application

of these data is for planning future interventions, for which they are critical,^{44,45} this does not rely on comparisons to previous prevalence estimates.

There is still an appreciable programme requirement in Tigray with 23 woredas requiring further MDA and further impact surveys and eight woredas requiring surveillance surveys in 2 years's time. Since these surveys took place, the trachoma programme has been impacted initially by the global coronavirus pandemic and then by conflict in the region. For these reasons, planned antibiotic MDA and survey activities had been on hold for 2 years at the time of publication. The impact of this interruption on disease prevalence will not be clear until activities resume. The conflict has impacted other parts of the trachoma programme. TT surgical services have continued during this period, but their capacity has been restricted by the local instability. Medical supplies have been very limited, necessitating a shift from outreach to static clinics. A recent eye health service readiness assessment in Tigray demonstrated physical damage to health posts and lack of basic (such as dosing pole, registration books, and drugs) or surgical equipment. More general resources such as fuel, communications, and banking services are also unavailable as a result of the conflict. Staff salaries have been paid despite absence of materials to conduct programmatic activities, leading to ongoing costs despite interruption of activities.

Conclusions

The prevalence of trachoma in the Tigray region is still high, with the TF elimination threshold having been reached in only eight woredas. To eliminate trachoma from Tigray, adequate human, financial, and material resources should be mobilised to strengthen ongoing SAFE implementation and periodic monitoring, evaluation, and reporting of progress as per WHO recommendations.

Acknowledgments

We thank staff of the Ethiopia Ministry of Health and Tigray Regional Health Bureau for direction and technical input.

We are grateful to the Woreda Health Office staff, Kebele administrators and managers, and the health extension workers surveyed woredas.

Finally, we thank the survey participants for their willingness to participate.

Disclosure statement

AB, SB, and RW are employed by the International Trachoma Initiative at the Task Force for Global Health, which receives

an operating budget and research funds from Pfizer Inc., the manufacturers of Zithromax® (azithromycin).

EMHE receives salary support from the International Trachoma Initiative.

All other authors have no conflicts to declare.

Funding

Surveys were funded by the United States Agency for International Development (USAID) Act to End Neglected Tropical Diseases | East program, led by RTI International, the UK Department for International Development and Sightsavers and the Crown Agents. Light for the World funded technical support for publication. RB's salary was supported by the Fred Hollows Foundation. Core Tropical Data funding was provided by the International Trachoma Initiative; Sightsavers; and RTI International through the United States Agency for International Development (USAID) Act to End NTDs | East program. AWS is a staff member of the World Health Organization. The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated, USAID, or the United States Government.

References

1. Flaxman SR, Bourne RRA, Resnikoff S, et al. Global causes of blindness and distance vision impairment 1990–2020: a systematic review and meta-analysis. *Lancet Glob Health*. 2017;5(12):e1221–e1234. doi:10.1016/S2214-109X(17)30393-5.
2. Hammou J, Obtel M, Razine R, Berraho A, Belmekki M. Elimination of trachoma from Morocco: a historical review. *East Mediterr Heal J*. 2020;26(6):713–719. doi:10.26719/emhj.19.014.
3. Francis V, Turner V. *Achieving community support for trachoma control: a guide for district health work (WHO/PBL/93.36)*. Geneva, Switzerland: World Health Organization; 1995.
4. World Health Organization. *Validation of elimination of trachoma as a public health problem (WHO/HTM/NTD/2016.8)*. Geneva, Switzerland: World Health Organization; 2016.
5. Sata E, Nute AW, Astale T, et al. Twelve-year longitudinal trends in trachoma prevalence among children aged 1–9 years in Amhara, Ethiopia, 2007–2019. *Am J Trop Med Hyg*. 2021;104(4):1278–1289. doi:10.4269/ajtmh.20-1365.
6. Solomon AW, Pavluck AL, Courtright P, et al. The Global Trachoma Mapping Project: methodology of a 34-country population-based study. *Ophthalmic Epidemiol*. 2015;22(3):214–225. doi:10.3109/09286586.2015.1037401.
7. Berhane Y, Worku A, Bejiga A, et al. National survey on blindness, low vision and trachoma in Ethiopia: methods and study clusters profile. *Ethiop J Heal Dev*. 2007;21(3):185–203. doi:10.4314/ejhd.v21i3.10049.
8. Abashaw A, Macleod C, Riag J, et al. Prevalence of trachoma in Gambella region, Ethiopia: results of three population-based prevalence surveys conducted with the Global Trachoma Mapping Project. *Ophthalmic Epidemiol*. 2016;23(1):77–83. doi:10.1080/09286586.2016.1247875.
9. Bero B, Macleod CK, Alemayehu W, et al. Prevalence of and risk factors for trachoma in Oromia regional state of Ethiopia: results of 79 population-based prevalence surveys conducted with the Global Trachoma Mapping Project. *Ophthalmic Epidemiol*. 2016;23(6):392–405. doi:10.1080/09286586.2016.1243717.
10. Sherief ST, Macleod C, Gigar G, et al. The prevalence of trachoma in Tigray Region, Northern Ethiopia: results of 11 population-based prevalence surveys completed as part of the Global Trachoma Mapping Project. *Ophthalmic Epidemiol*. 2016;23(1):94–99. doi:10.1080/09286586.2016.1250917.
11. Negash K, Macleod C, Adamu Y, et al. Prevalence of trachoma in the Afar region of Ethiopia: results of seven population-based surveys from the Global Trachoma Mapping Project. *Ophthalmic Epidemiol*. 2018;25(sup1):3–10. doi:10.1080/09286586.2017.1362008.
12. Duale AB, Negussu Ayele N, Macleod CK, et al. Epidemiology of trachoma and its implications for implementing the “SAFE” strategy in Somali Region, Ethiopia: results of 14 population-based prevalence surveys. *Ophthalmic Epidemiol*. 2018;25(sup1):25–32. doi:10.1080/09286586.2017.1409358.
13. Adamu Y, Macleod C, Adamu L, et al. Prevalence of Trachoma in Benishangul Gumuz Region, Ethiopia: results of seven population-based surveys from the Global Trachoma Mapping Project. *Ophthalmic Epidemiol*. 2016;23(1):70–76. doi:10.1080/09286586.2016.1247877.
14. Adera TH, Macleod C, Endriyas M, et al. Prevalence of and risk factors for trachoma in Southern Nations, Nationalities, and Peoples’ Region, Ethiopia: results of 40 population-based prevalence surveys carried out with the Global Trachoma Mapping Project. *Ophthalmic Epidemiol*. 2016;23(Suppl. 1):1–7. doi:10.1080/09286586.2016.1247876.
15. Courtright P, Rotondo LA, Macarthur C, et al. Strengthening the links between mapping, planning and global engagement for disease elimination: lessons learnt from trachoma. *Br J Ophthalmol*. 2018;102(10):1324–1327. doi:10.1136/bjophthalmol-2018-312476.
16. World Health Organization. *Report of the 2nd global scientific meeting on trachoma. 25-27 August 2003*. Geneva, Switzerland: World Health Organization; 2003.
17. Solomon A, Zondervan M, Kuper H, Buchan J, Mabey D, Foster A. *Trachoma control: a guide for program managers*. Geneva, Switzerland: World Health Organization: World Health Organization; 2006.
18. WHO Strategic and Technical Advisory Group on NTDs. *Technical consultation on trachoma surveillance. September 11–12, 2014, Task Force for Global Health, Decatur, USA. (WHO/HTM/NTD/2015.02)*. Geneva, Switzerland: World Health Organization; 2015.
19. Courtright P, MacArthur C, Macleod C, et al. *Tropical Data: training system for trachoma prevalence surveys (Version 2)*. London, UK: International Coalition for Trachoma Control; 2017.
20. Courtright P, MacArthur C, Macleod C, et al. *Tropical Data: training system for trachoma prevalence surveys*

- (Version 3). London, UK: International Coalition for Trachoma Control; 2019.
21. World Health Organization. *Design parameters for population-based trachoma prevalence surveys (WHO/HTM/NTD/PCT/2018.07)*. Geneva, Switzerland: World Health Organization; 2018.
 22. Macleod CK, Bailey RL, Dejene M, et al. Estimating the intracluster correlation coefficient for the clinical sign “trachomatous inflammation—follicular” in population-based trachoma prevalence surveys: results from a meta-regression analysis of 261 standardized preintervention surveys carried out in Ethiopia, Mozambique, and Nigeria. *Am J Epidemiol*. 2019;1–9. doi:10.1093/aje/kwz196.
 23. Thylefors B, Dawson CR, Jones BR, West SK, Taylor HR. A simple system for the assessment of trachoma and its complications. *Bull World Health Organ*. 1987;65:477–483.
 24. Solomon AW, Le Mesurier RT, Williams WJ. A diagnostic instrument to help field graders evaluate active trachoma. *Ophthalmic Epidemiol*. 2018;25(5–6):399–402. doi:10.1080/09286586.2018.1500616.
 25. Solomon AW, Kello AB, Bangert M, et al. The simplified trachoma grading system, amended. *Bull World Health Organ*. 2020;98(10):645–724. doi:10.2471/BLT.19.248708.
 26. World Health Organization. *Report of the 4th global scientific meeting on trachoma, Geneva, 27–29 November 2018 (WHO/CDS/NTD/PCT/2019.03)*. Geneva, Switzerland: World Health Organization; 2019.
 27. World Health Organization, United Nations Childrens Fund. *Core questions on drinking water and sanitation for household surveys*. New York, USA: United Nations Childrens Fund; 2006. http://www.who.int/water_sanitation_health/monitoring/oms_brochure_core_questionsfinal24608.pdf.
 28. World Health Organization, United Nations Childrens Fund. *Core questions on drinking water, sanitation and hygiene for household surveys: 2018 update*. New York: United Nations Children’s Fund; 2018.
 29. Solomon AW, Willis R, Pavluck AL, et al. Quality assurance and quality control in the Global Trachoma Mapping Project. *Am J Trop Med Hyg*. 2018;99(4):858–863. doi:10.4269/ajtmh.18-0082.
 30. Seyum D, Fetene N, Kifle T, et al. Prevalence of trachoma from 66 impact surveys in 52 Woredas of Southern Nations, Nationalities and Peoples’ and Sidama Regions of Ethiopia, 2017–2019. *Ophthalmic Epidemiol*. 2022;30(6):637–646. doi:10.1080/09286586.2022.2065313.
 31. Garn JV, Boisson S, Willis R, et al. Sanitation and water supply coverage thresholds associated with active trachoma: modeling cross-sectional data from 13 countries. *PLoS Negl Trop Dis*. 2018;12(1):1–20. doi:10.1371/journal.pntd.0006110.
 32. Dodson S, Heggen A, Solomon AW, Sarah V, Woods G, Wohlgenuth L. Behavioural change interventions for sustained trachoma elimination. *Bull World Health Organ*. 2018;96(10):723–725. doi:10.2471/BLT.18.212514.
 33. World Health Organization. *Ending the neglect to attain the sustainable development goals: a road map for neglected tropical diseases 2021–2030*. Geneva, Switzerland: World Health Organization; 2020. https://www.who.int/neglected_diseases/Revised-Draft-NTD-Roadmap-23Apr2020.pdf?ua=1.
 34. Delea MG, Solomon H, Solomon AW, Freeman MC, Senok A. Interventions to maximize facial cleanliness and achieve environmental improvement for trachoma elimination: a review of the grey literature. *PLoS Negl Trop Dis*. 2018;12(1):1–26. doi:10.1371/journal.pntd.0006178.
 35. Freeman MC, Ogden S, Jacobson J, Liang S, et al. Integration of water, sanitation, and hygiene for the prevention and control of neglected tropical diseases: a rationale for inter-sectoral collaboration. *PLoS Negl Trop Dis*. 2013;7(9):e2439. doi:10.1371/journal.pntd.0002439.
 36. United Nations. *Work of the statistical commission pertaining to the 2030 agenda for sustainable development*. Vol. 11371. New York, USA: United Nations; 2017:4–25.
 37. Cromwell EA, Courtright P, King JD, Rotondo LA, Ngondi J, Emerson PM. The excess burden of trachomatous trichiasis in women: a systematic review and meta-analysis. *Trans R Soc Trop Med Hyg*. 2009;103(10):985–992. doi:10.1016/j.trstmh.2009.03.012.
 38. Habtamu E, Rajak SN, Tadesse Z, Ngondi JM, et al. Epilation for minor trachomatous trichiasis: four-year results of a randomised controlled trial. *PLoS Negl Trop Dis*. 2015;9(3):1–15. doi:10.1371/journal.pntd.0003558.
 39. Rajak SN, Habtamu E, Weiss HA, Lewallen S, et al. Surgery versus epilation for the treatment of minor trichiasis in Ethiopia: a randomised controlled noninferiority trial. *PLoS Med*. 2011;8(12):e1001136. doi:10.1371/journal.pmed.1001136.
 40. Habtamu E, Wondie T, Gobeze W, Ngondi JM, et al. Effect of repeated epilation for minor trachomatous trichiasis on lash burden, phenotype and surgical management willingness: a cohort study. *PLoS Negl Trop Dis*. 2020;14(12):e0008882. doi:10.1371/journal.pntd.0008882.
 41. World Health Organization, United Nations Childrens Fund. *Joint monitoring programme progress on drinking water, sanitation and hygiene*. New York, USA: United Nations Childrens Fund; 2017. <https://www.unicef.org/reports/progress-on-drinking-water-sanitation-and-hygiene-2019>.
 42. Ethiopia Central Statistical Agency, ICF. *Ethiopia demographic and health survey 2016*. Addis Ababa, Ethiopia: Central Statistical Agency; 2016.
 43. World Health Organization Strategic and Technical Advisory Group for Neglected Tropical Diseases, Working Group on Monitoring and Evaluation. *Design and validation of a trachomatous trichiasis-only survey (WHO/HTM/NTD/PCT/2017.08)*. Geneva, Switzerland: World Health Organization; 2017.
 44. Solomon AW, Hooper PJ, Bangert M, et al. The importance of failure: how doing impact surveys that fail saves trachoma programs money. *Am J Trop Med Hyg*. 2020;103(6):2481–2487. doi:10.4269/ajtmh.20-0686.
 45. Federal Democratic Republic of Ethiopia Population Census Commission. *Population and housing census 2007*. Addis Ababa, Ethiopia: Central Statistical Agency; 2008.