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Prevalence of Trachoma in Kano State, Nigeria: Results of 44 Local Government Area-Level Surveys

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Abstract

Purpose—We sought to determine the prevalence of trachoma in 44 Local Government Areas (LGAs) of Kano State, Nigeria.

Methods—A population-based prevalence survey was conducted in each Kano LGA. We used a two-stage systematic and quasi-random sampling strategy to select 25 households from each of 25 clusters in each LGA. All consenting household residents aged 1 year and above were examined for trachomatous inflammation–follicular (TF), trachomatous inflammation–intense (TI) and trichiasis.

Results—State-wide crude prevalence of TF in persons aged 1–9 years was 3.4% (95% CI 3.3–3.5%), and of trichiasis in those aged ≥15 years was 2.3% (95% CI 2.1–2.4%). LGA-level age- and sex-adjusted trichiasis prevalence in those aged ≥15 years ranged from 0.1% to 2.9%. All but 4 (9%) of 44 LGAs had trichiasis prevalences in adults above the elimination threshold of 0.2%.

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Declaration of interest
The authors report no conflicts of interest. The authors alone are responsible for the writing and content of this article.

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State-wide prevalence of trichiasis in adult women was significantly higher than in adult men (2.6% vs 1.8%; OR = 1.5, 95% CI 1.3–1.7; $p = 0.001$). Four of 44 LGAs had TF prevalences in 1–9 year-olds between 10 and 15%, while another six LGAs had TF prevalences between 5 and 9.9%. In 37 LGAs, >80% of households had access to water within 30 minutes round-trip, but household latrine access was >80% in only 19 LGAs.

Conclusion—Trichiasis is a public health problem in most LGAs in Kano. Surgeons need to be trained and deployed to provide community-based trichiasis surgery, with emphasis on delivery of such services to women. Antibiotics, facial cleanliness and environmental improvement are needed in 10 LGAs.

Keywords

Global Trachoma Mapping Project; Kano State; Nigeria; prevalence; trachoma; trichiasis

Introduction

Trachoma is the leading infectious cause of blindness. In 2013, it was thought to be a public health problem in rural communities of 51 countries, including Nigeria.[1,2] Trachoma is caused by the bacterium *Chlamydia trachomatis*, which in endemic populations repeatedly infects and inflames the conjunctivae. This results, in some individuals, in conjunctival scarring with shortening and eventual in-turning of the eye lid; the product of this is continuous rubbing of the cornea by the eyelashes, which can lead to corneal damage and blindness.

Since 1998, the international community has been committed to the elimination of trachoma as a public health problem by the year 2020, through the implementation of the SAFE strategy (Surgery for trichiasis, Antibiotics to clear infection, and promotion of Facial cleanliness and Environmental improvement to reduce transmission), as recommended by WHO.[3] Putting the SAFE strategy into practice depends on the availability of district-level, population-based prevalence data to guide programme managers on where the strategy needs to be deployed.[4] In Nigeria, the Local Government Area (LGA) is the equivalent of the district.

A recent population-based survey of trachoma in Kano showed that trachoma is a public health problem in this showed that trachoma is a public health problem in this state.[5] However, this study did not provide LGA-level prevalence estimates to direct implementation of the elimination strategy. The minimum LGA-level data required for planning are the prevalences of trachomatous inflammation–follicular (TF) in 1–9 year-olds (for which the elimination target is <5%), and trachomatous trichiasis (TT) in adults aged 15 years and above (for which the elimination target is <0.2%).

This study, which was undertaken as part of the Global Trachoma Mapping Project (GTMP), sought to provide essential district level prevalence data for trachoma in Kano State, in order to help plan local elimination by the year 2020.

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Methods

Ethics

The study was approved by the Ethics Committee of the London School of Hygiene & Tropical Medicine (6319) and the National Health Research Ethics Committee of Nigeria (NHREC/01/01/2007), while the Kano State Ministry of Health gave permission to conduct the study locally. Research assistants explained the examination protocol to each adult in a language the prospective subject understood. Since most study subjects could neither read nor write, verbal consent for enrolment and examination was obtained from the head of each household for minors; adults gave verbal consent for their own participation and this was recorded in an Open Data Kit-based Android smartphone application (LINKS).[6] Individuals with active trachoma were each given two tubes of 1% tetracycline eye ointment together with instructions on its use, while adults with trichiasis were referred for lid surgery at the nearest facility that had trained TT surgeons.

Survey planning

These followed the standard GTMP protocols, as described previously.[6] In Kano State, villages were used as clusters. In each LGA, we systematically selected 25 villages from a list of all the villages in the LGA, using a probability-proportional-to-size technique. In each selected village, we selected 25 households, with a household defined as a compound head together with all the individuals normally resident in the compound and eating from the same pot. Because we expected to find at least two children 1–9 years old in each household, that allowed us to expect to recruit the minimum sample size of 1019 children[6] in each LGA, allowing for non-response. Security in northern Nigeria was tenuous at the time of survey planning and implementation, so a household selection method known to the population was felt to be highly desirable. Therefore, the random walk approach was used, despite its epidemiological drawbacks.[7–9] A person resident in the village showed the survey team the center of the village. A pen was spun on the ground at that point and the direction the pen pointed was followed, with successive households in this direction being selected. All persons above one year of age living in each selected household were examined.

Survey definitions

We used the WHO simplified grading scheme[10] to grade trachoma. GTMP-certified graders examined subjects for the presence of TF, trachomatous inflammation–intense (TI) and trichiasis. We report here the prevalence of TF in 1–9 year-olds, and the prevalence of trichiasis in persons aged 15 years and above, as our primary outcome measures for epidemiological and planning purposes. In eyes with trichiasis, we did not record the presence or absence of trachomatous conjunctival scar, so although there is an assumption that the trichiasis found was trachomatous, this may not be uniformly valid; in our results, therefore, we refer to the prevalence of “trichiasis” rather than the prevalence of “TT.” (Awareness that there might be a significant background prevalence of non-trachomatous trichiasis in trachoma-endemic populations, and that sufferers might require alternative management to those with trachomatous trichiasis, has only recently emerged[11]). LGAs were considered to have attained trichiasis elimination where the trichiasis prevalence was <2 per 1000 adults: equivalent to the elimination threshold for trichiasis of <1 per 1000 total

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population, based on the reasoning presented in the report on the 2nd Global Scientific Meeting on Trachoma,[12] and now further clarified by WHO.[13] An “improved water source” was defined as one which by nature of its construction and proper use adequately protects the water from outside contamination, while an “improved sanitation facility” was defined as any sanitation facility that hygienically separates human excreta from human contact.

Data analyses

As described elsewhere,[6] data were checked and cleaned by the data manager (RW) and analysed using automated algorithms for the primary outcome measures. Prevalence of TF was adjusted for age in 1-year age bands while the prevalence of trichiasis was adjusted for sex and age in 5-year age bands. We calculated the trichiasis backlog in each LGA by multiplying the prevalence estimate in persons aged 15 years and above by 56% of the total population in the LGA (as determined in the 2006 census population estimates), because 56% of the Nigerian population was estimated to be aged 15 years or above.[14] Groups were compared using odds ratios; these analyses were carried out in Epi Info version 7.0.

Univariable and multivariable analyses of association were performed using STATA 14.1. A null model considering sex and age *a priori* was developed separately for the outcomes trichiasis and TF. For TF in children aged 1–9 years, clustering was carried out at the EU-level, and the inclusion of adjustment for village or household did not significantly improve the model (Likelihood ratio test (LRT), $p < 0.05$). For trichiasis, clustering was carried out at EU- and household-levels, and the inclusion of adjustment for village did not significantly improve the model (LRT; $p < 0.05$). Prior to undertaking the multivariable analyses, co-linearity of variables was examined using the Mantel-Haenszel test, but this was not an absolute exclusion criterion. We then constructed multi-level hierarchical models, with stepwise inclusion. We considered a variable for inclusion if the univariable association was significant at the $p < 0.05$ level (Wald’s test), and retained it in the model if statistical significance was found at the $p < 0.05$ level (LRT).

Results

Surveys were conducted in 44 LGAs between May and July 2013. A total of 164,346 persons were examined. The ages of persons examined ranged from 1 year to over 100 years. Approximately the same number of females (82,860; 50.0%) and males (82,953; 50.0%) were examined. The age and sex distribution of the study population is shown in Table 1.

A total of 85,617 children aged 1–9 years were examined; 45,590 (53.2%) were males and 40,027 (46.8%) were females. The state-wide crude TF prevalence in this age group was 3.4% (95% CI 3.3–3.5%). The TF prevalence in male children (3.3%, 95% CI 3.2–3.5%) was less than in female children (3.5%, 95% CI 3.3–3.7%); but this difference was not statistically significant (odds ratio = 1.0, 95% CI 1.0–1.1; p = 0.2156). The LGA-level age-adjusted prevalence of TF in 1–9 year-olds ranged from 0.0–15.5% (Table 2, Figure 1).

A total of 63,361 persons aged 15 years and above were examined; 27,904 (44.0%) were males while 35,457 (56.0%) were females. The state-wide crude trichiasis prevalence in this age group was 2.3% (95% CI 2.1–2.4%). The prevalence in females (2.6%, 95% CI 2.5–2.8%) was significantly higher than in males (1.8%, 95% CI 1.6–1.9%); (odds ratio = 1.5, 95% CI 1.3–1.7; $p = 0.001$). The LGA-level age- and sex-adjusted prevalence of trichiasis in adults ranged from 0.03–2.86% (Table 2, Figure 2).

Four (9%) of 44 LGAs in Kano State had TF prevalences in 1–9 year-olds of 10% or more. Another six (14%) LGAs had TF prevalences between 5 and 9.9%. Only 4 (9%) LGAs had a trichiasis prevalence of <2 per 1000 adults (Table 2).

With an estimated population of 9,401,288 in Kano state,[11] the estimated trichiasis backlog is 47,988 persons. Without considering incident trichiasis cases, mortality, or persons entering or leaving the state, this suggests that 38,149 persons will need to be offered trichiasis surgery so as to attain the trichiasis prevalence targets for "elimination as a public health problem" (Table 3).

In 37 (84%) of the 44 LGAs, more than 80% of households had access to water for hygiene purposes within 1 km of the house; of the remaining seven LGAs with poorer access to water, all except Madobi had accompanying poor access to improved latrine facilities. Household-level access to improved latrine facilities was very low in some LGAs (less than 1%) and up to 100% in other LGAs, just as household-level water access also had wide variation between LGAs (Table 4).

Full results for associations with TF are shown in Table 5. In the multivariable analysis, compared to children aged 7–9 years, children aged 1–3 years had 1.5 times greater odds (95% CI 1.4–1.7), and children aged 4–6 years had 1.7 times greater odds (95% CI 1.6–1.9) of having TF. Compared to those with improved sanitation facilities, those with unimproved sanitation facilities had 1.2 times greater odds of having TF (95% CI 1.0–1.3). A protective association was found for those whose drinking source was at least 30 minutes away.

Full results for associations with trichiasis are shown in Table 6. In the multivariable analysis, time to main source of drinking water was dropped because it was collinear with time to main source of washing water. Compared to males, females had 3.3 times (95% CI 2.9–3.7) greater odds of having trichiasis. Compared to adults aged 15–24, adults aged 25–34 years had 3.3 times (95% CI 2.1–5.4) greater odds of having trichiasis; each decade-older age group had a further increased odds of trichiasis, with adults aged 65+ years having 141 times (95% CI 90.0–220.4) greater odds than adults aged 15–24 years. Compared to adults with improved sanitation facilities, adults with unimproved sanitation facilities had 1.3 times (95% CI 1.1–1.5) greater odds of having trichiasis. Having further to travel to the main source of washing water had a protective association.

Discussion

Active trachoma is still a public health problem in four LGAs of Kano State: Gabasawa, Kura, Shanono and Tudun Wada. These LGAs qualify for mass distribution of antibiotics and implementation of the F and E components of the SAFE strategy.[4] Three of these LGAs (Gabasawa, Shanono, and Tudun Wada) had a low proportion of households using improved latrine facilities; latrine ownership has been shown elsewhere to associate with a lower risk

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of trachoma.[15,16] Exposed human faeces provides a ready breeding medium for the fly vector that transmits ocular *Chlamydia*, and greater fly numbers should in theory increase trachoma's transmission intensity. Kura was the only LGA in which latrine coverage was observed to be high in the presence of a high prevalence of active trachoma, but access to improved washing water was rather low in this LGA. In all four LGAs, wash water access was low and may explain why active trachoma remains a common finding. Going against this is our finding of lower odds of disease, state-wide, for those located further from their source of water, an association that is somewhat counter-intuitive,[17,18] and may represent the effect of an unmeasured confounder. It is notable that in a previous study in neighbouring Yobe State, distance to water source was not associated with trachoma.[19] Access to water and latrine facilities, of course, is unlikely to be enough: people must also understand and prioritize the need for facial cleanliness, and probably also be taught techniques to use water efficiently to keep faces clean. More emphasis may need to be given to education on the relationship between trachomatous blindness and personal and environmental hygiene in these LGAs, though approaches in this area that are proven to have impact on disease prevalence are still needed. Further work to explore these risk factors for disease in Kano State, and to examine associations more thoroughly using pooled data from multiple sub-projects of the GTMP, is awaited. In six other districts of Kano state (Ajingi, Albasu, Bichi, Garun Mallam, Gezawa, Gwalle) the prevalence of TF was less than 10% but above 5%. WHO previously recommended determination of sub-district-level prevalence of active trachoma in such cases to determine whether mass treatment with antibiotics was required in segments of the district, but recently, guidance has changed so that a single round of districtwide mass treatment, followed by an impact survey, is now advocated.[20] In addition to the possible need for antibiotic treatment, in these LGAs there is a need to implement the F and E components of the SAFE strategy. Four of these districts (Ajingi, Albasu, Bichi, and Gezawa) also had trichiasis at prevalences above the elimination threshold.

A total of 40 LGAs had prevalences of trichiasis above the level that indicates public health significance. The estimated number of persons needing surgery is above 38,000; this does not include incident cases that may occur in the next few years. This huge trichiasis problem has been highlighted previously in Kano State.[5] With prevalence figures now available at the LGA level, the trachoma programme in Kano needs to prioritize LGAs with bigger trichiasis backlogs for immediate intervention, while planning to cover the whole state in the near future. Currently there are only about 15 active trichiasis surgeons in Kano State. It is important that more trichiasis surgeons are properly trained,[21] equipped and posted based on the needs identified in each LGA in this study. It is also important that community-based surgeries be provided and females be specifically encouraged to access services, if the goal of elimination by the year 2020 is to be achieved.[22]

There are many more Kano State LGAs with significant levels of trichiasis than there are LGAs with significant levels of active trachoma, which may suggest that trachoma is a disappearing disease here; socioeconomic development may be responsible. This is evidenced by better water coverage than previously reported: some LGAs now have up to 100% coverage at household level, compared to a national average of 43% in 2008.[23] The proportion of households using improved latrine facilities has also improved, from a 2008 national average of 18%,[24] to 64% in Kano State in our surveys. These improvements in water and sanitation have occurred despite the absence of any specific dialogue about trachoma elimination, suggesting that a collaborative trachoma programme could leverage the work of water and sanitation agencies to achieve trachoma elimination targets.

Though it is possible that trachoma is already slowly disappearing from Kano, the huge numbers of persons with potentially blinding disease need to be urgently managed, to save them both from going blind and from the misery[25] of eyelashes rubbing on their eyeballs each day.

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Appendix

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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.

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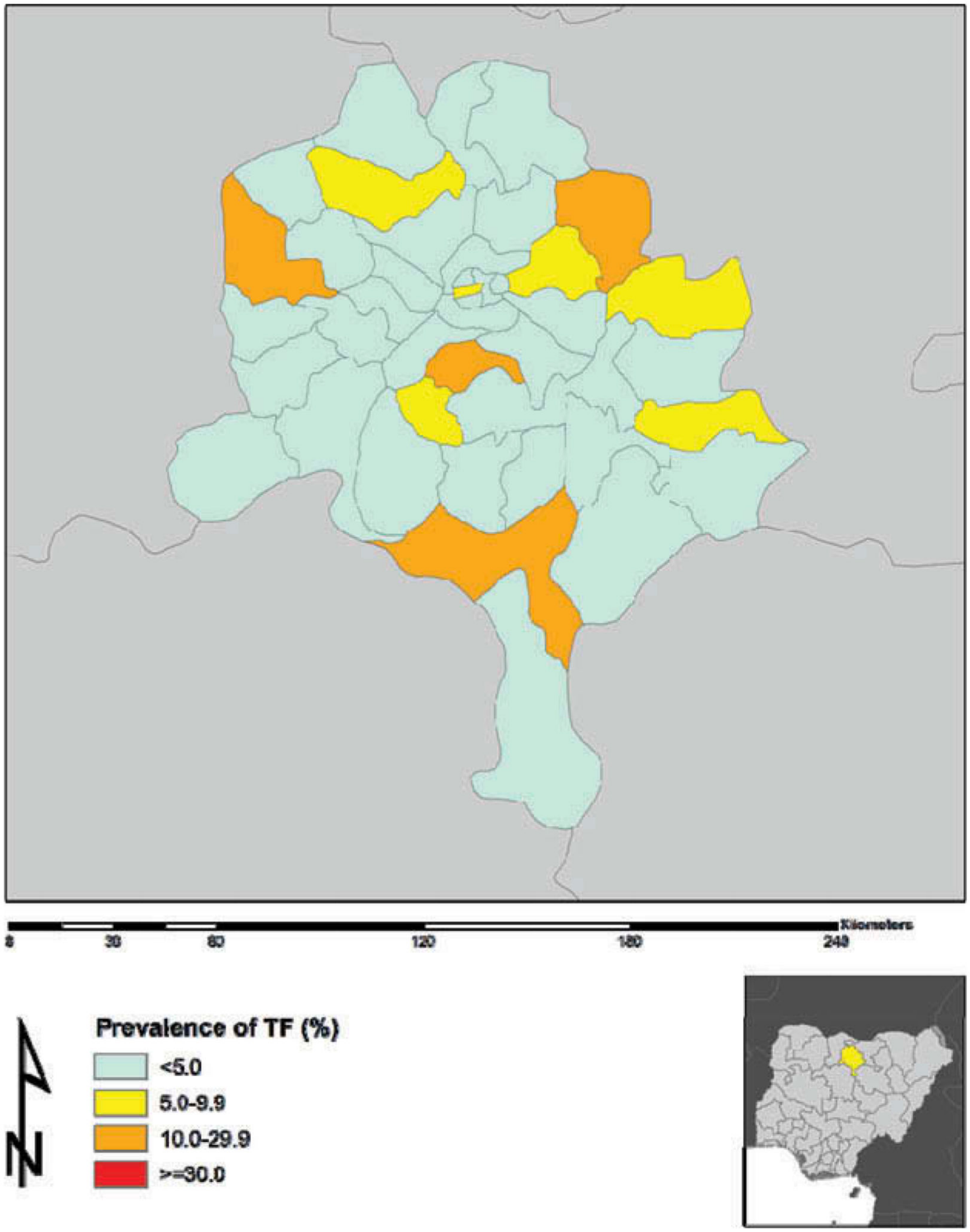

Figure 1.

Prevalence of trachomatous inflammation–follicular (TF) in 1–9-year-old children, by Local Government Area, Kano State, Nigeria, Global Trachoma Mapping Project, May–July 2013.

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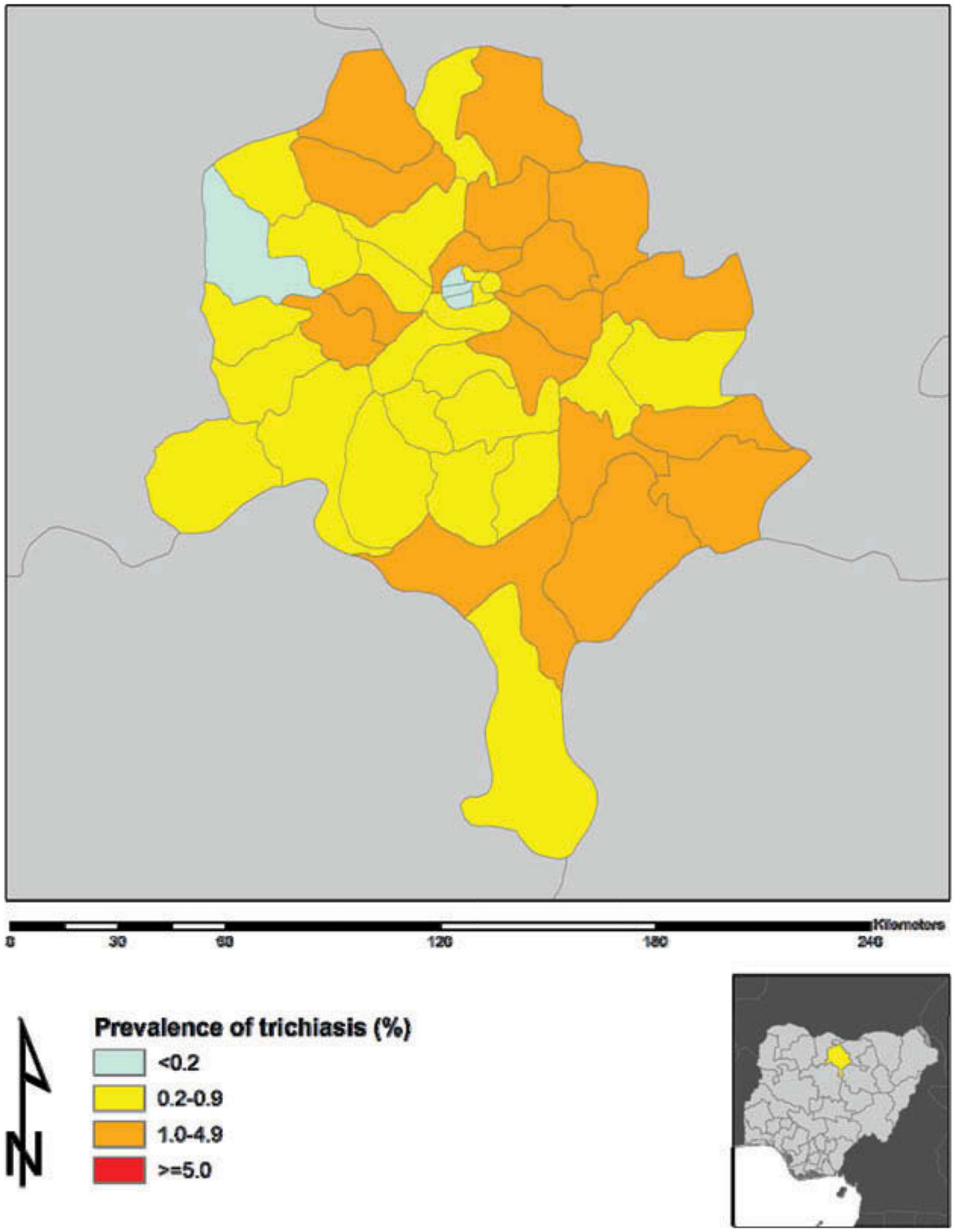

Figure 2.
Prevalence of trichiasis in adults, by Local Government Area, Kano State, Nigeria, Global Trachoma Mapping Project, May–July 2013.

Table 1

Age and sex distribution of study participants, Global Trachoma Mapping Project, Kano State, Nigeria, May–July 2013.

Age (years)	Females	%	Males	%	Total	% of total
1–10	42,310	46.7	48,378	53.4	90,688	54.7
11–20	10,406	50.7	10,104	49.3	20,510	12.4
21–30	12,216	73.2	4483	26.9	16,699	10.1
31–40	9000	59.0	6263	41.0	15,263	9.2
41–50	4708	44.3	5921	55.7	10,629	6.4
51–60	2322	37.0	3947	63.0	6269	3.8
61–70	1252	34.2	2407	65.8	3659	2.2
71–80	484	29.2	1173	70.8	1657	1.0
≥81	162	36.9	277	63.1	439	
Total	82,860	50.0	82,953	50.0	165,813	

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Table 2

Local Government Area (LGA)-level prevalences of trachomatous inflammation–follicular (TF) and trichiasis, Global Trachoma Mapping Project, Kano State, Nigeria, May–July 2013.

LGA	Age-adjusted TF prevalence in 1–9 year olds (%)	95% CI		Age- and sex-adjusted trichiasis prevalence in those aged ≥ 15 years (%)	95% CI	
Ajingi	9.7	6.6	13.0	2.24	1.42	3.49
Albasu	9.2	5.9	13.0	2.12	1.43	2.94
Bagwai	3.7	2.5	5.2	0.30	0.08	0.62
Bebeji	3.8	2.9	5.0	0.57	0.29	0.93
Bichi	5.6	3.5	8.1	1.44	0.64	2.32
Bunkure	2.5	1.4	4.0	0.62	0.30	1.03
D/Kudu	1.8	0.4	3.7	0.13	0.04	0.23
D/Tofa	2.4	1.4	3.5	1.41	0.81	2.22
Dala	0.1	0.0	0.3	1.22	0.73	1.88
Dambatta	2.3	1.6	3.2	0.73	0.46	1.09
Doguwa	1.3	0.5	2.4	0.94	0.45	1.53
Fagge	0.5	0.1	1.1	0.60	0.30	1.00
Gabasawa	15.5	12.4	19.5	1.97	1.23	3.02
Garko	0.4	0.2	0.6	1.26	0.62	2.07
Garum Mallam	5.8	4.2	7.4	0.54	0.17	0.87
Gaya	1.5	0.4	3.1	0.84	0.34	1.38
Gezawa	8.6	7.0	10.7	1.48	0.70	2.25
Gwale	6.2	3.4	9.1	0.16	0.03	0.34
Gwarzo	1.2	0.7	2.0	0.40	0.10	0.84
Kabo	2.9	2.2	3.7	1.04	0.75	1.43
Kano	1.2	0.2	2.6	0.03	0.00	0.06
Karaye	1.8	1.1	2.4	0.60	0.34	0.97
Kibiya	4.2	2.8	5.9	0.70	0.34	1.04
Kiru	4.2	3.0	5.7	0.50	0.24	0.86
Kumbotso	0.3	0.1	0.6	0.52	0.21	0.88
Kunchi	0.2	0.0	0.5	1.12	0.72	1.51
Kura	13.4	11.8	15.2	0.71	0.35	1.25
Madobi	0.5	0.2	0.8	0.59	0.39	0.84
Makwoda	1.6	0.7	2.6	0.85	0.23	1.76
Minjibir	0.7	0.3	1.3	2.86	1.89	4.15
Nasarawa	0.7	0.3	1.0	0.33	0.10	0.63
R/Gado	2.6	1.7	3.7	0.24	0.07	0.52
Rano	4.8	3.5	6.3	1.03	0.49	1.66
Rogo	2.3	1.3	3.5	0.29	0.10	0.60
Shanono	13.1	9.8	16.0	0.07	0.02	0.15
Sumaila	4.6	3.2	6.5	1.24	0.70	1.93

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LGA	Age-adjusted TF prevalence in 1–9 year olds (%)	95% CI		Age- and sex-adjusted trichiasis prevalence in those aged ≥ 15 years (%)	95% CI	
T/Wada	3.1	1.4	4.7	2.21	1.47	3.07
Takai	0.1	0.0	0.1	0.83	0.46	1.30
Tarauni	1.9	0.8	3.4	0.49	0.28	0.73
Tofa	0.1	0.0	0.2	0.75	0.43	1.04
Tsanyawa	10.8	8.3	14.1	1.81	1.32	2.47
Ungogo	1.7	1.3	2.4	1.30	0.80	2.00
Warawa	0.2	0.0	0.5	1.40	0.95	1.84
Wudil	0.0	0.00	0.1	1.49	0.93	2.15

Prevalences of trichiasis are displayed to two decimal places in order to provide clarity on whether or not the best estimate of prevalence was above or below the elimination threshold of 0.2% in adults ≥ 15 years.

CI, confidence interval.

Table 3

Local Government Area (LGA)-level estimates of the trichiasis backlog, Global Trachoma Mapping Project, Kano State, Nigeria, May–July 2013.

LGA	Estimated total population of persons aged ≥15 years	Trichiasis prevalence in persons aged ≥15 years (%)	Estimated trichiasis backlog	Number of people to be offered trichiasis operations to achieve the trichiasis component of "elimination of trachoma as a public health problem"
Ajingi	96,662	2.2	2161	1967
Albasu	105,078	2.1	2230	2020
Bagwai	90,458	0.3	275	94
Bebeji	107,473	0.6	609	394
Bichi	155,853	1.4	2239	1927
Bunkure	97,701	0.6	609	413
Dala	234,505	0.1	316	0
Dambatta	117,865	1.4	1665	1429
Dawakin Kudu	126,278	1.2	1540	1287
Dawakin Tofa	137,870	0.7	1011	735
Doguwa	84,361	0.9	793	625
Fagge	112,053	0.6	675	451
Gabasawa	118,274	2.0	2328	2091
Garko	90,701	1.3	1142	960
Garun Mallam	66,428	0.5	361	228
Gaya	116,155	0.8	972	739
Gezawa	158,104	1.5	2337	2021
Gwale	200,383	0.2	322	0
Gwarzo	102,829	0.4	416	210
Kabo	85,768	1.0	892	721
Kano Municipal	207,896	0.0	58	0
Karaye	80,665	0.6	485	324
Kibiya	77,626	0.7	547	392
Kiru	149,614	0.5	754	455
Kumbotso	164,859	0.5	861	532
Kunchi	61,695	1.1	694	570
Kura	80,133	0.7	570	410
Madobi	77,104	0.6	451	297
Makoda	123,252	0.9	1048	802
Minjibir	122,982	2.9	3517	3271
Nasarawa	333,990	0.3	1097	429
Rano	83,035	0.2	198	32
Rimin Gado	57,888	1.0	597	481
Rogo	127,460	0.3	373	118
Shanono	77,912	0.1	56	0
Sumaila	140,212	1.2	1740	1460

LGA	Estimated total population of persons aged ≥15 years	Trichiasis prevalence in persons aged ≥15 years (%)	Estimated trichiasis backlog	Number of people to be offered trichiasis operations to achieve the trichiasis component of “elimination of trachoma as a public health problem”
Takai	113,478	2.2	2506	2279
Tarauni	124,232	0.8	1027	778
Tofa	55,218	0.5	269	159
Tsanyawa	88,329	0.8	667	490
Tudun Wada	128,049	1.8	2312	2056
Ungogo	204,813	1.3	2658	2248
Warawa	73,840	1.4	1037	890
Wudil	105,638	1.5	1575	1363
Total 44 LGAs	5,264,719		47,988	38,149

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Table 4

Household access to washing water and improved latrines, by Local Government Area (LGA), Global Trachoma Mapping Project, Kano State, Nigeria, May–July 2013.

LGA	Wash water <1 km (%)	Improved wash water access (%)	Improved latrine access (%)
Ajingi	84.0	24.7	56.2
Albasu	63.9	58.7	36.9
Bagwai	96.0	52.1	16.1
Bebeji	96.0	26.6	100.0
Bichi	97.3	34.5	80.9
Bunkure	99.8	1.0	100.0
D/Kudu	98.6	79.4	94.5
D/Tofa	99.0	20.8	58.1
Dala	100.0	83.8	73.1
Dambatta	97.0	55.1	83.7
Doguwa	70.1	35.6	9.8
Fagge	88.7	63.3	100.0
Gabasawa	99.8	11.9	49.7
Garko	87.7	45.7	70.8
Garum Mallam	96.8	37.5	92.6
Gaya	71.7	48.5	0.7
Gezawa	99.7	4.2	98.4
Gwale	100.0	92.1	100.0
Gwarzo	89.5	88.3	33.6
Kabo	69.0	74.2	52.1
Kano	98.5	92.9	99.5
Karaye	89.9	88.5	26.2
Kibiya	94.6	20.1	51.8
Kiru	95.4	47.7	97.8
Kumbotso	100.0	78.4	66.7
Kunchi	87.9	60.3	11.0
Kura	99.5	38.3	93.4
Madobi	52.6	76.9	77.9
Makwoda	93.2	20.7	81.5
Minjibir	88.5	72.3	60.8
Nasarawa	99.8	100.0	99.7
R/Gado	96.4	24.2	97.7
Rano	60.4	84.3	79.6
Rogo	97.6	57.9	2.2
Shanono	96.0	47.7	20.1
Sumaila	89.6	17.0	9.0
T/Wada	100.0	61.2	53.8
Takai	100.0	100.0	100.0

LGA	Wash water <1 km (%)	Improved wash water access (%)	Improved latrine access (%)
Tarauni	96.6	88.3	75.4
Tofa	81.9	90.7	52.6
Tsanyawa	84.7	31.5	28.3
Ungogo	87.5	17.2	100.0
Warawa	95.0	93.0	89.3
Wudil	66.7	57.6	16.0

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Table 5

Multilevel univariable and multivariable analysis of factors associated with trachomatous inflammation–follicular (TF) in 1–9-year-olds, Global Trachoma Mapping Project, Kano State, Nigeria, May–July 2013.

Variable		*n*	TF%	Univariable OR	95% CI	Multivariable OR	95% CI
Age (years)	1–3	25,687	3.7	1.6	1.4–1.7	1.5	1.4–1–7
	4–6	33,666	4.0	1.7	1.6–1.9	1.7	1.6–1.9
	7–9	26,225	2.3	1	–	1	–
Sanitation facilities[a]	Unimproved	25,710	3.8	1.2	1.0–1.3	1.2	1.0–1.3
	Improved	59,868	3.2	1	–	1	–
Time to main source of drinking water (minutes)	<30	78,095	3.5	1	–	1	–
	≥30	7483	2.5	0.8	0.7–1.0	0.8	0.7–1.0
Sex	M	45,573	3.3	1	–		
	F	40,005	3.5	1.0	1.0–1.1		
Time to main source of washing water (minutes)[b]	<30	78,445	3.5	1	–		
	≥30	7133	2.6	0.9	0.7–1.0		

Note: Multivariable ORs are adjusted for age, sanitation facilities, and time to main source of drinking water.

[a]Grouped according to the WHO/UNICEF Joint Monitoring Program (JMP) for Water Supply and Sanitation's "Sanitation Ladder" from the 2008 JMP Report (http://www.wssinfo.org/fileadmin/user_upload/resources/1251794333-JMP_08_en.pdf). The category "open defecation" was added to "unimproved facilities" as there was too small a number of people in this group (≤3%) for both TT and TF to make a meaningful comparison with "improved" and "unimproved" facilities.

[b]"Washing at source" was included in the "≤30 min" group as this applied to a small group and would not make for a meaningful comparison. OR, odds ratio; CI, confidence interval.

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Table 6

Multilevel univariable and multivariable analysis of associations with trichiasis in adults aged 15 years and above, Global Trachoma Mapping Project, Kano State, Nigeria, May–July 2013.

Variable		*n*	TT%	Univariable OR	95% CI	Multivariable OR	95% CI
Sex	M	27,895	1.8	1	–	1	–
	F	35,447	2.6	1.5	1.4–1.7	3.3	2.9–3.7
Age (years)	15–24	14,467	0.2	1	–	1	–
	25–34	15,820	0.5	3.8	2.3–6.1	3.3	2.1–5.4
	35–44	13,306	1.3	9.2	5.8–14.5	9.3	5.9–14.7
	45–54	9411	3.0	21.5	13.8–33.7	25.4	16.2–39.8
	55–64	5420	6.1	47.5	30.4–74.3	60.6	38.7–95.0
	65+	4918	10.9	101.4	65.0–158.0	140.9	90.0–220.4
Sanitation facilities[a]	Unimproved	24,098	2.7	1.3	1.1–1.5	1.3	1.1–1.5
	Improved	39,244	2.0	1	–	1	–
Time to main source of washing water (minutes)[b]	<30	56,701	2.3	1	–	1	–
	≥30	6641	2.2	0.8	0.6–0.9	0.7	0.6–0.9
Time to main source of drinking water (minutes)[c]	<30	56,433	2.3	1	–		
	≥30	6909	2.2	0.8	0.6–1.0		

Note: Multivariable ORs are adjusted for sex, age and sanitation facilities.

[a]Grouped according to the WHO/UNICEF Joint Monitoring Program (JMP) for Water Supply and Sanitation's "Sanitation Ladder" from the 2008 JMP Report (http://www.wssinfo.org/fileadmin/user_upload/resources/1251794333-JMP_08_en.pdf). The category "open defecation" was added to "unimproved facilities" as there was too small a number of people in this group (≤3%) for both TT and TF to make a meaningful comparison with "improved" and "unimproved" facilities.

[b]"Washing at source" was included in the "≤30 min" group as this applied to a small group and would not make for a meaningful comparison.

[c]Significant in univariable analysis but not included in multivariable analysis as collinear with "time to main source of washing water." OR, odds ratio; CI, confidence interval.