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### Permalink

<https://escholarship.org/uc/item/7d8562gj>

### Journal

Ophthalmic Epidemiology, 25(sup1)

### ISSN

0928-6586

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### Publication Date

2018-12-28

### DOI

10.1080/09286586.2018.1467468

Peer reviewed

## Prevalence of Trachoma in Four Local Government Areas of Jigawa State, Nigeria

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### ABSTRACT

**Purpose:** To determine the prevalence of trachoma and water and sanitation coverage in four local government areas (LGAs) of Jigawa State, Nigeria: Birnin Kudu, Buji, Dutse and Kiyawa.

**Methodology:** A population-based cross-sectional survey was conducted in each LGA using Global Trachoma Mapping Project (GTMP) protocols. From each LGA, 25 villages were selected using probability-proportional-to-population size sampling; in each village, 25 households were selected using the random walk technique. All residents aged  $\geq 1$  year in selected households were examined by GTMP-certified graders for trachomatous inflammation – follicular (TF) and trichiasis, defined according to the WHO simplified trachoma grading scheme definitions. Water, sanitation and hygiene data were also collected through questioning and direct observation.

**Results:** In 2458 households of four LGAs, 10,669 residents were enumerated. A total of 9779 people (92% of residents) were examined, with slightly more females examined (5012; 51%) than men. In children aged 1–9 years, the age-adjusted prevalence of TF ranged from 5.1% (95% CI 2.5–9.0%) in Birnin Kudu to 12.8% (95% CI 7.6–19.4%) in Kiyawa, while the age- and gender-adjusted trichiasis prevalence in persons aged  $\geq 15$  years ranged from 1.9% (95% CI 1.4–2.5%) in Birnin Kudu to 3.1% (95% CI 2.2–4.0) in Dutse. Access to improved water sources was above 80% in all LGAs surveyed but access to improved sanitation facilities was low, ranging from 23% in Buji to 50% in Kiyawa.

**Conclusion:** Trachoma is a public health problem in all four LGAs surveyed. The full SAFE strategy needs to be implemented to achieve trachoma elimination.

### ARTICLE HISTORY

Received 13 January 2018  
Revised 17 March 2018  
Accepted 13 April 2018

### KEYWORDS

Global Trachoma Mapping Project; prevalence; sanitation; trachoma; Trichiasis; water

## Introduction

Trachoma is a disease caused by repeated infection of the conjunctival epithelium by particular strains of the bacterium *Chlamydia trachomatis*;<sup>1,2</sup> it is the principal cause of blindness of infectious origin worldwide.<sup>3</sup> The main reservoir of the infection is in young children,<sup>4</sup> in whom the clinical sign of trachomatous inflammation – follicular (TF), a feature of prolonged *C. trachomatis*-induced conjunctival inflammation, is often found.<sup>5</sup> Frequent repeated infection and inflammation of the conjunctivae,<sup>6,7</sup> can lead to conjunctival scarring, with resultant in-turning of the eyelashes. In-turned eyelashes that touch the eyeball (trichiasis)<sup>5</sup> may damage the

cornea, resulting in irreversible visual impairment or blindness.

An estimated 171 million people are at risk of the disease in Africa.<sup>8</sup> In Nigeria, various surveys have shown trachoma to be of public health significance in many local government areas (LGAs, the equivalent of “districts” elsewhere).<sup>9–14</sup> To implement the SAFE (Surgery for trichiasis, Antibiotics to clear infection, and promotion of Facial cleanliness and Environmental improvement to reduce transmission) strategy, which is recommended by the World Health Organization (WHO) for the elimination of trachoma,<sup>15</sup> district-level data on the prevalence of TF in 1–9 year-olds and trichiasis in persons aged  $\geq 15$  years are required. These

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\*See Appendix.

Color versions of one or more of the figures in the article can be found online at [www.tandfonline.com/iope](http://www.tandfonline.com/iope).

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data help programme managers determine which elements of the strategy to implement.<sup>16</sup>

Jigawa State is located in northern Nigeria and surrounded by states where trachoma has been found to be a public health problem.<sup>9,14,17</sup> A 2007 state-level survey also documented trachoma to be a public health problem in Jigawa State itself; although this work did not generate the LGA-level prevalence indicators generally recommended to guide programme implementation,<sup>18</sup> it was used as the basis to initiate SAFE strategy rollout<sup>19</sup> for a number of LGAs. In 2013, the Global Trachoma Mapping Project (GTMP)<sup>20</sup> supported the collection of LGA-level data in four LGAs of Jigawa where elimination activities had not yet commenced.

## Methods

### Sample size calculation

Each LGA was considered its own evaluation unit, with a separate population-based prevalence survey being conducted in each one, according to the same principles. Details of the sample size calculation have been reported elsewhere.<sup>21</sup> Briefly, each survey attempted to include enough households to ensure that 1019 children aged 1–9 years would be present and consent to participate, because this would provide sufficient power to estimate an expected TF prevalence in 1–9-year olds of 10% with an absolute precision of 3%, assuming a design effect of 2.65.

### Team training

Each field team consisted of a grader and a recorder. These personnel were trained and certified according to the standard operating procedures of the GTMP.<sup>21</sup> Version 1 of the GTMP training system<sup>22</sup> was used. Grader trainees were required to pass a slide-based test of diagnostic accuracy after which they were eligible to attempt live subject-based inter-grader assessment tests to prove themselves survey-ready, while recorder trainees were required to pass an examination testing their data capture accuracy, as described previously.<sup>21</sup>

### Household selection

In each LGA, 25 villages were selected using a systematic, probability-proportional-to-population-size methodology.<sup>16</sup> In selected villages, 25 households were selected. Despite the limitations of the random walk method,<sup>23–25</sup> it was used to select households as the security situation at that time was volatile and

survey coordinators felt it was better to use a method with which communities were familiar.

### Data collection

Members of selected households aged  $\geq 1$  year were eligible to be included. With the aid of  $\times 2.5$  magnifying loupes, graders examined the eyes of all consenting participants for the signs of trichiasis, TF and trachomatous inflammation – intense (TI), according to the criteria of the WHO simplified grading system.<sup>5</sup> Collection of data on household-level sources of water and the type of sanitation facility was integrated into the survey, through interviews with household members plus direct observation. All data were entered into the LINKS-GTMP app running on Android smartphones, which automatically collected global positioning system (GPS) coordinates for each household.<sup>21</sup> Once phones were within range of a suitable network, data were uploaded to a secure cloud-based server.<sup>21,26</sup>

### Data analysis

The Nigeria census for 2006<sup>27</sup> was used as the reference for data adjustment. The proportion of 1–9-year-olds with TF was adjusted at village level for age, in one year age bands. The proportion of adults with trichiasis was adjusted at village level for gender and age, in 5-year age bands. The means of the adjusted village-level proportions provided the LGA-level prevalences. Confidence intervals (CIs) were determined by bootstrapping adjusted village-level proportions, with replacement, over 10,000 replications.

Water sources and sanitation facilities were defined as “improved” using the criteria established by the WHO/UNICEF Joint Monitoring Program (JMP) for Water Supply and Sanitation, as reported up until 2015.<sup>28</sup>

### Ethical considerations

Ethical approval was obtained from the National Health Research Ethics Committee of Nigeria (NHREC/01/01/2007) and the ethics committee of the London School of Hygiene & Tropical Medicine (reference 6319). Consent was obtained verbally, and documented electronically. For individuals below 15 years of age, consent was given by a parent or guardian. Persons with active trachoma were given a course of 1% topical tetracycline eye ointment, and those with trichiasis were referred to the nearest certified trichiasis surgeon.

## Results

Residents enumerated from 2458 households across the four LGAs totalled 10,669. A total of 5,538 (52%) residents were female (Table 1). A total of 9779 people (92% of residents) were examined; 473 people (4%) were absent, while 447 people (4%) refused examination (Table 1). Of examined individuals, 5012 (51%) were female.

A total of 3,611 children aged 1–9 years were examined, of whom 1775 (49%) were female. The age-adjusted prevalence of TF in 1–9-year-olds ranged from 5.1% (95% CI 2.5–9.0%) in Birnin Kudu to 12.8% (95% CI 7.6–19.4%) in Kiyawa (Table 1, Figure 1).

A total of 5,435 individuals aged  $\geq 15$  years were examined. Of those, 2,878 (53%) were female. The age- and gender-adjusted prevalence of trichiasis in  $\geq 15$ -year-olds ranged between 1.9% (95% CI 1.4–2.5%) in Birnin Kudu and 3.1% (95% CI 2.2–4.0) in Dutse (Table 1 and Figure 2). The estimated backlog of trichiasis and the number of persons needing surgery to reach the elimination threshold in each LGA is shown in Table 3.

In all four LGAs surveyed, over 80% of households had access to an improved source of water for face-washing within a 30 minute round trip (the equivalent of a < 1 km round trip). Household access to improved sanitation facilities ranged from 23.1% in Buji to 50.2% in Kiyawa (Table 2).

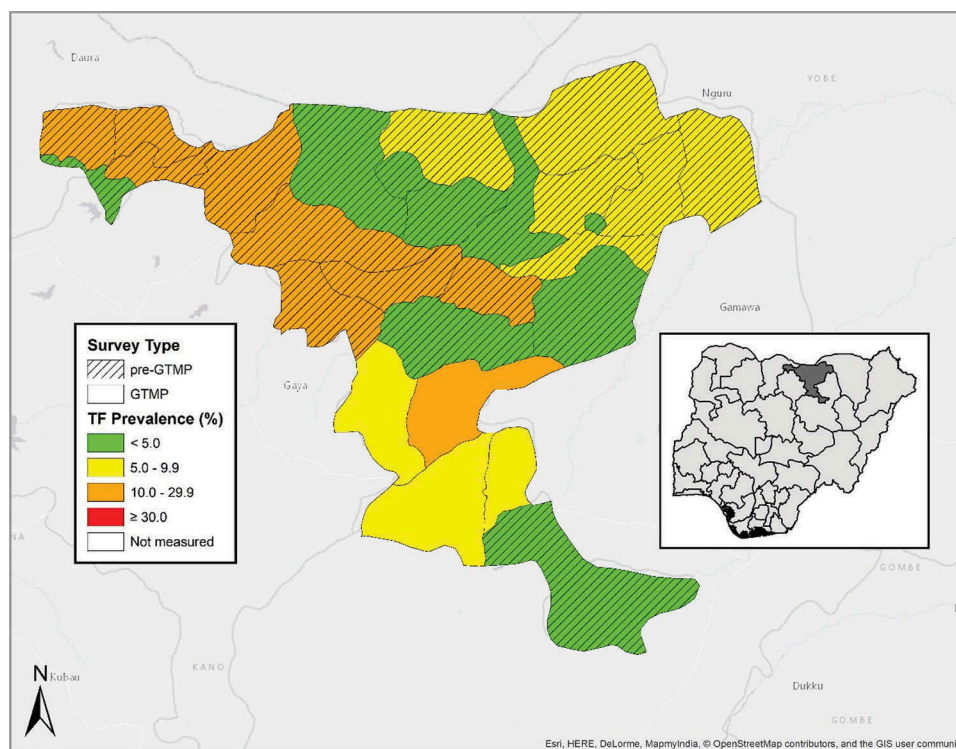
**Table 1.** Number of 1–9-year olds and number of  $\geq 15$ -year-olds resident, examined, absent and refused; prevalence of trachomatous inflammation – follicular (TF); and prevalence of trichiasis; by Local Government Area (LGA), Global Trachoma Mapping Project Jigawa State, Nigeria, June and July, 2013.

LGA	Number of villages sampled	1–9-year olds				TF prevalence <sup>a</sup> (95% CI)	$\geq 15$ -year-olds				Trichiasis prevalence <sup>b</sup> (95% CI)
		Resident	Examined	Absent	Refused		Resident	Examined	Absent	Refused	
Birnin Kudu	25	942	913	11	18	5.09 (2.5–9.0)	1576	1458	99	19	1.9 (1.4–2.5)
Buji	25	953	928	18	7	8.1 (4.8–11.5)	1469	1344	72	53	2.1 (1.5–2.8)
Dutse	25	892	867	8	17	8.1 (4.5–13.1)	1534	1314	118	102	3.1 (2.2–4.0)
Kiyawa	25	942	903	13	26	12.8 (7.6–19.4)	1593	1319	141	133	2.8 (2.1–3.4)
Totals	100	3727	3611	50	68	N/A	6172	5435	430	307	N/A

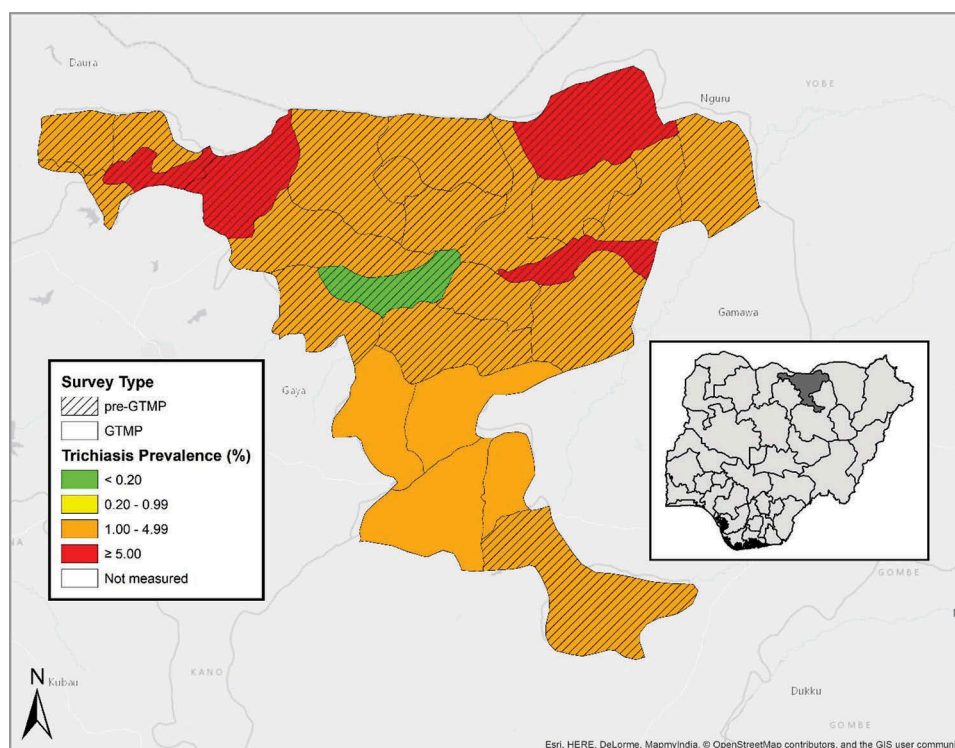
<sup>a</sup>Adjusted for age in 1-year age bands (see text).

<sup>b</sup>Adjusted for gender and age in 5-year age bands (see text).

CI: confidence interval; N/A: not applicable.



**Figure 1.** Local Government Areas (LGAs) surveyed, and prevalence of trachomatous inflammation—follicular (TF) in 1–9-year-olds, by LGA, Jigawa State, Nigeria, June and July, 2013. GTMP: Global Trachoma Mapping Project.



**Figure 2.** Prevalence of trichiasis in  $\geq 15$ -year-olds, by LGA, Jigawa State, Nigeria, June and July, 2013. GTMP: Global Trachoma Mapping Project.

## Discussion

In all four LGAs surveyed here, trachoma was a public health problem, as perhaps might have been predicted on the basis of 2007 state-level survey data.<sup>18</sup> All LGAs surveyed require interventions for active trachoma, comprising antibiotic mass drug administration, promotion of facial cleanliness and environmental improvement.<sup>16</sup> While Birnin Kudu, Buji and Dutse will require these interventions for at least one year, Kiyawa will require them for at least three years before impact surveys would be recommended.<sup>29</sup> Considering the relatively high household-level water coverage ( $>80\%$ ) in all LGAs surveyed, in order to faithfully implement the SAFE strategy, emphasis should be placed on encouraging use of water for hygiene purposes, perhaps using established hygiene behaviour change techniques.<sup>30</sup> Residents of these LGAs

need to be able to relate the disease trachoma to poor personal hygiene so that water is used to ensure that faces are clean. Success in this area might be anticipated, as the hardware is already available to implement the ‘F’ component of SAFE.

Availability of improved sanitation facilities was noted to be suboptimal. Though sanitation coverage was above the 2008 national average of 18%,<sup>31</sup> there remains considerable room for improvement. Some studies associate latrine ownership with a lower risk of trachoma,<sup>32–34</sup> and a recent model incorporating GTMP data from 13 countries, including Nigeria, found evidence of herd protection against TF for children living in communities in which sanitation coverage is  $>80\%$ .<sup>35</sup> To succeed in implementing the ‘E’ component of the SAFE strategy here, greater attention to providing the means for appropriate disposal of human faeces is recommended.

The trichiasis prevalence was above the elimination threshold in each LGA surveyed. In these four LGAs, an estimated 11,479 people have the potentially blinding stage of trachoma; if left untreated, this could progress in each person to cause corneal damage and irreversible visual impairment or blindness. There is therefore an urgent requirement to scale-up the surgery component of the SAFE strategy. A programme that provides surgery as close as possible to the residences of persons affected<sup>36</sup> is needed to encourage all trichiasis

**Table 2.** Household-level access to water and sanitation, by Local Government Area (LGA), Global Trachoma Mapping Project, Jigawa State, Nigeria, June and July, 2013.

LGA	House-holds, n	Improved washing water, n (%)	Washing water source (improved or unimproved) $<1$ km, n (%)	Improved sanitation facilities, n (%)
Birnin Kudu	598	525 (87.8)	517 (86.5)	273 (45.7)
Buji	623	546 (87.6)	535 (85.9)	144 (23.1)
Dutse	619	548 (88.5)	566 (91.4)	165 (26.7)
Kiyawa	618	602 (97.4)	572 (92.6)	310 (50.2)

**Table 3.** Local Government Area (LGA)-level estimates of the trichiasis backlog, Jigawa State, Nigeria. Global Trachoma Mapping Project, June and July 2013.

Local Government Area	Number of ≥15-year-olds examined	Number of ≥15-year-olds with trichiasis	Prevalence of trichiasis in ≥15-year-olds, % (95% CI) <sup>a</sup>	Estimated total population aged ≥15 years	Estimated trichiasis backlog	Number of persons that need trichiasis management to achieve elimination threshold
Birnin Kudu	1458	67	1.9 (1.4–2.5)	175,900	3360	3046
Buji	1344	56	2.1 (1.5–2.8)	54,479	1128	1,030
Dutse	1314	76	3.1 (2.2–4.0)	140,635	4318	4,066
Kiyawa	1319	65	2.8 (2.1–3.4)	96,853	2673	2500
Total	5435	264	N/A	413,442	11,479	10,643

patients to present for surgery; we note that in many places, women have lower access to trichiasis surgery services, are more afraid of surgery, and are less likely to have been offered surgery in the past.<sup>37</sup> Thankfully, Jigawa State has already started training trichiasis surgeons to meet the predicted service requirements. In these four LGAs alone, a total of 10,643 trichiasis surgeries are likely to be needed to reach the elimination prevalence target. Training and certification of trichiasis surgeons will need to follow WHO recommendations.<sup>38</sup> This will ensure that when surgeons are equipped and deployed, they provide high quality surgery to persons afflicted.

Trachoma is a public health problem in all four LGAs of Jigawa State surveyed in this series. There is a need to implement the full SAFE strategy in each of them, in order to move towards elimination of trachoma as a public health problem.

### Declaration of interest

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

### Funding

This study was principally funded by the Global Trachoma Mapping Project (GTMP) grant from the United Kingdom's Department for International Development (DFID; ARIES: 203145) to Sightsavers, which led a consortium of non-governmental organizations and academic institutions to support health ministries to complete baseline trachoma mapping worldwide. The GTMP was also funded by the United States Agency for International Development (USAID), through the ENVISION project implemented by RTI International under cooperative agreement number [AID-OAA-A-11-00048], and the END in Asia project implemented by FHI360 under cooperative agreement number OAA-A-10-00051. A committee established in March 2012 to examine issues surrounding completion of global trachoma mapping was initially funded by a grant from Pfizer to the International Trachoma Initiative. AWS was a Wellcome Trust Intermediate Clinical Fellow [098521] at the London School of Hygiene & Tropical Medicine. 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. None of the funders had any role in project design, in project implementation or analysis or interpretation of data, in the decisions on where, how or when to publish in the peer reviewed press, or in preparation of the manuscript.

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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