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Trachoma prevalence in Niger: results of 31 district-level surveys

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Background: The leading cause of preventable blindness worldwide is trachoma, a condition caused by an infection of the inner eyelid. In Niger, a landlocked republic in Western Africa, surveys in 1988–89 identified trachoma as endemic in all but one region and, as a result, there is a National Prevention of Blindness Program plan to eliminate trachoma by 2015.

Methods: Thirty-one districts in eastern and western Niger were surveyed for trachoma prevalence from May 2009 to March 2012 as part of routine program impact evaluations. Prevalence surveys were implemented independently in each district using a two-stage cluster random design. Probability proportional to size was used to randomly select villages and 25 households were selected in each cluster. The prevalence of trachoma of clinical grade trachomatous follicular (TF) was estimated in children aged 1–9 years, and the prevalence of blinding trachoma, trachomatous trichiasis (TT), was measured in adults aged ≥15 years.

Results: A total of 14 211 households was surveyed; 58 617 individuals were evaluated for clinical signs of trachoma, of whom 27 087 were children aged 1–9 years. District-wide implementation of the full SAFE strategy is warranted in 16 districts where TF prevalence exceeds 10% and targeted implementation of the SAFE strategy (surgery for trichiasis; antibiotic therapy to control transmission; facial cleanliness for hygiene promotion; environmental change for improvements in access to water and sanitation) is recommended in the remaining 15 districts. The prevalence of TT among adults exceeded 1% in nine districts, suggesting that surgical services to treat TT should be implemented district-wide.

Conclusions: These results establish the need for continued SAFE strategy implementation throughout Niger.

Keywords: Niger, Prevalence, Trachoma, Trichiasis

Introduction

Trachoma is the leading cause of preventable blindness worldwide. Current estimates suggest that 8 million people are visually impaired as a result of advanced trachoma and 129 million people live in areas known to be trachoma endemic.[1,2] Trachoma is caused by an infection of the inner eyelid with the bacterium *Chlamydia trachomatis*. Trachoma infections are self-limiting, but repeated infections over time can lead to scarification of the inner eyelid.[3] Advanced trachoma disease is characterized by a condition known as trichiasis, in which the eyelashes abrade the cornea, resulting in infection and injury, reduced visual acuity and possibly blindness.

The World Health Organization before (WHO) simplified grading system is used to diagnose five clinical signs of trachoma disease: trachomatous follicular (TF); trachomatous follicular-intense (TI); trachomatous scarring (TS); trachomatous trichiasis (TT); and corneal opacity (CO).[4] To reduce the prevalence of trachoma and eliminate the burden of blinding disease, the WHO endorses the SAFE strategy: surgery for trichiasis; antibiotic therapy to control transmission; facial cleanliness for hygiene promotion; environmental change for improvements in access to water and sanitation.[5] The Global Alliance for the Elimination of Blinding Trachoma by 2020 (GET 2020) has established the following prevalence thresholds for the elimination of trachoma as a public health problem: TF prevalence <5% among children aged 1–9 years at the district level and TT prevalence <1% among adults aged ≥15 years.[6]

In 1998–99, the National Prevention of Blindness Program in Niger conducted a nation-wide survey of trachoma prevalence to estimate the prevalence of TF and TT at the regional level (data not published). These surveys identified all regions of the country except Agadez as endemic for trachoma, with prevalence of TF among children ranging from 27.7% in Tillaberi to 62.7% in Zinder. The prevalence of TT also indicated the need for

intervention in these regions, with the prevalence among adults exceeding 1% in Diffa, Maradi, Tahoua and Zinder regions. The current era of SAFE implementation in Niger began in 1999, with ongoing implementation throughout eastern Niger (Diffa, Maradi and Zinder regions). In general, SAFE implementation in Niger includes provision of free trichiasis surgery via local health facilities (S), annual mass antibiotic distribution of azithromycin (indicated for the general population) or 1% tetracycline eye ointment (indicated for infants <1 year of age and pregnant women) targeted to the entire population (A), hygiene promotion through primary school health education, community health education, rural radio and local soap production (F), and household latrine promotion (E). Mass drug administration (MDA) for trachoma control has typically been implemented annually in districts in which the prevalence of TF among children 1–9 years old exceeds 10%. Additional districts in Western Niger (Dosso, Filingue and Tillaberi regions) began trachoma interventions, specifically MDA and health education in the mid-2000s. Since 2009, the Niger national program has expanded SAFE interventions nationally with the goal of eliminating blinding trachoma by 2015.

As part of the Nigerien national plan to eliminate trachoma by 2015, the Ministry of Health implements surveys every 3–5 years to measure trachoma prevalence at the district level, following guidelines set out by the WHO.[5] District-level trachoma prevalence surveys are carried out to identify the extent of SAFE strategy implementation needed, with the following criteria[7] applied to the district-level prevalence of TF among children 1–9 years of age: TF prevalence >10% qualifies for district-wide full SAFE implementation for 3–5 years; TF prevalence of 5–9% warrants sub-district implementation of SAFE interventions and monitoring of trachoma prevalence; and TF prevalence <5% indicates reduced SAFE implementation and no MDA. The implementation of district-wide programs to offer free surgery to individuals living with TT is warranted for districts with a TT prevalence exceeding 1% among adults aged 15 years and older. In this paper, we present data from 31 district-level trachoma prevalence surveys conducted from 2009 to 2012 in order to determine eligibility for district-wide or sub-district SAFE implementation according to current international guidelines for trachoma control program monitoring.[5]

Materials and methods

Sampling

We conducted trachoma prevalence surveys in 31 districts in Niger from May 2009 to March 2012. The date, number of clusters and response rate of each district survey are presented in Table 1. Among districts already implementing the full SAFE strategy, the timing of the surveys was consistent with the national program's impact evaluation schedule. Surveys were implemented at least 6 months after the most recent MDA for trachoma control. In order to detect a prevalence of TF in children aged 1–9 years of 4% with a precision of 2% and a design effect of 2, and a prevalence of TT in adults of 2.5% with a precision of 1.5% and a design effect of 1.5, we calculated a minimum sample size of 738 children aged 1–9 years and 624 adults 15 years and older for each district. We assumed an average household size of six individuals, the proportion of the population aged 1–9 years to be 30% and a non-response proportion of 15% among adults. To achieve this sample size, 20 clusters of 25 households each were sampled per district.

The primary sampling unit (the cluster) was defined as a village or neighborhood using Niger's census list as a sampling frame. In each district, clusters were selected using probability proportional to size (PPS). In each cluster, secondary sampling units (households) were selected using the map and segment method to ensure equal probability of household selection within the cluster.[8] Using this method, a map of the cluster was drawn at the time of data collection. The map was divided into segments of five households each; the segments were numbered and five segments were randomly selected by the survey team. Once households were selected, the entire household was enumerated. All household members aged 1–9 years who were present at the time of the interview were evaluated for clinical signs of trachoma and all adults aged 15 years and older were examined for trichiasis. Households were defined as a group of people who routinely ate from the same cooking pot. Short-term visitors to the household were excluded from the survey. In the event that a selected household was absent at the time of data collection, the survey team made one return visit at the end of data collection in the cluster. In the event that a selected household was absent during the second visit, the household was not replaced. The survey protocol used is consistent with several other trachoma prevalence surveys implemented in West and East Africa.[9–15]

Ethical considerations

Informed consent was obtained from community leaders before data collection began. Verbal informed consent was obtained from the head of household in surveyed households. If the head of household was not present, an adult member was asked to provide consent. Individual verbal consent was obtained from adult household members for the clinical examination and verbal assent was obtained from children aged 6–11 years of age. Topical tetracycline eye ointment (1%) was provided to any child with clinical signs of trachoma and participants with TT were referred to free trichiasis surgery at their local health clinic.

Questionnaire and clinical examination

All 31 district surveys presented in this paper used the same data collection tool and clinical examination protocol. A brief questionnaire was administered to the head of household to collect data for the following indicators: number of household members; presence of latrine in the household; and location of household water source. If a household latrine was reported, the survey team inspected the latrine for evidence of use. After the household questionnaire was administered, the survey team enumerated all household members, including those absent at the time of the interview. The household list was recorded on a standard census form. The following data were collected for each individual: age; sex; and participation in the previous year's MDA for trachoma control. A clinical examination for signs of trachoma was then performed on all household members.

Children aged 1 year and older and all adults were examined for clinical signs of trachoma. Among children aged 1–9 years surveyed, facial cleanliness was observed before the clinical examination was performed. Facial cleanliness was defined as the absence of nasal and ocular discharge and the presence of

Table 1. Summary of trachoma prevalence surveys carried out in 31 districts in Niger

District	Date of survey	Clusters	Households surveyed	Individuals enumerated	Individuals surveyed[a]	Children surveyed[b]
Abalak	December 2011	20	471	2082	1675 (80.4)	650
Boboye	October 2010	20	468	2071	1499 (72.3)	548
Bouza	October 2010	20	441	2381	1831 (76.9)	840
Dakoro	August 2011	20	443	2563	2110 (82.3)	944
Dosso	October 2010	20	465	2274	1785 (78.4)	764
Doutchi	October 2010	20	472	2223	1814 (81.6)	723
Filingue	October 2010	20	454	2399	1957 (81.5)	804
Gaya	January 2011	20	457	2551	1962 (76.9)	814
Goure	December 2011	20	477	2717	2205 (81.1)	833
Guidan Roumji	August 2011	20	473	2500	2000 (80.0)	898
Illela	October 2010	20	454	2075	1716 (82.6)	649
Keita	October 2010	20	438	2247	1652 (73.5)	691
Kollo	October 2010	20	465	2456	2014 (82.0)	788
Konni	October 2010	20	462	2466	1642 (66.5)	630
Loga	June 2009	20	449	2252	1815 (80.5)	738
Madaoua	October 2010	20	454	2372	2034 (85.7)	946
Madarounfa	March 2012	20	477	3107	2078 (66.8)	867
Magaria	November 2009	20	435	2238	1810 (80.8)	746
Maine	June 2009	20	464	2276	1885 (82.8)	781
Maradi Commune	June 2009	20	468	2902	2420 (83.3)	997
Matameye	November 2009	20	432	2298	1743 (75.8)	732
Mayahi	August 2011	20	466	2230	1868 (83.7)	798
N'guigmi	June 2009	20	450	2166	1697 (78.3)	639
Ouallam	October 2010	20	447	2403	1986 (82.6)	780
Say	October 2010	20	462	2671	2082 (77.9)	859
Tahoua	October 2010	20	472	2330	2031 (87.1)	899
Tanout	January 2012	20	476	2283	1715 (75.1)	697
Tchinta	December 2011	20	480	2574	2366 (91.9)	919
Tera	August 2011	20	465	2111	1663 (78.7)	663
Tessaoua	June 2009	20	407	2459	1846 (75.0)	794
Tillabery	October 2010	20	467	2041	1716 (84.0)	669

Values are n or n (%).
[a] Number and percent of individuals present at the time of interview and consented to participate.
[b] Aged 1–9 years; present at the time of interview.

discharge was recorded on the census form. Clinical examinations for all children and adults were performed using the WHO Simplified Grading System.[4] Examiners graded clinical stages using a 2.5x binocular loupe and flashlight then recorded the presence or absence of clinical signs for each eye on the census form.

Training and survey implementation

District-level surveys were implemented in groups over a 3-year period. Before each group of districts was surveyed, survey team members attended a 4-day training course on data collection procedures, including questionnaire administration and household selection using the map and segment method. Upon completing classroom-based training exercises, survey team members were evaluated during a pilot test of the survey in a community not selected for the survey. Ophthalmic nurses were recruited to conduct clinical examinations and were required to pass an inter-observer reliability test of trachoma grading against a standardized set of 50 photographs and a field examination of 50 children each. Only nurses who demonstrated at least 80% reliability compared to a gold standard grader were retained for survey implementation.

Data management and statistical analysis

Data were collected on paper forms and double-entered into a Microsoft Access® spreadsheet. Data entry errors were corrected by verification against the original paper form. Clusters, households and household members were assigned unique identification numbers to de-identify the datasets. The prevalence of TF was estimated as the proportion of children aged 1–9 years

present at the time of the survey and the prevalence of TT was estimated as the proportion of adults aged 15 years and older present at the time of the survey. To account for the cluster design, point estimates and 95% confidence intervals were estimated using the PROC SURVEYFREQ procedure in SAS V.9.2 (SAS Institute, Cary, NC, USA). District-level results are self-weighting on account of the PPS design. The proportion of households with a latrine, proportion of households with a water source located within the household, within the community or beyond the community, the proportion of children with an unclean face and the proportion of respondents who participated in the most recent MDA for trachoma were estimated for Niger as a whole by assigning weights based on the probability of selection; the proportions reported for these indicators are weighted.

Results

A total of 14 211 households and 58 617 individuals (of whom 27 087 were children 1–9 years of age) were surveyed. We present in Table 1 the date of each survey and the number of clusters, households and individuals sampled per district. Among all districts surveyed, we estimated the average household size to be 5.2 members (95% CI: 5.1–5.3). Overall, 1 607 out of 14 126 households (11.1%, 95% CI: 7.8–14.4) reported owning a latrine, which in 1507 households (95.3%, 95% CI: 93.4–97.3) showed evidence of use at the time of the survey (data on evidence of latrine use were missing for 31 households). Among 14 109 households who reported the location of their water source (well, piped, etc.), primary access to a water source

Table 2. Characteristics, by district, of households surveyed during 2009–2011 to determine prevalence of trachoma in Niger

District	No. of residents Mean (SE)	Latrine present n (%)	Latrine with evidence of use n (%)	Location of water source		
				In home n (%)	In village n (%)	Outside village n (%)
Abalak	4.4 (0.15)	41 (8.7)	39 (95.1)	16 (3.4)	195 (41.4)	260 (55.2)
Boboye	4.4 (0.14)	58 (12.5)	57 (100.0)	56 (12.0)	403 (87.0)	4 (0.9)
Bouza	5.3 (0.18)	0 (0.0)	[a]	0 (0.0)	171 (38.7)	270 (61.2)
Dakoro	5.7 (0.11)	17 (3.9)	15 (88.2)	9 (2.0)	356 (80.7)	76 (17.2)
Dosso	4.8 (0.12)	0 (0.0)	[a]	0 (0.0)	209 (44.9)	256 (55.0)
Doutchi	4.7 (0.11)	77 (16.3)	69 (100.0)	10 (2.1)	446 (95.0)	13 (2.8)
Filingue	5.2 (0.18)	48 (10.5)	46 (100.0)	12 (2.7)	434 (96.2)	5 (1.1)
Gay	5.5 (0.16)	135 (29.5)	130 (100.0)	41 (9.0)	376 (82.2)	40 (8.8)
Goure	5.6 (0.18)	93 (19.4)	92 (98.9)	22 (4.6)	204 (42.7)	251 (52.6)
Guidan Roumji	5.2 (0.16)	127 (26.8)	124 (97.6)	6 (1.3)	375 (79.2)	92 (19.4)
Illela	4.5 (0.16)	40 (8.8)	40 (100.0)	25 (5.5)	273 (60.2)	155 (34.2)
Keita	5.1 (0.14)	13 (3.0)	13 (100.0)	5 (1.1)	195 (44.8)	235 (54.0)
Kollo	5.2 (0.17)	58 (12.4)	57 (100.0)	35 (7.5)	282 (60.6)	148 (31.8)
Konni	5.3 (0.14)	50 (10.8)	50 (100.0)	28 (6.1)	219 (47.4)	215 (46.5)
Loga	5.0 (0.16)	4 (0.9)	2 (100.0)	384 (85.7)	64 (14.2)	0 (0.0)
Madaoua	5.2 (0.17)	7 (1.6)	7 (100.0)	32 (7.2)	284 (63.6)	130 (29.1)
Madarounfa	6.5 (0.22)	213 (44.6)	172 (80.7)	0 (0.0)	359 (75.2)	118 (24.7)
Magaria	5.1 (0.21)	19 (4.5)	16 (94.1)	3 (0.7)	335 (77.9)	92 (21.3)
Maine	4.9 (0.20)	47 (10.1)	47 (100.0)	25 (5.4)	210 (45.4)	227 (49.1)
Maradi Commune	6.2 (0.16)	63 (13.7)	54 (91.5)	11 (2.6)	305 (67.0)	150 (32.9)
Matameye	5.3 (0.13)	23 (5.3)	23 (100.0)	58 (13.0)	327 (76.2)	91 (21.2)
Mayahi	4.7 (0.15)	17 (3.7)	14 (82.3)	12 (2.6)	332 (71.8)	130 (28.1)
N'guigmi	4.8 (0.32)	117 (26.1)	116 (100.0)	3 (0.6)	222 (49.8)	165 (37.0)
Ouallam	5.3 (0.16)	16 (3.6)	15 (100.0)	0 (0.0)	228 (51.2)	217 (48.7)
Say	5.7 (0.18)	26 (5.7)	26 (100.0)	1 (0.2)	227 (49.7)	217 (47.5)
Tahoua	4.9 (0.14)	10 (2.2)	10 (100.0)	0 (0.0)	359 (78.0)	101 (21.9)
Tanout	4.7 (0.11)	29 (6.1)	26 (89.6)	0 (0.0)	244 (51.2)	229 (48.1)
Tchinta	5.3 (0.21)	3 (0.6)	3 (100.0)	0 (0.0)	48 (10.0)	432 (90)
Tera	4.5 (0.11)	21 (4.5)	20 (100.0)	0 (0.0)	62 (13.3)	403 (86.6)
Tessaoua	6.0 (0.23)	102 (25.1)	94 (92.1)	23 (5.7)	323 (79.7)	59 (14.5)
Tillabery	4.3 (0.10)	133 (29.3)	130 (100.0)	23 (5.2)	266 (59.7)	156 (35.0)

[a] Confidence intervals not estimated where point estimate is zero.

Table 3. Clinical signs of trachoma, by district, in Nigerien households surveyed during 2009–2011

District	In children aged 1–9 years						In adults aged ≥15 years		In all ages	
	TF		TI		Unclean face		TT		Participation in MDA reported	
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI
Abalak	10 (1.5)	(0.2–2.9)	5 (0.8)	(0.0–1.8)	312 (48.6)	(40.5–56.8)	0 (0.0)	[a]	871 (52.3)	(35.0–69.6)
Boboye	25 (4.6)	(2.3–6.9)	6 (1.1)	(0.3–1.9)	223 (41.4)	(34.4–48.4)	0 (0.0)	[a]	1250 (84.4)	(78.8–90.0)
Bouza	86 (10.2)	(5.5–14.9)	8 (1.0)	(0.0–1.9)	315 (38.0)	(32.6–43.4)	3 (0.4)	(0.0–0.9)	1544 (84.8)	(77.0–92.7)
Dakoro	78 (8.3)	(5.6–10.9)	9 (1.0)	(0.3–1.6)	631 (68.3)	(63.3–73.4)	5 (0.6)	(0.0–1.2)	1755 (83.9)	(79.8–88.0)
Dosso	19 (2.5)	(1.0–4.0)	3 (0.4)	(0.0–0.8)	156 (20.4)	(15.3–25.4)	8 (1.0)	(0.3–1.6)	1402 (79.8)	(66.7–92.9)
Doutchi	118 (16.3)	(9.18–23.4)	14 (1.9)	(0.4–3.5)	321 (44.3)	(38.1–50.6)	0 (0.0)	[a]	1500 (82.7)	(72.2–93.2)
Filingue	14 (1.7)	(0.6–2.9)	0 (0.0)	[a]	367 (45.6)	(40.9–50.3)	0 (0.0)	[a]	1779 (91.4)	(89.6–93.1)
Gaya	1 (0.1)	(0.0–0.4)	0 (0.0)	[a]	512 (63.1)	(57.7–68.4)	1 (0.1)	(0.0–0.4)	1680 (85.8)	(82.1–89.6)
Goure	120 (14.4)	(8.8–20.0)	21 (2.5)	(1.0–4.0)	428 (51.5)	(46.7–56.3)	22 (2.1)	(0.9–3.4)	1631 (73.9)	(64.0–83.9)
Guidan Roumji	94 (10.4)	(6.7–14.2)	12 (1.3)	(0.5–2.2)	593 (66.5)	(61.7–71.3)	10 (1.1)	(0.2–2.1)	1771 (88.7)	(85.6–91.7)
Illela	24 (3.7)	(0–8.0)	8 (1.2)	(0.0–3.8)	213 (32.8)	(23.1–42.4)	4 (0.5)	(0.0–1.1)	1539 (89.7)	(87.2–92.1)
Keita	113 (16.3)	(12.5–20.1)	4 (0.6)	(0.0–1.3)	349 (50.5)	(46.3–54.7)	1 (0.1)	(0.0–0.4)	1339 (81.9)	(78.4–85.4)
Kollo	13 (1.7)	(0.3–3.0)	0 (0.0)	[a]	312 (39.5)	(33.1–46.0)	0 (0.0)	[a]	1468 (74.7)	(65.1–84.2)
Konni	80 (12.6)	(7.8–17.5)	5 (0.8)	(0.1–1.5)	259 (41.1)	(34.5–47.6)	11 (1.4)	(0.5–2.3)	1391 (84.8)	(82.8–86.8)
Loga	29 (3.9)	(2.1–5.8)	2 (0.3)	(0–0.66)	194 (26.3)	(20.7–31.8)	1 (0.1)	(0.0–0.4)	7 (0.39)	(0.0–0.83)
Madaoua	269 (28.4)	(23.7–33.1)	54 (5.7)	(4.0–7.4)	582 (61.5)	(55.4–67.6)	10 (1.3)	(0.4–2.1)	1823 (90.0)	(87.7–92.3)
Madarounfa	128 (14.7)	(10.9–18.5)	10 (1.2)	(0.5–1.8)	625 (73.5)	(68.4–78.6)	38 (4.2)	(2.5–5.9)	1798 (86.6)	(85.0–88.2)
Magaria	314 (42.4)	(33.1–51.7)	70 (9.5)	(4.3–14.6)	459 (69.2)	(61.2–77.2)	38 (4.8)	(2.4–7.2)	900 (50.0)	(38.4–61.6)
Maine	242 (31.0)	(23.0–39.1)	72 (9.2)	(5.0–13.4)	345 (44.2)	(34.2–54.2)	5 (0.6)	(0.0–1.3)	1301 (71.5)	(56.7–86.3)
Maradi Commune	277 (27.9)	(19.9–35.9)	44 (4.4)	(2.6–6.23)	441 (44.4)	(37.0–51.7)	32 (3.3)	(2.2–4.3)	1949 (84.8)	(76.8–92.8)
Matameye	292 (40.2)	(31.3–49.2)	41 (5.7)	(2.3–9.0)	524 (72.2)	(62.6–81.9)	39 (5.4)	(3.0–7.8)	1133 (66.2)	(63.1–69.4)
Mayahi	83 (10.4)	(6.3–14.4)	22 (2.8)	(1.4–4.1)	593 (75.0)	(70.5–79.5)	5 (0.6)	(0.1–1.2)	1512 (82.5)	(79.3–85.6)
N'guigmi	121 (19.1)	(14.4–23.7)	17 (2.7)	(0.9–4.5)	220 (34.8)	(26.9–42.6)	5 (0.6)	(0.1–1.2)	1181 (74.1)	(63.8–84.4)
Ouallam	27 (3.5)	(1.4–5.5)	2 (0.3)	(0.0–0.6)	489 (62.9)	(57.5–68.2)	1 (0.1)	(0.0–0.3)	1851 (94.1)	(93.0–95.2)
Say	8 (0.9)	(0.0–2.1)	4 (0.5)	(0.0–1.2)	402 (46.7)	(39.4–54.1)	0 (0.0)	[a]	1796 (87.8)	(82.5–93.1)
Tahoua	108 (12.0)	(8.4–15.7)	1 (0.1)	(0.0–0.3)	525 (58.5)	(52.6–64.5)	1 (0.1)	(0.0–0.4)	1668 (85.1)	(81.6–88.5)
Tanout	24 (3.4)	(1.8–5.1)	1 (0.1)	(0.0–0.4)	450 (64.6)	(60.1–69.1)	4 (0.5)	(0.0–1.3)	753 (43.9)	(22.4–65.4)
Tchinta	2 (0.2)	(0.0–0.5)	0 (0.0)	[a]	355 (38.9)	(33.9–43.9)	1 (0.1)	(0.0–0.3)	987 (41.8)	(19.0–64.6)
Tera	3 (0.5)	(0.0–1.0)	0 (0.0)	[a]	320 (48.4)	(42.1–54.6)	0 (0.0)	[a]	1408 (86.1)	(77.1–95.0)
Tessaoua	262 (33.4)	(21.0–45.8)	65 (8.3)	(4.3–12.2)	381 (48.4)	(42.0–54.7)	8 (1.1)	(0.0–2.2)	1406 (79.6)	(69.5–89.7)
Tillabery	41 (6.1)	(1.6–10.50)	9 (1.3)	(0.0–3.1)	402 (60.1)	(53.5–66.7)	0 (0.0)	[a]	1541 (92.9)	(89.4–96.4)

MDA: mass drug administration; TF: trachomatous follicular; TI: trachomatous follicular-intense; TT: trachomatous trichiasis.
[a] Confidence intervals not estimated where point estimate is zero.

located inside the household was reported among 839 households (4.2%, 95% CI: 2.8–5.6). An additional 8333 households (63.3%, 95% CI: 60.6–66.1) reported access to a water source within the boundaries of their community and 4937 households (32.5%, 95% CI: 29.3–35.7) reported traveling beyond their community to collect water. Table 2 presents the results of household characteristics by district.

We present the results of the clinical examination by district in Table 3. A total of 16 districts were found to have a prevalence of TF among children 1–9 years of age (point estimate) >10%. The prevalence of TF among children ranged from 0.1% (Gaya) to 42.4% (Magaria). Two districts were estimated to have a prevalence point estimate of TF between 5% and 9% and 13 districts had a TF prevalence point estimate of <5%. Countrywide, clean face was observed in 12 298 children out of 23 880 examined (46.6%, 95% CI: 39.3–40.9) aged 1–9 years of age (clean face data were missing for 220 children). The proportion of those children with unclean face varied from 20.4% (Dosso) to 75.0% (Mayahi). The point estimate of TT prevalence in adults aged 15 years and above exceeded 1% in nine districts. Among districts where cases of TT were identified, the prevalence among adults ranged from 0.1% (several districts) to 5.4% (Matameye). Across all districts where mass administration of antibiotics for trachoma control was implemented, 49 934 individuals out of 57 682 surveyed reported participating during the previous year (78.7%, 95% CI: 77.5–81.6).

Discussion

The results of this survey demonstrate the need for continued implementation of the full SAFE strategy in 16 out of 31 surveyed districts, primarily concentrated in eastern Niger. In the remaining districts, SAFE implementation is warranted at the sub-district level, but the overall prevalence estimates do not suggest that district-wide, multi-year implementation of the full SAFE strategy is indicated. However, future surveys are needed to estimate sub-district prevalence of trachoma and thus identify communities still eligible for SAFE interventions.

Our results show that trichiasis continues to be a problem in nine districts of eastern Niger: Goure, Guidan Roumdji, Konni, Madaoua, Madarounfa, Magaria, Maradi Commune, Matameye and Tessaoua. Continued implementation of the 'S' component of SAFE through active trichiasis case identification and provision of free TT surgery is warranted in these districts to reduce the backlog of untreated trichiasis. Compared to the 1998–99 surveys, 15 districts no longer require full SAFE implementation; however sub-district level intervention may be warranted. A total of 16 districts still require district-wide SAFE intervention, although only nine merit district-wide trichiasis surgical outreach.

Limitations

While these surveys demonstrate a significant achievement in the mapping of trachoma prevalence in Niger, we recognize a few limitations. Overall, response rates among surveyed households exceeded 80% in most districts; however, the lowest participation was observed in Madarounfa (66.8%) and Konni (66.5%). Among children 1–9 years of age, participation was 89% overall, and the lowest district-specific response rate was 72%. District-level non-response among adults 15 years and older ranged from 64.7% in Boboye to 86.8% in Tchinta. The lower response rate among adults may have biased the TT prevalence estimates upwards, as adults without visual impairment are more likely to be absent during the time of survey. Recall bias may also affect our estimates of the proportion of respondents who participated in mass administration of antibiotics for trachoma control. However, respondents were shown examples of the antibiotics administered to aid recall. Although the ophthalmic nurses were required to demonstrate at least 80% reliability in training, it is also possible that misclassification of trachoma signs occurred during the surveys, although it would likely result in over-diagnosis of TF and TT, resulting in more conservative estimates of trachoma prevalence.

Conclusions

The data from these surveys suggest that although trachoma is still of public health importance in Niger, several districts no longer require district-wide SAFE intervention. The completion of these surveys has established district-level estimates necessary for program planning in accordance with the guidelines of the Alliance for GET 2020 and WHO. These results provide the evidence base to target the SAFE strategy at district or sub-district level, a critical step in the establishment of program targets to eliminate blinding trachoma by the year 2015.

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