**Survey of active trachoma, trichiasis and visual acuity in the Casamance region of Senegal**

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**ABSTRACT:**

***Introduction:***

***Methods:***

***Results:***

***Discussion/Conclusion:***

**INTRODUCTION:**

The last national survey of trachoma in Senegal showed that 10.8% of children aged less than 10 years had active trachoma, 2.6% of women aged over 14 years had trichiasis, and 1.4% of women aged more than 14 years had corneal opacity ([Saal et al., 2003](#_ENREF_8)).

The World Health Organization (WHO) recommends the SAFE strategy for trachoma control: **S**urgery for trichiasis, **A**ntibiotics to treat active disease, **F**ace washing and **E**nvironmental improvement. The WHO recommends that any trichiasis case should be operated, but that surgery should be prioritised in communities where the prevalence is >0.1%. Districts and communities with a follicular trachoma (TF) prevalence of ≥10% in 1-9 year-olds should receive mass antibiotic treat annually for 3 years, before re-assessing the prevalence to determine whether treatment can be discontinued (when TF prevalence in 1-9 year-olds falls <5%). Facial cleanliness and environmental improvement should be implemented in communities with a TF prevalence in 1-9 year-olds >5% ([WHO, 2006](#_ENREF_12)).

The Casamance region of Senegal, which is located south of The Gambia (Figure 1), was not included in the national trachoma survey, and the SAFE strategy interventions have not been specifically implemented there. It has been suggested that re-emergence of trachoma in The Gambia may be due to re-infection from Senegal ([Burton et al., 2005](#_ENREF_1), [Harding-Esch et al., 2008](#_ENREF_6)). A prevalence survey in the Casamance region was needed so that the Senegalese National Eye Care Programme (NECP) could plan its trachoma control activities (number of trichiasis operations, requirements for mass antibiotic treatment, and whether hygiene and sanitation interventions are needed). Similarly, in order to determine whether interventions to improve the population’s visual acuity (VA), and potentially avoidable causes of blindness, are required, an assessment of VA in the Casamance region was also deemed important.

The aims of the study were to: i.) train selected community members, village health workers and community nurses from the Casamance region to diagnose trachoma and to measure VA; and ii.) to conduct a population-based trachoma prevalence survey. Fieldwork took place between January and May 2010.

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| **Figure 1**. Map of Senegal, with the Casamance region in purple, and the Bignona Department included in the survey highlighted in red |
| Casamance regions + districts 160112.TIF |

**METHODS:**

***Ethical approval:***

Ethical approval was obtained from the Comité d’éthique du CNRS (National Centre for Scientific Research), Dakar, Senegal.

***Sample size calculation:***

A census of all villages in the Bignona Department of Casamance (comprising the districts of Diouloulou, Sindian, Tendouck and Tenghori; Figure 1) was made, totalling a population of 232 427. Based on the assumption that a third of the population was aged 1-9 years, it was estimated that there were 7748 children in the region. The sample size calculation recommended by the WHO for trachoma programme managers was used ([WHO, 2006](#_ENREF_12)). We estimated that the active trachoma prevalence would be 20% based on the national surveys of Senegal and Guinea-Bissau ([Saal et al., 2003](#_ENREF_8), [ITI, 2012](#_ENREF_7)), and used an estimate precision of ± 20%, an alpha risk of 5%, and a design effect of 4. These criteria led to a sample size of 2732 children aged 1-9 years. We set the cluster size to 50 children, thereby requiring 55 villages.

***Community selection:***

We randomly selected 60 communities using probability of selection proportional to size, employing a sampling interval of 3784 inhabitants and a random starting point of 2716. We over-sampled villages in the rural communities of Sindian and Iles Karone, where a higher trachoma prevalence was expected, by halving the sampling interval. We restricted selection in the urban zones of Bignona, Tenghori Transgambienne 1 and 2, and Thionck-Essyl, by doubling the sampling interval.

***Household selection:***

Household head lists were made for the selected communities. If the community population exceeded 1000, it was divided in two, and the half to be included in the survey was randomly selected.

A random selection of 10 households was made for each community, and three reserve households were also identified in case any of the selected households could or would not participate.

***Training:***

A total of 45 community members, village health workers and community nurses from the Casamance region, were selected by the Bignona cataract surgeon to be trained. Training took place between 7th-11th December 2009 and encompassed trachoma grading based on the WHO simplified grading system ([Thylefors et al., 1987](#_ENREF_10)) (practised every day using projected photographs), visual acuity measurement using Snellen E-charts, survey methods, field practice, and form filling. On the final day, the trainees were formally tested for trachoma grading and form filling skill. Only those achieving a trachoma grading kappa score of ≥0.6 were certified to perform trachoma grading for the survey.

***Survey:***

Of the 45 trainees, 40 were involved in the survey. They formed four teams of ten trainees, five of whom did trachoma grading and 5 of whom filled in the forms. The teams enumerated all household members who had slept in the household the night before (the *de facto* population) for the randomly selected households in the randomly selected villages.

All censused household members had their eyes examined for trachoma clinical signs according to the WHO simplified grading system ([Thylefors et al., 1987](#_ENREF_10)): trachomatous inflammation, follicular (TF), trachomatous inflammation, intense (TI), trachomatous scarring (TS), trachomatous trichiasis (TT) and corneal opacity (CO). Facial cleanliness, nasal and ocular discharge, and flies on the face at the time of examination were recorded. Individuals aged ≥50 years had their VA measured using Snellen E-charts.

***Statistical analyses:***

Data were double entered by different data entry clerks into a Microsoft Access database (v. 2007). Data cleaning and analyses were conducted in Stata (v12, STATA Corp., College Station, TX, USA). Discrepancies between the databases were resolved by a third individual by referring to the paper forms.

The prevalence of TF was calculated for children aged 1-9 years and the prevalence of TT for individuals aged ≥15 years, in accordance with WHO guidelines ([WHO, 2006](#_ENREF_12)). For visual acuity, the WHO classification ([WHO, 2010](#_ENREF_13)) was employed, whereby an individual’s best eye distance VA is taken. An individual is said to be blind if their VA is <3/60 to no perception of light (NPL); have low vision if VA is <6/18 to ≥3/60; and have normal vision if VA is 6/6 to ≥6/18.

Prevalence was calculated at the community and commune levels. Communes are the next administrative level after districts, and there are 19 communes in the Bignona region. Each commune includes approximately 18 villages and 13000 inhabitants.

The spatial distribution of TF, TT and VA was presented using ArcMap v9.2 (Environmental Systems Research Institute, Inc. Redlands, CA, USA).

**RESULTS:**

***Overview of study participants:***

Of the 60 randomly selected communities, all consented to participate. Ten randomly selected households per community were included, except in one community where only nine households were approached. A total of 5639 individuals were censused and 5005 (88.8%) were examined. Individual participation in the study was high at ≥88% in all age categories (Table 1). Of those censused, 2758 (48.9%) were male. Of the total examined, 2398 (47.9%) were male.

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| **Table 1. Participation rates** | | | | | | |
| **Age (years)** | **Number eligiblea** | **Number (%) examinedb** | **Number (%) not examined** | | | |
| Absent | Refused | Other reason | No reason |
| <1 |  |  |  |  |  |  |
| 1-9 | 1559 | 1432 (91.9)c | 117 (7.5) | 4 (0.3) | 1 (0.1) | 5 (0.3) |
| 10-14 |  |  |  |  |  |  |
| 15-49 | 2345 | 2063 (88.0)d | 270 (11.5) | 7 (0.3) | 3 (0.1) | 2 (0.1) |
| ≥50 | 778 | 687 (88.3)e | 87 (11.2) | 1 (0.1) | 3 (0.4) | 0 (0) |
| **Total** | **4682** | **4182 (89.3)** | **474 (10.1)** | **12 (0.3)** | **7 (0.1)** | **7 (0.1)** |

a Age missing for 48 individuals; 128 children aged 0 years and 781 individuals aged 10-14 years were not in the eligible age range for TF, trichiasis or visual acuity examination

b 120 children aged 0 years and 703 individuals aged 10-14 years had their eyes examined for trachoma clinical signs

c Could not evert eyelid in seven children aged 1-9 years examined

d Trichiasis status not recorded for three individuals aged 15-49 examined and three individuals aged ≥50 years examined

e Visual acuity data not recorded for 116 individuals aged ≥50 years examined

***Prevalence of clinical signs:***

*TF in 1-9 year-olds:*

TF was found in 38 (2.7%, 95% Confidence Interval (CI) 1.9-3.6) children aged 1-9 years (Table 2). None of the 19 communes had a prevalence ≥10%, and only two (Tenghori Transgambiene and Oulampane) had a prevalence ≥5%. Of the 60 communities, only two (Tenghory and Silinkine) had a prevalence ≥10%, and 11 had a prevalence 5≥10%. Thirty-four communities had a prevalence of 0% (Figure 1).

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| **Figure 1. Community spatial distribution of TF in 1-9 year-olds** |
| TF prev map 130112.tif |

*Trichiasis in ≥15 year-olds:*

A total of 40 trichiasis cases were found (1.5%, 95% CI 1.0-2.0) in individuals ages ≥15 years. Three communes had a prevalence of 0%, three a prevalence between 0.1% and 1%, and the remaining 13 had a prevalence ≥1% (range 1.1-5.0%) (Table 2). At the community level, 28 of the 60 communities had a TT prevalence of 0% and the remaining 32 had a prevalence ≥1% (range 1.3-15.0%) (Figure 2).

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| **Figure 2. Community spatial distribution of trichiasis in ≥15 year-olds** |
| TT prev map 130112.tif |

*Visual acuity in ≥50 year-olds:*

The prevalence of blindness was 5.1% (95% CI 3.4-7.2) in ≥50 year-olds; 25.9% (95% CI 22.4-29.7) had low vision, and 69.0% (95% CI 65.0-72.8) had normal vision (Table 2). At the commune level, normal vision ranged between 52.7% and 88.2% of ≥50 year-olds. At the community level, prevalence of blindness and low vision ranged between 0% and 80% (Figure 3).

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| **Figure 3. Community spatial distribution in ≥50 year-olds of:**   1. **% Blind** 2. **% with Low Vision** 3. **% Blind and Low Vision** |
| **A.**  **% Blind map 130112.tif** |
| **B.**  **% Low vision prev map 130112.tif** |
| **C.**  **% Blind or low vision map 130112.tif** |

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| **Table 2. Commune prevalence of TF, trichiasis and visual acuity** | | | | | | | | | | | | | | |
|  |  | **TF** | | | **TT** | | | **Visual acuity** | | | | | | |
| **Commune** | **No. villages in commune** | **No. 1-9 year-olds examined** | **No. with TF** | **%** | **No. ≥15 year-olds examined** | **No. with TT** | **%** | **No. ≥50 year-olds examined** | **No. Blinda** | **%** | **No. with low visionb** | **%** | **No. with normal VAc** | **%** |
| Suelle | 3 | 63 | 1 | 1.6 | 123 | 4 | 3.3 | 27 | 3 | 11.1 | 5 | 18.5 | 19 | 70.4 |
| Djibidione | 2 | 46 | 1 | 2.2 | 64 | 0 | 0.0 | 15 | 0 | 0.0 | 4 | 26.7 | 11 | 73.3 |
| Sindian | 6 | 136 | 4 | 2.9 | 297 | 4 | 1.3 | 55 | 9 | 16.4 | 17 | 30.9 | 29 | 52.7 |
| Bignona | 5 | 100 | 2 | 2.0 | 265 | 2 | 0.8 | 42 | 3 | 7.1 | 7 | 16.7 | 32 | 76.2 |
| Tenghori | 3 | 61 | 1 | 1.6 | 98 | 2 | 2.0 | 34 | 0 | 0.0 | 13 | 38.2 | 21 | 61.8 |
| Tenghori Transgambienne | 2 | 39 | 2 | 5.1 | 83 | 0 | 0.0 | 17 | 0 | 0.0 | 2 | 11.8 | 15 | 88.2 |
| Ouonck | 3 | 78 | 0 | 0.0 | 137 | 3 | 2.2 | 29 | 1 | 3.4 | 11 | 37.9 | 17 | 58.6 |
| Coubalan | 3 | 7 | 0 | 0.0 | 159 | 2 | 1.3 | 33 | 2 | 6.1 | 8 | 24.2 | 23 | 69.7 |
| Niamone | 2 | 41 | 1 | 2.4 | 70 | 1 | 1.4 | 22 | 2 | 9.1 | 7 | 31.8 | 13 | 59.1 |
| Thionck-Essyl | 2 | 39 | 1 | 2.6 | 94 | 0 | 0.0 | 15 | 0 | 0.0 | 2 | 13.3 | 13 | 86.7 |
| Mangagoulack | 2 | 30 | 0 | 0.0 | 79 | 1 | 1.3 | 17 | 0 | 0.0 | 3 | 17.6 | 14 | 82.4 |
| Balinghor | 1 | 26 | 1 | 3.8 | 55 | 1 | 1.8 | 11 | 0 | 0.0 | 4 | 36.4 | 7 | 63.6 |
| Karthiackk | 2 | 32 | 1 | 3.1 | 79 | 2 | 2.5 | 19 | 0 | 0.0 | 5 | 26.3 | 14 | 73.7 |
| Diegoune | 2 | 50 | 0 | 0.0 | 101 | 3 | 3.0 | 27 | 0 | 0.0 | 9 | 33.3 | 18 | 66.7 |
| Djinaky | 4 | 97 | 3 | 3.1 | 190 | 2 | 1.1 | 42 | 1 | 2.4 | 11 | 26.2 | 30 | 71.4 |
| Kafountine | 4 | 106 | 4 | 3.8 | 183 | 1 | 0.5 | 35 | 0 | 0.0 | 7 | 20.0 | 28 | 80.0 |
| Iles Karone | 3 | 47 | 2 | 4.3 | 80 | 4 | 5.0 | 23 | 3 | 13.0 | 5 | 21.7 | 15 | 65.2 |
| Diouloulou | 6 | 217 | 6 | 2.8 | 306 | 2 | 0.7 | 55 | 1 | 1.8 | 10 | 18.2 | 44 | 80.0 |
| Oulampane | 5 | 147 | 8 | 5.4 | 281 | 6 | 2.1 | 53 | 4 | 7.5 | 18 | 34.0 | 31 | 58.5 |
| **Total** | **60** | **1425** | **38** | **2.7** | **2744** | **40** | **1.5** | **571** | **29** | **5.1** | **148** | **25.9** | **394** | **69.0** |

a Blind = <3/60 to no conscious light perception (NPL)

b Low vision = <6/18 to ≥3/60

c Normal = 6/6 to ≥6/18

**DISCUSSION:**

This survey of the Bignona Department in the Casamance Region of Senegal shows that active trachoma is no longer a public health problem in this area according to WHO recommendations ([WHO, 2006](#_ENREF_12)). The region-level prevalence of TF in 1-9 year-olds was <10%, and therefore community-level assessments are used to make control intervention decisions. Of the 60 communities visited, two had a TF prevalence ≥10%, indicating they should receive annual mass treatment for three years as well as facial cleanliness and environmental improvement interventions. The 11 villages with 5≥10% TF are recommended to receive facial cleanliness and environmental improvement interventions for 3 years before re-assessing, and in the remaining 47 villages, trachoma control is not a priority.

These low prevalence rates of active trachoma in Casamance were unexpected as no specific trachoma control efforts have been implemented in this area. Casamance is bordered by The Gambia to the north and although active trachoma prevalence in The Gambia is low ([Harding-Esch et al., 2009](#_ENREF_5), [Harding-Esch et al., 2010](#_ENREF_4)), there have been instances of re-emergence of ocular *C. trachomatis* infection and Senegal was thought to be the source (Burton et al., 2005, Harding-Esch et al., 2008, Harding-Esch et al., In press). Furthermore, Casamance is bordered by Guinea-Bissau to the south where active trachoma is estimated to be approximately 20% in children aged 1-9 years ([ITI, 2012](#_ENREF_7)), which in itself was expected to be a source of infection for Casamance.

A dry and dusty environment is the classic setting in which trachoma is found ([Smith et al., 2011](#_ENREF_9)). The low active trachoma prevalence in Casamance may be a reflection of the higher rainfall it experiences compared with northern Senegal, as it lies in the Sudan climatic zone transition between the dry Sahel area to the north and the Guinean and equatorial climates to the south ([Fall et al., 2006](#_ENREF_3)). Trachoma is also associated with poverty, and Senegal fares slightly better than Guinea-Bissau with a Human Development Index rank of 155 compared with 176, out of 187 ([UNDP, 2011](#_ENREF_11)). The less conducive climate and lack of infection from The Gambia may explain the low active trachoma prevalences found in this study.

In contrast to the low active trachoma prevalence, prevalence of trichiasis was high and far exceeded the WHO public health problem cut-off of 1% ([WHO, 2006](#_ENREF_12)). The WHO recommends that all trichiasis cases should be operated on, and should be prioritised where the prevalence ≥0.1%. Of the 60 villages in our study, surgery should be prioritised in 32 of them.

The high prevalence of trichiasis despite the low active trachoma prevalence and lack of trachoma-specific control measures indicates that the Casamance region may have experienced a general improvement in socio-economic conditions over the last few decades. This was documented in The Gambia, where a village’s active trachoma prevalence in 0-9 year-olds fell from 65.7% in 1959 to 2.4% in 1996 in the absence of trachoma-specific interventions but in association with improvements in sanitation, water supply, education and health care ([Dolin et al., 1997](#_ENREF_2)).

In terms of visual acuity, the prevalence of blindness in the region was high (5% blind and 26% low vision), with one-third of ≥50 year-olds blind in one village. These levels are high when compared with other rapid assessments of avoidable blindness and visual impairment: 3.3% in Malawi (Kalua et al.), 2.9% in Bangladesh (Wadud et al., 2006), and 1.3-4.0% in Latin America (Limburg et al., 2008). A better understanding of the causes of the high prevalence of blindness and low visual acuity in the region is needed. This could be achieved by employing the Rapid Assessment of Avoidable Blindness (RAAB) methodology, reassessing visual acuity in all ≥50 year-olds in the randomly selected households in the 60 villages. Recommendations could then be made to the Senegalese NECP regarding interventions to be introduced.

**Conclusion:**

The prevalence of TF in the region was low, indicating that trachoma control for TF is not a priority in this setting. However, the prevalence of trichiasis exceeded the WHO criteria of trachoma as a public health problem (1/1000 total population), with surgery needing to be prioritised in half the surveyed villages. Levels of blindness and low vision were high, and a RAAB survey to determine the causes for this is warranted.

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