

Towards elimination of blinding trachoma in Burkina Faso, West Africa.

The results of three consecutive years of mass antibiotic treatment and health education.



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ABSTRACT

Introduction. Trachoma is the main infectious cause of blindness in the world, and is caused by repeated *Chlamydia trachomatis* infections of the inner eyelid from early childhood.

Materials and methods. Following three rounds of mass drug administration (MDA) with azithromycin and implementation of the World Health Organization (WHO)'s SAFE strategy, 11 districts in Burkina Faso were evaluated between 2010 and 2012. Probability sampling proportional to size was used to identify villages and households to be included in the survey. Children aged 1 to 9 years were examined for signs of active trachoma and individuals older than 15 years were examined for signs of the long-term complication trichiasis.

Results. In total, 11 districts were surveyed, including 12,501 children and 11,365 individuals older than 15 years of age. The prevalence of trachoma in children was reduced from 21% to below 10% in all districts, with some local pockets of infection exceeding 10%. The prevalence of trichiasis in individuals older than 15 years varied from 0.0 to 0,6%. Access to an improved water source and availability to latrines was limited in all surveyed districts.

Conclusions. Three consecutive years of MDAs of antibiotics has successfully reduced the overall prevalence of trachoma in these 11 districts in Burkina Faso. The prevalence of active trachoma is currently below the WHO recommended threshold for MDA of 10% in all districts; however, further interventions at a sub-district level are needed. Improved surgical treatment, access to clean water and improvements in sanitation must be prioritised in these resource-limited areas in order to ensure sustainable results in the control of trachoma.

INTRODUCTION

Trachoma is the leading infectious cause of blindness in the world (1). The infection is caused by the intracellular bacteria *Chlamydia trachomatis*, and as opposed to genital trachomatous infection caused by serotypes D to K, ocular infection is caused by *C. trachomatis* serotypes A to C (2). Trachoma affects people living in poor settings, and the infection is oftentimes acquired already in early childhood through repeated infections of the inner conjunctival surface of the eyelid (active trachoma) (2). Conjunctival scarring, which is believed to be caused by an immunological response to the bacterial infection, develops progressively over several years (3). If left untreated, the scarring typically results in the eyelid inverting (entropion), which in turn causes painful damage to the corneal surface of the eye due to scraping of the surface by the eyelashes, called trichiasis. This ultimately leads to blindness through opacification of the cornea, occurring typically at the age of 30 to 40 years (2).

Disease transmission

Ocular *C. trachomatis* is transmitted between individuals through direct or indirect spread of infected nasal or ocular secretions on skin or cloth (fomites) or by eye-seeking flies (4-6). Young children constitute the primary reservoir for other children and caretaking adults, typically mothers. There are no known animal reservoirs of *C. trachomatis*. Studies have found that ocular and nasal discharge effectively act as a vehicle for transmission of *C. trachomatis*, especially in families living in crowded conditions without access to clean water or latrines (7-9). Regular washing of children's faces has been shown to reduce transmission rates, and therefore access to clean water, as well as improved sanitation and health education are paramount to control of infection (8, 10).

Epidemiology

The World Health Organization (WHO) estimates that trachoma is endemic¹ in 53 countries in the world, and Africa is the most affected region (13). Trachoma leads to debilitating pain and visual impairment in more than two million people worldwide, of whom nearly one in two suffer from blindness (13). Trachoma constitutes about 3% of the global burden of blindness, and therefore represents a serious public health problem (14, 15). In 1997, in order to address the high burden of blindness due to trachoma, WHO established “The Global Alliance for the Elimination of Blinding Trachoma” (GET2020). GET2020 aims to eliminate² trachoma worldwide by the year 2020, and is an alliance of Ministries of health in endemic countries, international and non-governmental organisations that work with WHO to ensure epidemiological surveys, mass treatment and health education of trachoma (17).

SAFE control strategy

A Cochrane review found that environmental sanitary and hygienic factors play an important role in the prevention of active trachoma (18). Factors such as the availability to clean water, use of latrines, regulation of animals within the household environment, personal and community hygiene (10), and population density (19) have all been shown to have an effect on the prevalence of trachoma.

The main approach to achieve elimination of trachoma is a multi-faceted WHO recommended strategy named “SAFE” that aims to address the main aspects of the transmission cycle and consequences of trachoma: surgery of established trichiasis (S), administration of antibiotics against active infection (A), facial cleanliness (F) and environmental improvement including

¹ More than 10% of a population with active disease (11, 12).

² A reduction to less than 5% of follicular trachoma (TF) in children 1-9 years old and a reduction of trachomatous trichiasis (TT) to less than 0.1% of the total population (16).

access to clean water and improved sanitation (E) (20). The Water, Sanitation and Hygiene (WASH) programme initiated in 2006 by the United Nations Children's Fund (UNICEF) is an important complement to the F and E elements of the SAFE strategy, and consists of initiatives that aim to halve, by 2015, the proportion of people without sustainable access to clean water and basic sanitation, and to ensure that all schools have adequate child-friendly water and sanitation facilities, as well as a hygiene education programme (21).

Control of trachoma in Burkina Faso

The SAFE strategy has been implemented with success in a number of low and middle income countries. Burkina Faso, a landlocked country in West Africa, is endemic for trachoma (22). In 2007, following nationwide mapping that started in 2005, a mass drug administration (MDA) campaign was put in place in order to treat all inhabitants living in endemic districts with oral azithromycin and tetracycline pomade annually for three consecutive years.

Collaborative efforts by the Ministry of Water, Hydraulic Planning and Sanitation of Burkina and the IRC (a non-governmental organization (NGO) formerly known as International Reference Center for Community Water Supply), aim to explore new ways to improve sustainable access to clean water, hygiene and sanitation services (23). In Burkina, primary schools are a strategic entry point to promote healthy behaviour, and the American NGO, Helen Keller International, supports integrated school health programs that aim to prevent trachoma through improving hygiene practices and education (24).

Study objectives

This study aims to review the effects of three consecutive annual MDA campaigns with antibiotics and health education in the control of trachoma in 11 health districts in Burkina.

MATERIALS AND METHODS

Study site and population

Burkina Faso is a medium-sized country that borders to Mali, Niger, Benin, Ghana, Togo and Ivory Coast in West Africa. In 2012, the population of Burkina was approximately 16.5 million inhabitants. Burkina is one of the poorest countries in the world, ranking 181 out of 186 countries on the United Nations Development Programme (UNDP)'s Human Development Index (HDI), showing little improvement in recent years (25). There is widespread distrust to national institutions, complicating the implementation of health care strategies (26). Forty-five per cent of the population live below the poverty level of less than 1.25 US dollars per day (25).

The country's population is largely rural, with more than two thirds of the population depending on subsistence agriculture for their livelihoods (27). The country is prone to recurrent natural disasters, such as drought, floods and locust invasions, which have grown increasingly frequent and severe. Desertification is rapidly spreading and the impact of climate change is increasingly affecting the availability of water and pasture (27). High poverty levels, combined with the fact that Burkina is landlocked, make the country's population particularly vulnerable to economic shocks and high food prices (27).

In 2011, life expectancy at birth in Burkina was 54 years for men and 57 years for women; the average for sub-Saharan Africa was 55 and 58 years, respectively. Child mortality is high; 66 of 1,000 live born children die before their first birthday, and 102 of 1,000 children die before the age of 5 years. Access to health care is poor; there is less than one physician for every 10,000 inhabitant, whereas the average in sub-Saharan Africa is close to three physicians per 10,000 inhabitants. Also, there are only six nurses and midwives for every 10,000 inhabitants;

that is less than half of the sub-Saharan African average (25). The fertility rate in Burkina is 5.8 live births per woman, rating the country among the six countries with the highest fertility rates in the world (28).

Estimates indicate that 82% of the total population in Burkina have access³ to an improved water source⁴ (31). In urban areas, 97% have access to an improved water source, whereas in rural areas, where the prevalence of trachoma is the highest (19), 76% have access to an improved water source (31). Sanitation facilities in Burkina are poorly developed. Estimates suggest that 57% of the total population defecate in the open, whereas the remaining population has access to improved facilities (19%), shared facilities (17%) or other unimproved facilities⁵ (7%) (31). Large differences exist in sanitation between rural and urban populations. In urban areas, 50% of sanitary facilities are improved, 36% shared, 5% other unimproved, and 9% practise open defecation. In rural areas, 7% of facilities are improved, 10% shared facilities, 8% other unimproved facilities, and 75% practise open defecation (31).

Trachoma control strategy

WHO recommends that antibiotic treatment should be given to the entire population regardless of individual diagnosis in districts where the prevalence of active trachoma among 1 to 9 year old children is greater than 10% (16). Annual treatment should be given for three years, at which time the prevalence should be reassessed. Annual treatment should continue until the prevalence drops below 5% (32).

³ A source of water less than one kilometre from its place of use and that makes it possible to reliably collect at least 20 litres of water per member of a household per day (29).

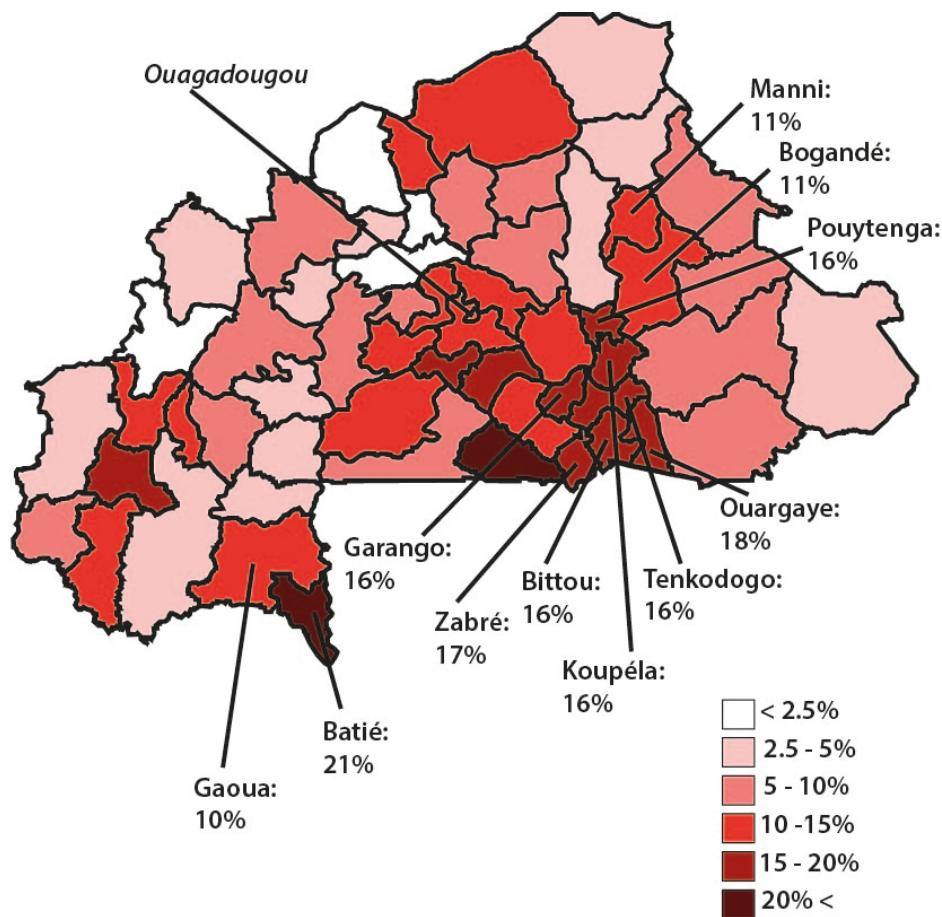
⁴ A water source that, by the nature of its construction, adequately protects the source from outside contamination, particularly faecal matter (30).

⁵ A sanitation facility that separates human excreta from human contact (30).

Pre-treatment mapping data

Between 2005 and 2010, the baseline prevalence⁶ of follicular trachoma (TF) and trichomatous trichiasis (TT) was mapped throughout all 63 health districts, and 30 districts were considered to be endemic according to the definition given by the Global Atlas of Trachoma (GAT)⁷. The prevalence of TF varied between 10% and 21% in endemic districts (Figure 1).

Figure 1. 2005-2010 baseline prevalence of follicular trachoma in health districts in Burkina Faso. Districts with a prevalence of >10% are considered endemic (GAT).

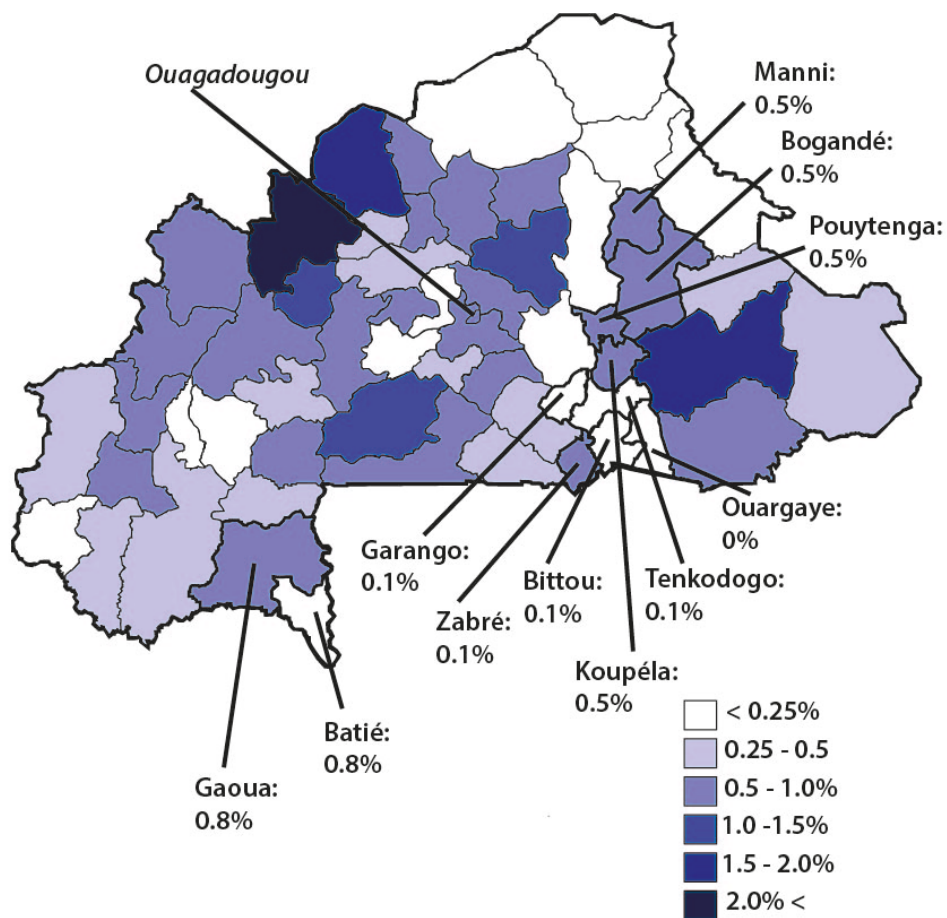


⁶ No data on age of participants was available

⁷ More than 10% of the population with active disease (12).

Furthermore, the 2005-2010 baseline mapping showed a prevalence of trichomatous trichiasis (TT) between 0.0 and 2.3% in endemic districts (Figure 2).

Figure 2. 2005-2010 baseline prevalence of trichomatous trichiasis in endemic districts in Burkina Faso.



Trachoma control in Burkina Faso

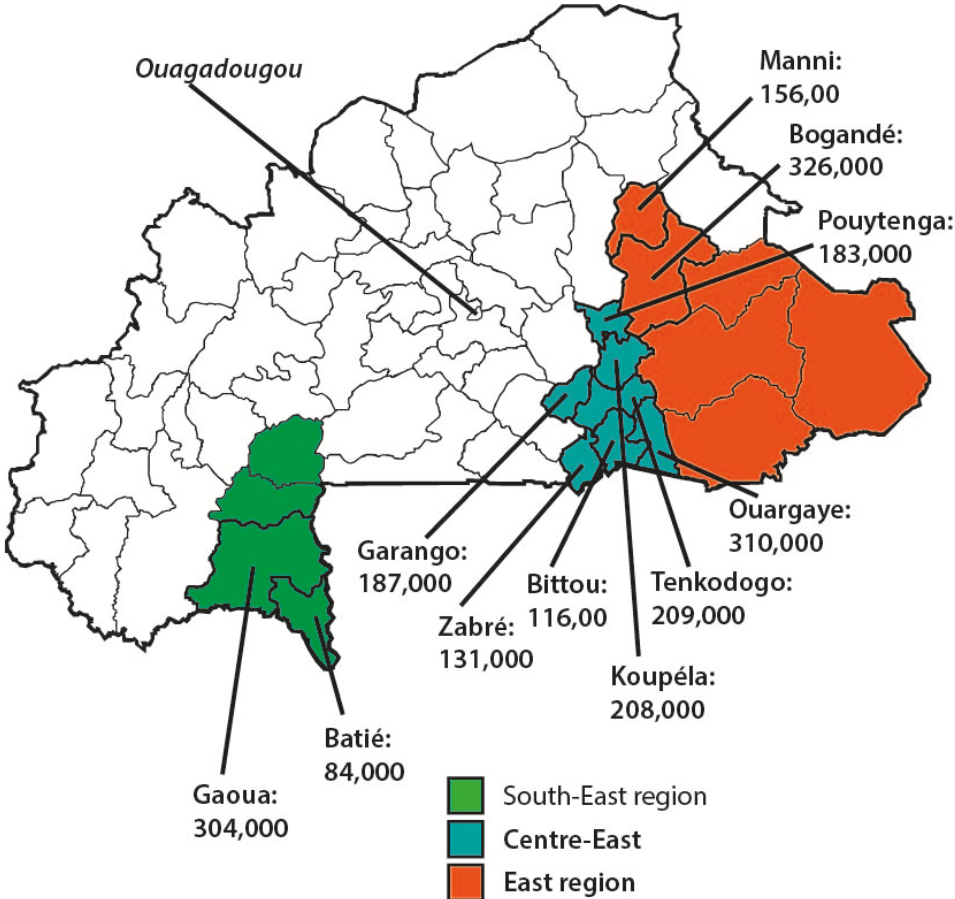
In 2007, the first MDA was rolled out in seven health districts of Burkina, reaching approximately one million individuals. Two years later, in 2009, treatment was introduced in a further 11 districts, thereby increasing the number of treated individuals to 3.3 million. In 2010, another four districts implemented MDA, and in 2011 the national MDA programme

ultimately included a total of 26 districts (33). Improved face-washing was included in health education activities and taught in primary schools (34).

Post-treatment evaluation

Between 2010 and 2012, following three rounds of MDA and other SAFE strategies, post-treatment evaluation was conducted in 11 health districts in Burkina. Figure 3 shows the location and population of the 11 health districts that are the study area of this paper.

Figure 3. Location and population of the districts and regions remapped in 2010-2012.



Study design and sampling methodology

In the 2010-2012 post-treatment impact evaluation, children aged 1 to 9 years and individuals aged 15 years and older were selected for examination (35, 36). The primary outcomes were active trachoma (TF) and trachomatous trichiasis (TT) in the two age groups, respectively.

Households were randomly selected following cluster sampling of villages within each health district. Twenty clusters per health district were selected using the probability proportional to size (PPS) sampling technique, in which the probability of selecting villages is proportional to their size (16). Villages with less than 150 or more than 4,000 inhabitants were excluded. No village or rural area was replaced once it had been randomly selected. Twenty-four households were then randomly selected within each village/cluster⁸. Sample size calculations estimated that at least 280 adults and 980 children were needed per health district in order to obtain adequate statistical power. An additional 10% was added in order to anticipate non-participation of subjects observed in other, similar surveys (35).

All members present in the selected households were examined. Children younger than 1 year old were excluded. Selected households were not replaced if residents were absent or declined examination. To minimize the number of missing residents in selected households, the survey teams revisited the household on the day of the survey (35).

Data collection

During six weeks of January and February 2014, the authors studied the methodology and in-country conditions for the 2010-2012 post-treatment evaluation survey in Burkina Faso.

Information and data were gathered through meetings with national Neglected Tropical

⁸ A household is defined as a man and his wife/wives plus all dependents, or as a widow and her dependents, or as a big brother/sister and their dependents in case they are orphans. (35)

Diseases (NTD) staff within the Ministry of health, including the national NTD coordinator in Ouagadougou, studies of internal and official survey documents and reports, and meetings with laboratory staff that had contributed to the survey. Survey results and study challenges were discussed and analysed throughout these meetings.

A household questionnaire was used to gather information on the number of people in each household, access to latrines and, if a latrine was present, whether it was in use. Residents were asked about access to an improved water source and the distance to the source. Name, sex and age of all residents were noted and children's education level was assessed (formal school/other school/no school). Absent members of the household were noted as "absent" and those who refused to participate were registered as "present, but refused".

A pair of binocular magnifiers at 2.5 times magnification and a flashlight were used for clinical examination (36). The presence of nasal or ocular discharge and clinical signs of trachoma were noted (36). The WHO grading system was used to assess the presence or absence of follicular trachoma (TF), intense trachoma (TI), trachomatous scarring (TS, trachomatous trichiasis (TT) and corneal opacity (CO) (16). In this study, the two relevant stages of trachoma, TF and TT, were registered. First, the eyelids were examined in order to identify any inverted eyelashes. This is done by pushing the upper eyelid slightly upwards, and thereby exposing the lid margin. One or more eyelashes found to be rubbing against the eye globe, and/or signs of removed eyelashes⁹ were considered as TT. Second, the upper eyelid was everted to inspect the tarsal plate for the presence of follicles (five or more follicles equals TF). Each eye was examined separately, and the clinical signs observed by the respective investigator were registered. If in doubt, signs were not considered.

⁹ Presence of broken or newly growing lashes, or areas of absent lashes (37).

Statistical analysis

The data were entered and analysed using Excel and Epi-Info Version 3.2 (36). Descriptive statistic results were presented, and no further comparative analyses were performed. The authors were not able to access the original dataset, and could therefore not perform further analyses of the results.

Ethical considerations

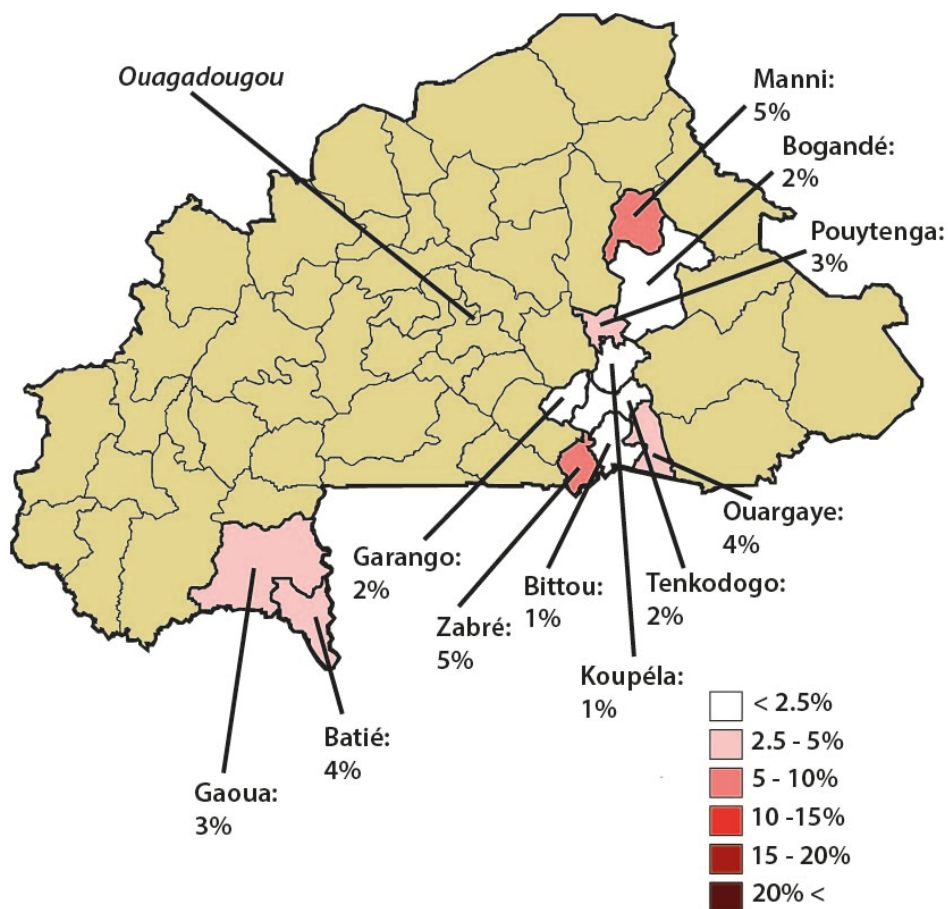
This study did not pose any harm or risk to the participants. Administrative and traditional authorities were informed about the study and its purposes prior to the survey in each village. Participants gave free and informed oral consent, and parents or other main caretakers provided consent on behalf of their children. Children with signs of active trachoma received local treatment with tetracycline ointment 1%, as indicated by national guidelines (16). Men and women with trichiasis were offered free surgery following the survey (35).

RESULTS

Prevalence of active trachoma

A total of 10,398 households in 11 districts were surveyed, and 12,501 children aged 1 to 9 years and 11,365 people aged 15 and older were examined for signs of trachoma; TF and TT, respectively (16). Figure 4 shows the prevalence of TF in children aged 1 to 9 years old in the health district included in this survey. Although the district level prevalence of TF in children remained between 1 and 5%, some villages were found to have a prevalence higher than 10%.

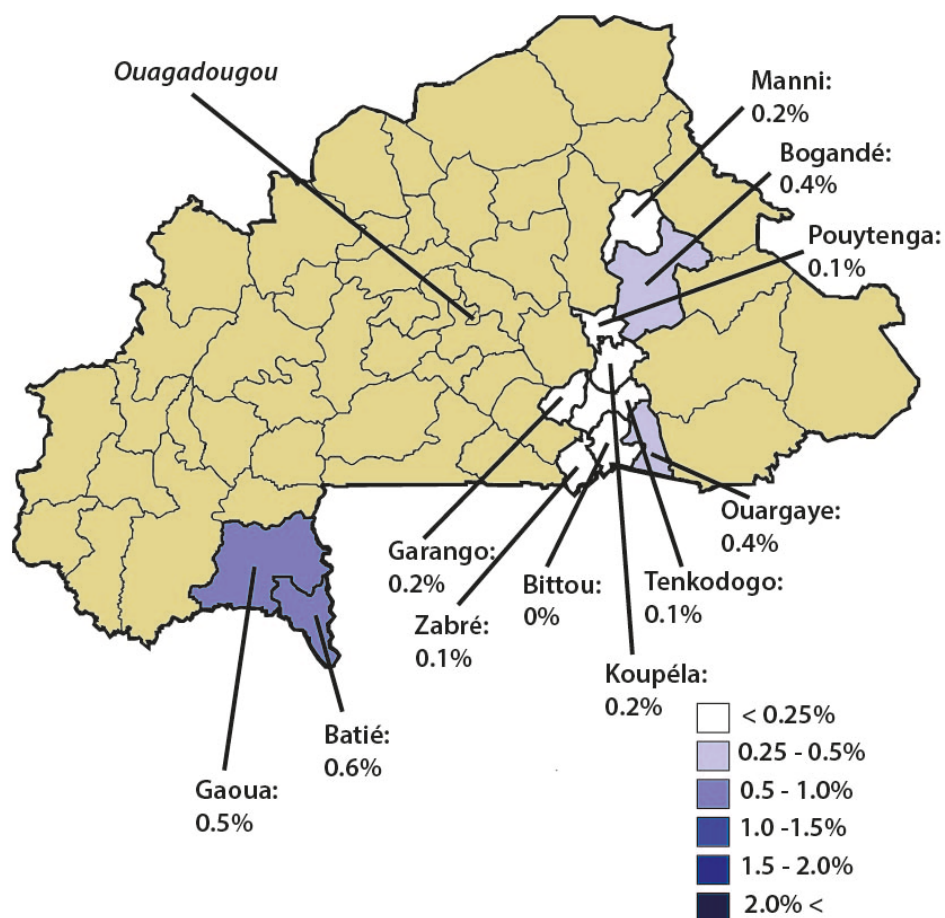
Figure 4. Prevalence of follicular trachoma (TF) in children 1 to 9 years old following three consecutive years of mass drug administration with azithromycin in Burkina Faso. The district level prevalence was below the 10% threshold for discontinuing mass drug administration on a district level (WHO 2006).



Prevalence of chronic trachomatous complications

The district level prevalence of trachomatous trichiasis in individuals aged 15 and older was below 1%. This equals more than 1 case per 1,000 individuals in the majority of districts, and only the district of Bittou had less than 1 case per 1,000 inhabitants. Figure 5 shows the levels of prevalence of TT of subjects older than 15 years in the health district included in this study.

Figure 5. The prevalence of trachomatous trichiasis (TT) in individuals 15 years and older following three consecutive years of mass drug administration with azithromycin in Burkina Faso. None of the 11 districts in this post-treatment survey had a prevalence higher than 1%, the limit for implementation of trachoma mass control activities (WHO 2006).



Sanitation and access to clean water

Less than 20% of all surveyed households had access to latrines. The district of Batié had the lowest access to latrines with fewer than 5% of households having access to an alternative to open defecation. Access to an improved water source varied from 78% to 98%.

DISCUSSION

Trachoma is a neglected tropical disease that causes debilitating pain and blindness in hundreds of thousands yearly, and is endemic in Burkina Faso with prevalences ranging from 10 to 21% in endemic districts (38). Following three consecutive years of MDA and health education, the prevalence of active trachoma in all 11 districts included in this 2010-2012 study was reduced to 5% or below. According to WHO guidelines, none of these districts are in need of district level control strategies of trachoma; however, continued interventions are recommended in nearly half of the villages in four districts with a prevalence equal to or greater than 5% (16). Unfortunately, no sub-district level data was available for the remaining seven districts; however, it is probable that sub-district interventions may be required.

The findings from the 2010-2012 post-treatment survey suggest that the prevalence of chronic complications of trachoma in adults, trachomatous trichiasis, has declined in eight districts. Although most districts had achieved a reduction in the prevalence of trachoma in children, only the district of Bittou achieved elimination, with zero identified cases of trachomatous trichiasis. In contrast, in the remaining three districts, the prevalence had increased.

Adequate sanitation and access to clean water are critical factors in the control of trachoma as a public health problem (8). In this survey, 78 to 98% of the population had access to an improved water source. The availability of household latrines was very limited, with more than 80% of people in any given district living without alternatives to open defecation. In Burkina, limited resources and low educational levels have led to underuse of latrines and environmental change; aspects related to the F and E components of the SAFE-strategy. In line with previous studies, the reduction in prevalence of trachoma following three

consecutive years of trachoma control in Burkina therefore seems to primarily be a result of antibiotic treatment (19, 39-43).

A study from Ghana showed a decrease of active trachoma from 16% to below 2% in children aged 1 to 9 years old following the distribution of oral azithromycin annually for three consecutive years (41). These results may have been strengthened through the implementation of several concomitant measures that were put in place in addition to the MDA. In a study from Niger, 31 districts considered to be endemic received MDA with azithromycin and tetracycline for infants and pregnant women for up to five consecutive years (42). In this study only 13 districts achieved a prevalence below 5%; however, the districts had a higher baseline prevalence than in Burkina, with more than 60% in some regions.

The SAFE strategy has been promoted as the ideal combination of strategies for the control of trachoma in endemic countries. Facial cleanliness and environmental improvement have shown some positive results; however, it is still a debate to which extent these measures may impact on the prevalence of trachoma (8, 45).

Until the late 1990s, the antibiotic treatment of choice was topical tetracycline (2). Studies have since shown that treatment with a single dose of oral azithromycin is equally effective and that this treatment has several advantages compared to topical ointment (40, 44). Firstly, a single oral dose leads to improved compliance, Secondly, the effect of the antibiotic treatment can be directly observed, and, thirdly, the single dose will also treat extra-ocular infection.

Surgery for trichiasis involves bilamellar rotation of the tarsal plate, thereby removing the possibility for the eyelashes to rub against the globe of the eye (46). This strategy aims to

reduce the number of individuals already infected and to avoid blindness as a consequence of corneal damage. However, surgery has no documented effect on the transmission of *C. Trachomatis*, and the recurrence of trichiasis is common (47). Surgery must therefore be combined with antibiotics in order to reduce the burden of ocular *C. trachomatis* infection at the individual and community level, thereby reducing the driving force for progressive trachomatous scarring and subsequent blindness.

This survey has several limitations. Firstly, information regarding the applied methodology is not readily accessible. The denominators used for each district may therefore not be validated. Moreover, neither details on the staff, training procedures nor supervision were given (16). Secondly, the level of reporting was variable, with a lack of data at village level. The baseline prevalence from the 2005 to 2010 surveys lacks information about factors such as age, gender ratio, number of participants and village inventory. Thirdly, despite being included in the questionnaire, data on the actual use versus presence of latrines, and actual access to improved water sources versus distance to nearest improved water source was not accessible. Finally, no relevant statistical analysis other than descriptive results was given, and association with WASH interventions was not assessed.

The mapping of trachoma in endemic countries is essential to optimal control and ultimately elimination of trachoma as a public health problem (50). Recent data indicate that 13 countries have completed national mapping of trachoma, 12 have partially completed mapping and 4 countries have not yet initiated mapping. Moreover, by the end of 2011, 36 countries reported the implementation of the SAFE strategy (49). Despite these successes, more emphasis on the use of MDA campaigns is needed in order to reduce the repeated infection cycles of trachoma that ultimately lead to corneal scarring and blindness (51).

Following the scale-up of advocacy efforts, mobilisation of resources and global commitment by WHO, pharmaceutical industry¹⁰, endemic countries and international and non-governmental organisations, the number of people exposed to trachoma has been reduced by nearly a third; from 315 million in 2011 to 230 million in 2013. In 2012, the Gambia, Ghana, Morocco, Myanmar, Oman and Vietnam reported that they had achieved the elimination targets for trachoma as a public health problem (49)¹¹.

In Burkina, the elimination of trachoma as a public health problem may be possible. WHO suggests that MDA may be replaced by routine diagnostics and treatment at an individual level when the prevalence of follicular trachoma in children aged 1 to 9 years old falls below 5% (16). In Burkina, the prevalence of active trachoma in children has been brought to the threshold value of 5% and below; however, only one district had reached a prevalence of TT below 0,1%. During three months in 2013 alone, 119 people underwent surgery for trichiasis of an estimated 200 people who were in need of it (34).

The government of Burkina has pledged to further improve access to clean water, and it is essential that health education accompanies these initiatives. Although face-washing is included in health education activities in primary schools, continued promotion of hygienic use of water is needed (34). Moreover, the use of latrines must be improved, especially in rural areas where only one in four use some form of latrines (31). Post-elimination surveillance activities have been scheduled and implementation will start this year (22). These measures are essential in order to maintain the effect of trachoma control achieved in Burkina.

¹⁰ The pharmaceutical company Pfizer has donated more than 225 million Zithromax® treatments in 19 countries with plans to soon be active in many more (48).

¹¹ <1 case of trichiasis per 1,000 inhabitants and a prevalence of active trachoma (TF) in children aged 1-9 years of <5% (16).

CONCLUSIONS

Following three consecutive years of MDA and health education, the prevalence of active trachoma in 11 districts in Burkina Faso has been reduced from 21% to below the 10% threshold for WHO recommended MDA at district level. Despite the overall reduction of prevalence levels, control strategies must be implemented at a sub-district level. Moreover, the chronic complications of trachoma still remain a public health problem in some districts. Alongside improved surgical treatment, access to clean water and improvements in sanitation must be prioritised in order to implement the comprehensive SAFE strategy and to successfully alleviate the burden of trachoma in Burkina.

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