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Impact Assessment of Active Trachoma Control in Garki Local Government Area of Jigawa State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: An estimated prevalence of trachoma inflammation – follicular (TF) of 20.9% was reported in Garki local government area (LGA). This led to annual mass azithromycin administration for three years targeted at eliminating TF in the LGA. This study was conducted to assess the impact of the mass azithromycin administration on prevalence of active trachoma in Garki LGA of Jigawa State, Nigeria.

Methods: A population-based cross-sectional survey of children aged 1- 9 years was conducted in April 2015. The study size was empowered at the sub-district level as recommended by a WHO-led

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scientific meeting. Subjects were selected using a two-stage cluster randomized sampling at sub-district level. A total of 1,746 children were targeted to be examined in each of the 4 sub-districts of the LGA. Each study participant was assessed for trachomatous inflammation - follicular (TF) and trachomatous trichiasis (TT). The households were also interviewed and/or assessed on access to water, hygiene and sanitation. All findings were recorded into the data collection proforma.

Results: A response rate of 92.6% (n = 6,472) was obtained in the whole LGA and it ranged between 92.2% and 93% across the 4 sub-districts. The mean age of participants was 3.8 years (SD 2.47). The prevalence of TF was 13.6% (95% CI 12.8% – 14.5%) for the LGA and ranged between 9.2% to 16.5% across the sub-districts. The prevalence of TT was 0.1% (95% CI: 0.09% - 0.12%). Presence of active trachoma was significantly associated with dirty faces, presence of human feaces and animal dung around the house at $p < 0.05$.

Conclusion: Active trachoma is still hyperendemic in Garki Local Government Area of Jigawa State. There is need to undertake annual mass azithromycin distribution for additional 3 years before another impact assessment.

Keywords: Trachoma; azithromycin; TF; TT; TI; CO; ITI; CBM.

1. INTRODUCTION

Trachoma is a debilitating eye disease resulting in chronic conjunctivitis caused by Chlamydia trachomatis [1]. It is one of the most common causes of preventable blindness that spreads through contact with the eye discharge of an infected person transmitted by eye-seeking flies, towels, handkerchiefs, and fingers [2,3]. It is the leading infectious preventable cause of blindness worldwide [4,5] accounting for about 3% of global blindness with approximately 1.2 million people irreversibly blind [3]. WHO has adopted a resolution to eliminate blinding trachoma by the year 2020. Over 8 million people are affected by trichiasis, the precursor to blindness from trachoma, while another 40 million have active disease [3]. The disease is endemic in more than 53 countries, affecting the poorest and most rural regions of Africa, Asia, the Middle East and some parts of Latin America and Australia [2-4]. The disease occurs in two phases; active trachoma (follicular trachoma, TF, and intense trachomatous inflammation, TI) which mainly affects children, and cicatricial trachoma (trachomatous trichiasis, TT, and trachomatous corneal opacity, CO) which mainly affects adults, especially females, with a female to male ratio of 1.8:1 [5].Trachoma is a disease that clusters in communities and is transmitted by close personal contact [2]. Prevention and control of trachoma is based on the SAFE strategy (surgery for trichiasis, antibiotics for active infection, facial cleanliness, and environmental improvements to reduce facial discharge and fly density) recommended by the World Health Organization (WHO) [6-8]. The SAFE strategy combines all the elements of primary, secondary and tertiary prevention [9].

The International Trachoma Initiative (ITI) provides the antibiotic azithromycin for mass distribution in trachoma control programs. In areas where trachoma has been found to be of public health importance, the implementation of the SAFE strategy has significantly reduced the prevalence of the disease. The WHO has reported a 78% fall in the global prevalence of trachoma attributable to this, [10] even though this may not be the same situation in individual communities especially those without active trachoma control programs.

The northern region of Nigeria falls within the trachoma belt of West Africa, and the few prevalence surveys conducted in this region show that trachoma is a disease of public health significance. The prevalence of active trachoma in children younger than 10years was reported at 11.8% in Katsina State and 18.3% in Yobe State, while the prevalence of trachomatous corneal scarring in persons 15 years and older was 0.48% and 1.6%, respectively [11,12]. However in Jigawa State, few epidemiological surveys are available as An estimated prevalence of trachoma inflammation – follicular (TF) of 20.9% was reported in Garki local government area (LGA) of Jigawa State [13,14]. A comprehensive eye care program is being managed by the state Ministry of Health in collaboration with a donor agency Christoffel Blinden Mission (CBM) to combat avoidable causes of blindness. For trachoma control, the World health Organization-recommended SAFE strategy is being implemented. This led to annual mass azithromycin administration for three years targeted at eliminating TF in the LGA. This study was conducted to assess the impact of the mass azithromycin administration on prevalence of active trachoma in Garki LGA of Jigawa State, Nigeria.

2. METHODOLOGY

A population-based cross-sectional survey of children aged 1- 9 years was conducted in April 2015 in Jigawa State, Northwestern Nigeria.

2.1 Study Area

Garki Local Government area is one of the 27 LGAs in Jigawa State. The headquarters is located in Garki town. It has a population of 152,233 [15]. It lies between latitudes 12.20 N to 12.60 N and longitudes 8.70 E to 9.50 E. It shares boundary with Ringim and Taura LGAs in the South, Babura LGA in the North West and Sule Tankar Kar and Gagarawa LGAs in the North East. It lies within the Sudan Savannah. The LGA is subdivided into 11 political wards. The majority of the population is into small scale farming and/or nomadic cattle rearing. A few of the population are civil servants and artisans. The majority speak Hausa and Fulani.

2.2 Study Design

This is a population-based cross-sectional survey conducted over a period of 4 weeks (from 10th April to 9th May 2015). A two-stage random cluster sampling was used to select the study population using probability proportional to size sampling. The first sampling stage (selection of clusters) was done using systematic sampling while the second sampling stage (selection of subjects) was done using random walk.

2.3 Sample Size

Sample size calculation was done using the Cochran's formula [16-18].

$$\mathbf{N = Z^2 pq / d^2}$$

The estimated prevalence (**p**) among children aged 1 to 9 years was 20.9% (0.209) based on previous trachoma survey in the state [14,15,17,18] prior to MDA. Estimated **q** (1-**p**) is 0.791. Precision (**d**) [13] at 4% is 0.04. Confidence level **Z** at 95% is 1.96 using design effect [13] of 4. The sample size was calculated thus:

$$N = \frac{(1.96)^2 \times 0.209 \times 0.791}{(0.04)^2}$$

$$N = 4 \times \frac{3.8416 \times 0.209 \times 0.791}{0.0016}$$

$$N = 4 \times \frac{0.6350894704}{0.0016}$$

$$N = 4 \times 396$$

Assuming an attrition of 10%

$$N = 1587 + 10\% \text{ Attrition}$$

$$N = 1746$$

For an impact assessment, the WHO recommends empowering the sample size at sub-LGA level to enable decision on stopping Mass Distribution of Antibiotics (MDA) [19]. In order to meet this WHO recommendation for trachoma impact assessments [19], the 11 political wards in the LGA were sub-divided into 4 sub districts of 2-3 political wards each [20] to power the sample size at sub-district level. The political wards were chosen based on existing traditional leadership. A total of 1746 children were targeted to be examined in each sub-district (6984 children in the entire LGA).

2.4 Sampling Design

Households in the direction selected were surveyed and children 1 - 9 years in those households were examined. Examination consisted of participant registration according to the households. Each study participant was assessed for signs of trachoma (trachomatous inflammation - follicular (TF) and trachomatous trichiasis (TT)) by eversion of the upper eyelid. Trachoma grading was assessed with a penlight and X2.5 loupe The Heads of each eligible household or their representatives was then interviewed by trained trachoma control officers on water source, waste disposal, availability of latrine, knowledge of trachoma as a blinding disease and previous administration of Azithromycin (Tablet or suspension) or Tetracycline ointment to the households' members especially the children. Inspection of household was conducted looking for presence of animal, animal dung, waste and the type of latrine used by the household members. The interview was conducted in Hausa, the predominant language and then back translated for recording in English. Each eligible child also had his or her eyes assessed for facial cleanliness. Where the number of households was less than 25 in a cluster, the sample was completed in a nearby village. All findings were a recorded into the data collection proforma.

2.5 Data Management and Analysis

Participant information and respective findings were filled into the data collection form for analysis using statistical package for social sciences version 16.0 (SPSS 16.0).

The data collected were presented in graphs and tables. The quantitative results were presented as proportion, means and standard deviations. Chi-square (χ^2) was used to analyze the risk factors for trachoma. Odd ratio > 1 or P < 0.05 was considered significant. The significant risk factors were assessed against each other in a logistic regression model to assess for significance.

2.6 Sampling Procedure

Enumeration areas or communities, according to existing register from MDA program [21], were identified from each districts of the local government area. Fifteen clusters of 25 households in each sub-district were sampled to examine children aged 1-9 years per household. It was estimated that 15 clusters (375 households) per sub-district will provide a representative sample for sub-district assessment and that will also meet the requirement for assessing the minimum sample size in the entire LGA.

A census list of all communities in the district was obtained including the population size from local census authority [22]. The towns and villages for each sub-district were arranged based on size of the population in an ascending order. Systematic sampling was used to randomly select the required 15 clusters for each sub-district. To obtain the sampling interval, the total population in each sub-district was divided by 15 (the desired number of clusters). The first cluster in each sub-district was selected by multiplying the sampling interval by a random number between 0 and 1. The 1st cluster was the town/village in which the product of this multiplication falls into under the cumulative total population. Subsequent 14 clusters in each sub-district were selected by adding the sampling interval to the previous number.

In each selected cluster, 25 households were selected by random walk method using a bottle or pen to randomly choose a direction from the center of the community. Eligible children 1-9 years in each household were enumerated after consent/assent was granted by their parents/guardians.

2.7 Inclusion Criteria

Persons aged one to nine years that are resident in the area for at least 6 months.

2.8 Exclusion Criteria

Participants who have not lived in the area for 6 months.

The study size was empowered at the sub-district level as recommended by a WHO-led scientific meeting. Subjects were selected using a two-stage cluster randomized sampling at sub-district level. A total of 1,746 children were targeted to be examined in each of the 4 sub-districts of the LGA. Enumeration areas or communities, according to existing register, was identified from each districts of the local government area. In order to power the sample size to meet the WHO recommendation [23] for trachoma impact assessments, the 11 political wards in the LGA was sub-divided into 4 sub districts of 3 wards each and 2 wards as the last group [24]. Fifteen clusters of 25 households in each sub-district was sampled to enroll children aged 1-9 years per household. It was estimated that 60 clusters (1,500 households) will attain the sample size for the LGA while 15 clusters (375 households) per sub-district will provide a representative sample for sub-district assessment.

A census list of all communities in the district was obtained including the population size from local census authority [25]. The towns and villages for each subgroup was arranged based on size of the population in an ascending order. The total population was divided by 15 (the number of clusters) to derive the sampling interval. The first cluster was selected by multiplying the sampling interval by a random number between 0 and 1. In the cumulative population column, the number that is the product of this multiplication was traced. The first cluster from the corresponding community was taken. Each subsequent cluster was selected by adding the sampling interval to the previous number. A total 25 households in each cluster was selected by spinning a bottle or pen to randomly choose a direction from the center of the community.

2.9 Pre - Survey Activities

The district heads and local government authority were visited prior to the survey date for advocacy to obtain permission and to fix a date for the survey.

2.10 Survey Team

This was made of one Resident doctor (the principal investigator – PI), two ophthalmic nurses, two trained state trachoma control officers, two focal persons and two support staff. Training, done for two days, was facilitated by the principal investigator and consisted of:

1. Description of the survey procedure and operational definitions for the survey.
2. Review of the WHO grading of trachoma for standardization of trachoma diagnoses.
3. A kappa rating was conducted to ensure agreement between the principal investigator and graders (nurses) using slides. Only graders that obtained a kappa rating of at least 0.8 were selected for the study (acceptable range is 0.7 to 1.0.) [26]. Principal Investigator and 2 other graders formed 2 teams. The principal investigator led a team while an ophthalmic nurse led the other team.
4. Field practical on selecting households and the clinical diagnoses of trachoma in form of pilot study was done in a nearby LGA (Dutse). The result of the pilot study was not included in the study.

The PI directed and facilitated the entire survey activities from the beginning to the end. He also ensured that:

1. Every member of the teams was fully briefed on the task;
2. Necessary materials for various tasks were made available;
3. The survey procedure and protocol were strictly adhered to;
4. Completeness and checking for errors in the data collected were done before leaving the cluster.

2.11 Fieldwork

The survey took place between 10th April and 9th May 2015 which was not a rainy season. The survey teams visited the village heads to inform them of their arrival and then proceeded on with the survey. Households in the direction selected were surveyed and children 1-9 years in those households were examined. Examination consisted of participant registration, by the support staffs, according to the households. The Heads of each eligible household or their representatives was then interviewed by trained trachoma control officers on water source, waste disposal, availability of latrine, knowledge of trachoma as a blinding disease and previous administration of Azithromycin (tablet or suspension) or Tetracycline ointment to the households' members especially the children. Inspection of house's environment was conducted looking for presence of animal, animal dung, waste and the type of latrine used by the household members. The interview was conducted in Hausa, the predominant language and then translated to English for recording. Each eligible child had his or her eyes assessed by principal investigator and 2 other graders for facial cleanliness and signs of trachoma by eversion of the upper eyelid. Trachoma grading was assessed with a penlight and X2.5 loupe. Where the number of households was less than 25 in a cluster, the sample was completed using household in a nearby village.

3. RESULTS

A response rate of 92.6% (n = 6,472) was obtained in the whole LGA and it ranged between 92.2% and 93% across the 4 sub-districts. The mean age of participants was 3.8 years (SD 2.47). The prevalence of TF was 13.6% (95% CI 12.8% – 14.5%) for the LGA and ranged between 9.2% to 16.5% across the sub-districts. The prevalence of TT was 0.1% (95% CI: 0.09% - 0.12%). Presence of active trachoma was significantly associated with dirty faces, presence of human feaces and animal dung around the house at $p < 0.05$.

There was significant association between prevalence of active trachoma and unimproved waste disposal**,** presence of animal in the compound and presence of animal dung and human feaces around the house. It was also associated with distance to sources of water, face washing and facial cleanliness**.** There was no association between prevalence of active trachoma and unimproved toilet and 2 or more days bathing.

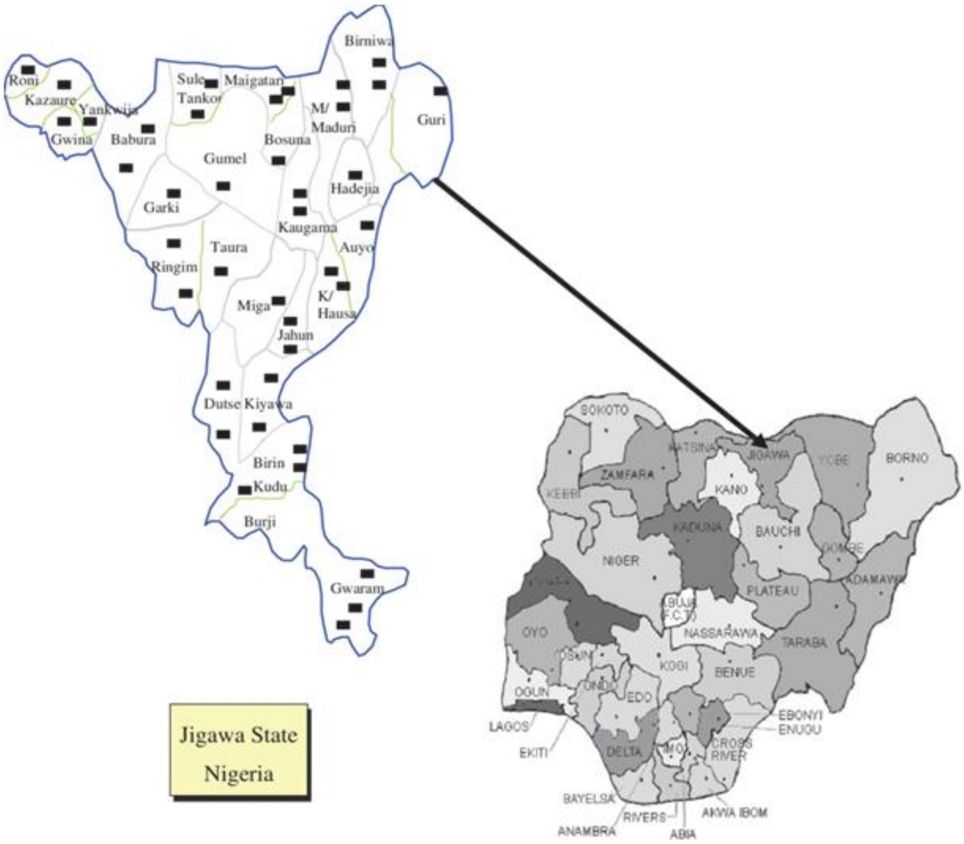

Fig. 1. Map of Nigeria showing Jigawa State with location of clusters surveyed for trachoma per local government area

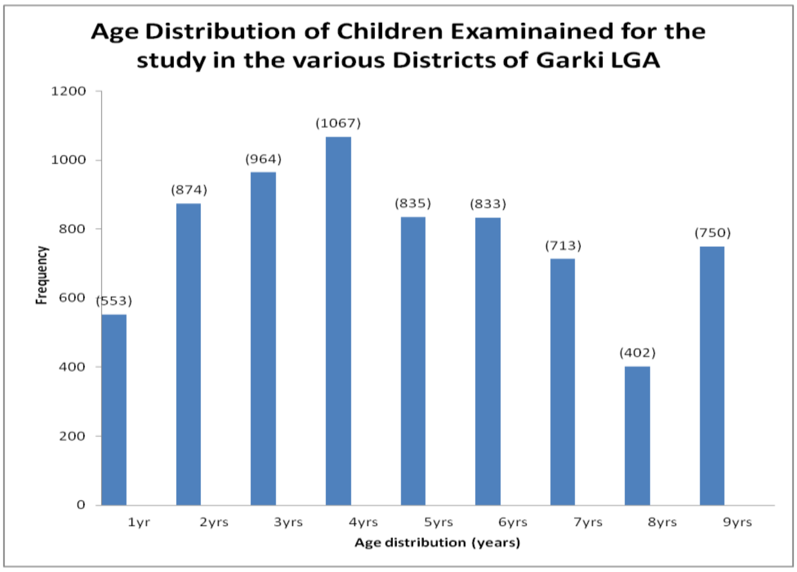

Fig. 2. Age Distribution of the enumerated children in Garki LGA of Jigawa State

Mean age ($\overline{x}$) = 3.8 yrs., standard deviation (σ_X) = ± 2.47

The distribution pattern and the dip for 8-year olds needed to be noted

Table 1. Prevalence of trachoma in the Sub - districts of Garki LGA of Jigawa State

Sub district	Normal N (%)	TF N (%)	TT (%)	Total
Buduru	1355 (83.9)	257 (15.9)	3 (0.2)	1615
Kanya	1412 (87.1)	207 (12.8)	2 (0.1)	1621
Sayori	1340 (83.3)	266 (16.5)	3(0.2)	1627
Garki	1477 (90.8)	150 (9.2)	0 (0.0)	1627
Total	**5584 (86.3)**	**880 (13.6)**	**8 (0.1)**	**6472**

The Sayori district is more affected TF 266 (16.5%) followed by Buduru district 257 (15.9%)

Table 2. Univariate analysis of environmental and hygienic risk factors and TF

Risk Factor	O.R	95% C.I	P value
Water source	0.78	0.50-1.06	0.81
Water distance	1.63	1.22-2.04	0.01
Access to improved Latrine	0.97	0.37-1.57	0.10
Waste disposal	3.01	2.00-4.02	0.04
Presence of animal in the compound	1.84	1.47-2.21	<0.0001
Presence of dung or feaces around the house	1.52	1.03-2.01	0.02
Facial cleanliness	1.47	1.31-1.63	<0.0001
Frequency of bathing	0.65	0.23-1.07	0.07
Frequency of face washing	2.51	1.03-3.99	<0.0001
Knowledge of trachoma as blinding disease	0.88	0.50-1.26	0.12
Knowledge of trachoma prevention	1.21	0.30-2.12	0.91
Knowledge of eye care services	1.40	0.52-2.28	1.31

Table 3. Multivariate analysis of environmental and hygienic risk factors and TF

Risk Factor	Adjusted O.R	95% C.I	P value
Water distance	1.20	0.69-1.71	0.09
Waste disposal	1.90	1.63-2.17	<0.0001
Presence of animal in the compound	2.45	1.78-3.12	<0.0001
Presence of dung or feaces around the house	1.74	1.43-2.05	<0.0001
Facial cleanliness	2.01	1.29-2.73	<0.0001
Frequency of face washing	0.90	0.31-1.49	0.21

Unimproved waste disposal, presence of animal in the compound, presence of dung and human feaces around the house and dirty faces were found to be significantly associated with TF in multivariable regression analysis.

4. DISCUSSION

The good response rate, in spite of the fear by some children/guardian that the process could be harmful, was achieved largely from advocacy visit prior to the field work and good level of knowledge in the households of Trachoma control. Inter observer error was controlled by adhering to the WHO grading system of Trachoma.

Majority of the children are under five years (mean age ($\bar{x}$) is 3.8years). This is consistent with what is obtainable in sub-Sahara Africa where mortality of children under five year is high [25-30]. The sex pattern showed almost equal distribution of male and female.

The prevalence of active trachoma of 13.6% shows that trachoma is still hyperendemic in the local government area though a substantial reduction in the prevalence of active trachoma from 20.6% [31-35] to 13.6% was seen. The hyperendemicity may also be due to persistent risk factors for transmission of trachoma such as unimproved waste disposal, presence of animal in the compound, presence of dung and human feaces around the house and dirty faces among the children. All the sub districts surveyed were affected. The prevalence of TF was above 10% in all the sub districts except Garki which is the headquarter of the LGA and a sub urban area. Some of the risk factors associated with transmission of trachoma such as dirty faces, unimproved waste disposal and human faeces and animal dung around houses were found to be lower in this sub district. This finding is similar to what was recorded in Sokoto and Kebbi states where prevalence of active trachoma in children aged 1-9 years was 15.6% [19]. However, that study was a pre-intervention survey meant to establish baseline. This is also in agreement with what was reported in Zamfara and Katsina states where prevalence of active trachoma in children aged 1-9 years were 0.04 to 18% [21,36] and 5.0 to 24.0% [23,37] respectively. These similarities may be as a result of the fact that Garki local government area share the demographic and geographic similarity.

This finding is also in agreement with what was recorded in Ghana from a post intervention survey where a reduction of 6-10% [24] in prevalence of active trachoma was recorded 2 years after implementation of SAFE strategy. Studies in Cameroun [36] and Tanzania [38] recorded similar results after 2 rounds of MDA [36,38].

This finding is different from what was recorded in Mali where 3 rounds of MDA brought the active trachoma among under 9years to 3.9%. This may be due to the fact that Jigawa state recorded a low coverage in the first and second rounds of MDA.

The poor coverage in the first 2 years was partly due to inadequate supply of the drugs and rejection of treatment by the parents [14,15,39]. There was better supply and acceptance of the drugs in the third year [15]. In like manner, a household survey in Plateau state showed a coverage of 60.3% as against the administrative coverage of 75.8% [40].

The risk factors for transmission of trachoma revolve around household and environmental cleanliness. Similar report was observed in a population-based survey in Kano where presence of animal in the compound, dirty faces and presence of flies on the face were considered significant risk factors for transmission of trachoma [20].

Likewise, a national community-based survey in Gambia noted trachoma risk factors were dirty faces (nasal discharges and ocular discharges) in addition to age 1-5 years and presence of at least a child with active disease [30]. The difference from experience in this study may be attributed to the fact that the author did not focus on environmental risk factors [30]. Another baseline community based cross sectional survey as part of control trial in Gambia and Tanzania, recorded similar risk factors for trachoma of dirty faces (ocular discharges, flies on the face) in both countries. Poor health education was additionally found in Gambia while inadequate water supply and lack of latrine were found in Tanzania [32]. This study was also similar to Ghana report in which dirty faces, dirty environment and personal hygiene were among the associated risk factors for transmission of trachoma [24]. Although the author did not subject the risks to test of significance, he was able to conclude that behavioral changes around these finding is key to control of trachoma [24].

In agreement with this study, a rapid assessment of trachoma in India [41] showed that cohabitation with animals was found to be significantly associated with transmission of trachoma.

This experience is different from what was recorded in Sokoto and Kebbi states where associated risk factors for trachoma transmission were distance from water source while clean faces, access to latrine and knowledge of trachoma were found to be protective [19]. The reasons may be due to the fact that it was a pre-intervention study [19].

The high proportion of facial cleanliness among the children may be associated with easy access to water and observance of good personal hygiene although the high prevalence of active trachoma is associated with dirty faces. Community based study across different communities in Ethiopia, Mali, Niger and Nigeria surveyed children of ages 1 to 15 years and reported facial cleanliness ranges from 57.2% in Nigeria to 89.9% in Ethiopia [40]. Data was collected at different stages of implementation of SAFE strategy in these countries, therefore some were baseline while others were impact studies or school-based survey; such may not provide valid estimate of facial cleanliness.

Population based cross sectional studies in Mali [25,42] and Tanzania [3] of children of less than 10 years in Mali show that 61.7% of the children had clean faces [42,43], while in Tanzania, home based and clinic-based examination of children revealed that 62% of them have clean faces at home while 51% have clean faces at clinic [44].

The same experience was recorded in Australia [39] and India [41]; clean faces among age 1-9 years ranged from 12 – 89% across different communities in Australia [39]. However, the surveys were done at different stages of intervention of trachoma. Some communities had implemented complete SAFE strategy while others had first ever trachoma survey. The wide variations observed might not be unconnected with this observation. In India, 15% of children aged 1-9 years old were noted to have dirty face [41].

5. CONCLUSION

Active Trachoma is still hyperendemic in Garki Local Government Area with major risk factors being; poor waste disposal, distant water sources, presence of domestic animal in the compound, presence of dung and faeces around the house and unclean faces. The antibiotic distribution coverage and facial cleanliness are commendable but short of the ultimate intervention goal. For effective trachoma control, there is need to increase level of community awareness on personal/environmental hygiene and continued Mass Distribution of antibiotics.

6. RECOMMENDATIONS

The following are some of the recommendations to enhance trachoma control in Garki LGA and Jigawa State;

1. There is need for adequate supply of antibiotics at appropriate time. This can be improved through better advocacy to government and donor agencies.
2. There is need to increase campaign on environmental sanitation. A well-articulated health education campaign can help in this area. Also, more efforts can be intensified to carry more messages and jingles about trachoma on radio in native language.
3. There is need to make policies that will enforce environmental sanitation among households. A well-organized waste disposal method with active sanitary inspection officers may help.
4. SAFE strategy being implemented in the state should focus more on “F” and “E” aspect of the control strategy.
5. To conduct another trachoma survey in Garki LGA at least 2-3 years from now so as to ascertain when to stop the MDA.

7. LIMITATIONS

1. It may be difficult to generalize the findings of this study on the entire state because the study covered only one LGA in Jigawa state.
2. Factors that affect drug distribution coverage were not evaluated. Another study may be needed to evaluate this.

CONSENT AND ETHICAL APPROVAL

Ethics and research committees of National Eye Centre Kaduna granted approval for the study. The Jigawa State Ministry of Health gave permission for the study. Permission of Local Government Health Department and the respective village chiefs was also obtained. Consent was obtained from the head of the household. The research complied with the tenets of Helsinki Declaration.

DISCLAIMER

Some part of this manuscript was previously presented and published in the conference: Annual Conference of the Ophthalmological Society of Nigeria on August 2017 at Kaduna, Nigeria. Web Link of the proceeding: https://www.researchgate.net/publication/319623009_Impact_assessment_of_active_trachoma_control_in_Garki_local_government_area_of_Jigawa_state_Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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