Original Article

Estimated Number of Cataract Surgeries Performed in Government Hospitals in Nigeria and Factors Affecting Cataract Surgical Activity

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Abstract

Aim: To estimate the number of cataract surgeries performed from 1 January 2017 to 31 December 2019 in government hospitals in Nigeria and explore factors affecting their cataract surgical activity. **Methods:** This was a retrospective study conducted between 1 August 2020 and 4 October 2020 through online survey emailed to respondents working in 55 government-owned hospitals in the 36 Nigerian states and federal capital territory. Information obtained included a number of cataract surgeries performed yearly and correlation analysed between variables obtained using IBM Statistical Package for Social Sciences software for Windows version 22 (SPSS Inc., Chicago, Illinois, USA). **Results:** A total of 40 institutions were included in the study, 26 (65%) federal government and 16 (35%) state government institutions. About 70,792 cataract surgeries were performed during the study period with the North-West geopolitical zone performing 47.7% of the surgeries. The average price for cataract surgical service in government hospital was USD($)77.45(±7.08) (surgical fee) and USD ($) 128.23(±11.96) (total treatment cost) with a wide variation from zone-to-zone. Lower fees were associated with increased surgical volumes, and GNI per capita of each state did not influence the price set for surgery or the number of surgeries performed. Provision of outreach services, free surgeries, and having an eye manager correlated to increased cataract surgical numbers ($P < 0.05$). **Conclusion:** There is need to improve existing strategies to increase cataract surgical numbers in government institutions such as increased advocacy for funding for eye care services, conducting frequent outreaches, establishing and redistribution of satellite centres to underserved communities and fostering surgical relationships between institutions to improve surgeon's competency and cataract surgical outcome.

Keywords: Cataract surgery, cataract surgical rate, government hospitals, Nigeria

Introduction

Globally, 253 million people are visually impaired, out of which at least 36 million people are blind.[1] Visually impaired or blind individuals from low- to middle-income countries (LMICs) account for 90% of the global burden, with blindness prevalence as much as four times higher than high-income countries.[2,3] With population growth and ageing, this number is expected to increase.[1,2] Some studies[4,5] have confirmed the trends of poor distribution of human resources in eye health in sub-Saharan Africa and Latin America and demonstrated their inability to keep up with the population increase.

Cataract surgical rate (CSR) and cataract surgical coverage (CSC) are two indicators that are used to monitor cataract surgical activity. The 2007 data on Nigeria's blindness and visual impairment survey documented a CSR of 317 per million population and a CSC of 42%, which are below

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the target recommended by the World Health Organization (WHO).[6] This can be attributed to poor health information systems and a disconnect between the service providers in the private and mission hospitals and the public hospitals under the ministries of health. More recent estimates are available in some states that have carried out population-based surveys to determine the prevalence of cataract blindness, the CSR and CSC, and the numbers are still not close to WHO **targets**.[7-9] The low CSR could be the result of poor cataract surgical service provision or patient-related factors.[10] Population-based studies in Nigeria have noted that low cataract surgical rate in Nigeria is strongly related to poor distribution of eye care professionals, cost, lack of awareness and access to eye care services.[11-13]

Cataract surgery is a cost-effective procedure and in LMICs, the manual small incision cataract surgery is the most cost-effective technique.[14] However, the direct and indirect cost to patients is still a major barrier to the uptake of cataract surgery in LMICs.[15-17]In sub-Saharan Africa, Gross Domestic Product (GDP) per capita is estimated at USD($) 585.5 (USD($)271.8–USD($)16,433.9) whilst, the Gross National Index (GNI) per capita is USD($)3,848 (USD($) 750–USD($) 29,120). Nigeria has a GDP per capita of USD ($)2,028.2, but GNI, a more helpful figure that includes all income to the population, and hence reflects the "spending power" is estimated at USD($)5,710 for Nigeria as a whole, but this value varies from state to state.[18] However, it is not clear if the wealth of a state judged by the socioeconomic indices translates to the populace affording health services such as cataract surgeries without facing the risk of impoverishment or catastrophic health expenditure.

Government hospitals are the target institutions in this study and this is because in Nigeria, the government is the highest employer of professionals for eye care delivery and the cost of cataract surgical services is cheaper when compared to private eye hospitals.[7,9,19] Therefore, it is expected that with the government subsidy and manpower available, eye care delivery should be closed to optimum in these government institutions.

The aim of this study was to estimate cataract surgeries performed between 1 January 2017 and 31 December 2019 and to identify factors affecting cataract surgical activities in Nigeria.

Methods

This was a multi-center, retrospective, cross-sectional study conducted between August and October 2020 in Nigeria. Cataract surgical services are provided at the secondary and tertiary health care levels and majority of the tertiary institutions are in the urban areas.

Data on number of institutions per state and contact details of respondents were obtained from the zonal representatives of the Ophthalmological Society of Nigeria and research assistants [Table 1].

Health institutions were selected using purposive sampling based on government ownership, availability of cataract surgical service, ease of accessibility to data and availability of responders in different institutions. Respondents were either heads of department of ophthalmology, outreach coordinators, eye care managers or ophthalmologists working in government-owned health institutions that provide cataract surgical services in the 36 states of the federation and the federal capital territory. The respondents were contacted via email and reminders were sent every week. Phone calls were also made when respondents failed to answer the emails sent to them. In a situation where the contact did not respond, data were then collected from other key informants, including outreach coordinators or eye managers of the eye department.

Data were collected using online forms and it included the following:

(1) number of cataract surgeries performed per institution yearly between 2017 and 2019.
(2) number of surgeons who performed cataract surgery per institution.
(3) number of days/week that cataract surgeries were conducted per institution.
(4) price of cataract surgery per institution.
(5) components of cataract surgical services that could be responsible for the number of surgeries performed; these were grouped under sub-headings as human resource (including an eye care manager and outreach coordinators), infrastructure (such as dedicated eye theatre and functional microscope) and funding for cataract surgical services (e.g., support for outreach services or satellite centres and presence of non-governmental organization (NGO) support).

Table 1: Distribution of States by Geopolitical Zones Indicating the number of Institutions Included in Study

Geopolitical zones	States	No of institutions
South-South	Akwa-Ibom, Bayelsa, Cross-Rivers, Delta, Edo, Rivers	8
South-East	Abia, Anambra, Ebonyi, Enugu, Imo	7
South-West	Ekiti, Lagos, Ogun, Ondo, Osun, Oyo	9
North-Central	Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, Federal Capital Territory	9
North-East	Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe	11
North-West	Jigawa, Kaduna, Kano, Kastina, Kebbi, Sokoto, Zamfara	11

Data on number of cataract surgeries performed per institution per year were obtained from theatre logs. Where data from theatre records were incomplete or missing, then a near estimate was used. The price of cataract surgery in institutions was obtained and converted to dollars using the official rate of Central Bank of Nigeria at the time of study (1USD = N360). Data cleaning was done daily and was entered on an Excel spreadsheet (Microsoft, Redmond, Washington, USA) whilst coding. Analysis was performed using IBM Statistical Package for Social Sciences software for Windows version 22 (SPSS Inc., Chicago, Illinois, USA). Variables were presented using descriptive statistics; continuous variables were summarised using range, mean and standard deviation. Categorical variables were described using percentages and proportions. Chi-square test of statistical significance was used in the bivariate analysis and the level of statistical significance was determined by a *P* value of <0.05. Correlation and simple linear regression analysis were done to determine the effect of predictors such as funding, cataract surgical fee, geopolitical zone, frequency of outreach, type of institution and if there was a waiting list on number of surgeries done yearly.

This protocol was approved by the Research Ethics Committee (REC) of the Alex Ekwueme Federal Teaching Hospital and London School of Hygiene and Tropical Medicine, and the study was undertaking in line with the principles of the Helsinki declaration.

Results

Fifty-five institutions were contacted; however, data were collected from 40 institutions (26 (65%) federal and 14 (35%) state institutions), giving a response rate of 72%. Participating institutions were from 30 states including the Federal Capital Territory with an 83.8% study coverage. States not included in the study were Abia (South-East), Benue (North-Central), Taraba (North-East), Kano (North-West), Kogi (North-Central) and Niger (North-Central).

North-West and South-West geopolitical zones have the highest number of institutions included in this study with each zone having 22.5% (9/40) of the institutions. The North-West zone has the various levels of institutions represented (tertiary, secondary and specialised eye facility) when compared to the South-West zone that institutions represented are all tertiary institutions. Among the institutions studied, 52.5% had an eye manager and outreach coordinator, with 82.5% providing outreach services and about 55% having satellite centres. Majority of the institutions studied had at least two microscopes with 92.5% having their own eye theatre [Table 2].

Cataract surgical activity in government institutions

Data collected on the number of cataract surgeries done per institution over 3 years (Jan 2017–Dec 2019) showed a steady increase in the total number of surgeries done. There was a 10.8% increase in the number of surgeries performed in 2018 when compared to the figures recorded in 2017 and a 10.3% increase in 2019 when compared to surgeries performed in 2018.

Furthermore, the distribution of average number of surgeries differs across the geopolitical zones ($P < 0.001$) with the North-West geopolitical zone performing 47.7% of the total number of cataract surgeries in government institutions annually.

Overall, state-funded hospitals performed higher proportion (61.3%) of cataract surgical procedures when compared to federal government-funded institutions (38.7%). Thirty tertiary institutions performed 12,320 (50.3%) cataract surgeries, 8300 (33.9%) cataract surgeries were performed in eight secondary institutions and 3897 (15.8%) cataract surgeries were performed in two specialist eye hospitals across Nigeria. Majority (37.5%) of the institutions studied preferred to perform cataract surgery at a visual acuity of 6/60; also, small incision cataract surgery (82.5%) was the predominant cataract surgical technique performed by surgeons in government hospitals in Nigeria.

Table 2: Descriptive statistics of institutions and their types involved in the study

	Categories	Frequency (n = 40)	%
Number of institutions per geopolitical zone			
	South-South	7	17.5
	South-East	4	10.0
	South-West	9	22.5
	North-Central	5	12.5
	North-East	6	15.0
	North-West	9	22.5
Type of institution			
	Tertiary	30	75.0
	Secondary	8	20.0
	Specialist eye facility	2	5.0

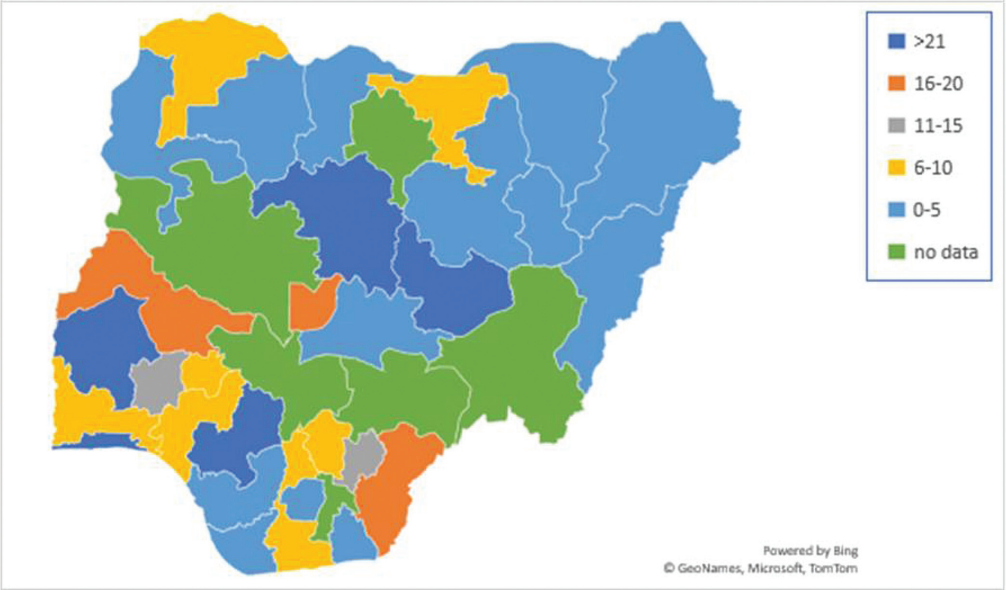

Figure 1: Distribution of eye surgeons in Government hospitals across Nigeria.

Thirty-three (82.5%) of the institutions studied provide outreach services as a strategy to increase the cataract surgical numbers and 22 (55%) institutions had satellite centres in rural areas. In this study, providing these services correlated with increase in the number of surgeries performed in these institutions ($P = 0.024$) [Figure 1].

Majority of the states (35%) had the least number of surgeons performing cataract surgeries whilst only five states had more than 20 surgeons operating in government hospitals in Nigeria [Table 3].

Table 3: Resources for eye health service delivery

	Frequency	%
Outreach coordinator	21	52.5
Eye manager	21	52.5
Outreach services	33	82.5
Satellite centres	22	55.0
Institutions with waiting list	27	62.5
Institutions with dedicated eye theatres	37	92.5
Institutions with at least two microscopes	33	82.5
Presence of NGO support	23	57.5

Price of cataract surgery in government hospitals in Nigeria

Data on price were categorised into price set by institutions for surgery alone and the total amount patient would have paid on discharge from the hospital. The price of cataract surgery varied from zone-to-zone with the lowest price (USD ($)14) in the North-West zone and the highest price (USD($) 229) in the South-West zone. The average price for cataract surgery fee alone was USD($)77.45 ± 48.71; whilst on discharge, the average total amount paid by cataract surgical patients was USD($)128.23 ± 75.65.

Using Pearson correlation analysis, there is a positive relationship between lower cataract surgical fee and higher average number of surgeries done per institution ($r = 0.6$, $P = 0.001$).

In determining whether the wealth of the individual states had an impact on the price set for cataract surgical services, the correlation analysis was done between the price set by institutions for cataract surgical services and the price/GNI per capita of each state. There was no correlation between the two variables ($P = 0.535$) [Figure 2].

Payment for cataract surgical services

Overall, in this study, over 70% of cataract patients pay for cataract services out-of-pocket, 15% pay through health insurance, 20% access free surgeries and 5% benefit from subsidised fees.

In this study, there is a strong positive linear correlation between higher cataract surgical number and provision of free surgeries in government-owned institutions ($r = 0.5$, $P = 0.002$) [Table 4].

Discussion

A total of 70,792 cataract operations are estimated to have been performed in government-supported hospitals in the 30 states from which data were obtained over our 3-year study period (23,597 average per year). Taking the population of Nigeria to be 200 million for this period, it can be estimated that these government services contribute 118 cataracts/million population/year to the CSR of Nigeria, approximately one-third of the documented CSR for Nigeria.[13]

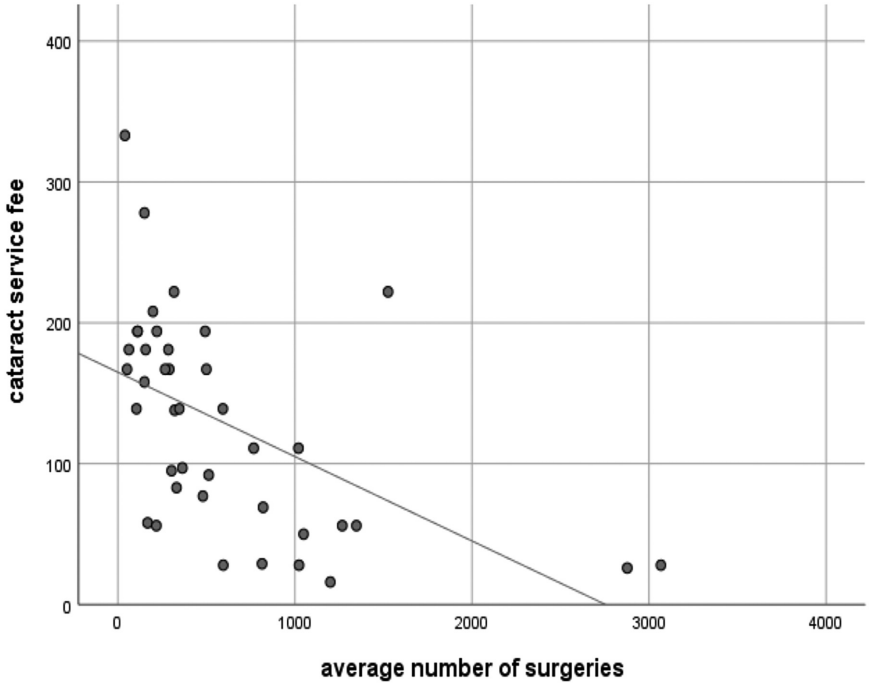

Figure 2: Relationship between cataract service fee and average number of surgeries.

Table 4: Predictors of average number of surgeries using regression analysis

Predictors	Unstandardised coefficients (*B*)	Sig.	95% CI	
			Lower bound	Upper bound
Frequency of outreach services**	161.711	0.008	43.917	279.505
Type of institution**	443.613	0.010	115.999	771.228
Funding**	471.712	0.025	164.059	879.365
Cataract surgery fee**	-84.177	0.002	-145.889	-3.798
Number of days/weeks for** surgery	212.182	0.030	56.120	368.244

**Statistically significant value of <0.05 is represented with asterisk.

Cataract surgical activity in government hospitals

Our findings indicate that cataract surgical activity in government-funded hospitals varies from zone-to-zone, with the North-West zone performing more surgeries when compared to other zones, accounting for about 48% of surgeries done yearly in government hospitals. This may be because the North-West zone is the most populated part of the country[20] and according to the Nigerian national blindness survey, it has the highest number of blind adults.[13] With an estimated 3% annual population growth nationally, it can be said that the government hospitals in Nigeria need to put some strategies in-place to take care of the backlog of cataract blindness. Predictors of increased cataract surgical activity in this study include higher frequency of outreach services, funding by the state government, surgeries carried out in secondary facilities, free cataract services and having more days for surgeries. Results of this study can be compared to a study in China that investigated the impact of similar factors on cataract surgical activity. They also measured the effect of surgical skills and patient satisfaction which had a positive relationship with cataract surgical numbers.[21,22] The percentage of centres reporting the use of small incision cataract surgical technique routinely was 82.5%, an increase compared to data from previous studies carried out in Nigeria[9,23] and may be related to training of surgeons in Small Incision Cataract Surgery (SICS) in many institutions. However, more training is still needed to improve outcomes which will influence patient satisfaction.

In this study, there is a strong positive correlation between the number of outreaches conducted and the number of surgeries performed annually per doctor/state. This is comparable to findings of a population-based study carried out in two communities in South-West Nigeria where outreach services were provided and CSC was 80% and the prevalence of cataract blindness was 1.6%.[12] In planning for eye care service delivery, having satellite centres and providing outreach services are strategies for creating demand for cataract services and clearing backlog of unmet needs. The challenges faced in implementing these

strategies include lack of adequate funding from either government or NGOs, and also the location of these services which may not be accessible to the underserved population.[9]

Price of surgery and related factors

In this study, the price set for cataract surgery fee was an average of USD($)77.45 whilst the average price for cataract services which covers surgery fee and other fees patients pay before accessing surgery was USD($)128.2. The price for surgery varied from zone-to-zone with Lagos state recording the highest price and Sokoto state, the lowest price. The price for cataract surgery in this study is comparable to studies from India[24] done in a high-volume private hospital and Ethiopia[25] which looked at price for cataract surgery from both private and public institutions but lower than the price of cataract surgery in government institutions in Ivory Coast.[26] According to the findings in this study, 70% of cataract surgery fee is paid from out-of-pocket. This is similar to the findings in other studies in Nigeria and elsewhere.[27-29] In Nigeria, 40.1% of the population lives below USD($)381.75 annually (approximately USD($)1/day) and about half of this population lives in the rural areas.[30] This may explain why most people prefer to get their surgeries done in free surgical camps or at a subsidised fee.[31,32] Although cataract surgery is subsidised under the National health insurance scheme (NHIS), majority of the government institutions where this service can be assessed are located in the urban areas and this reiterates that many Nigerians may not afford cataract surgery out-of-pocket.[33] Cost (direct and indirect) remains a major barrier to accessing cataract surgical services whilst out-of-pocket expenditure remains the major source of payment for cataract services in Nigerian institutions.[33]

Socioeconomic indices such as GNI/GDP have been linked with high CSR and CSC of a nation.[34,35] However, some studies in China and India have shown that despite low socio-economic indices, CSR is comparable to high-income countries.[21,36] In this study, it was observed that higher state GNI did not translate to higher number of surgeries done per institution, therefore, may not influence the CSR or CSC. Furthermore, a state having higher GNI does not imply that all individuals living in the state can afford cataract surgery fee. It could also be because states with lower GNI have financial support for cataract surgery from NGOs and philanthropists.

Funding for cataract surgery in Government institutions

Funding for eye care services in these institutions studied were either from the state (35%) or federal government (65%). Some institutions had funding from government and some international NGOs such as CBM, Sightsavers, Noor Dubai, etc.

In this study, funding by NGO was not a predictor of increased number of surgeries performed; however, it was observed that state-funded institutions perform more surgeries when compared to federal-funded institutions, which is similar to findings from Kwara and Kebbi State in Nigeria.[8,9]

The role of NGOs in supporting cataract surgical services includes capacity building of human resource and infrastructure for cataract services, advocacy to prioritise eye health issues at national and local level and to sponsor research on improving patients' access to care.[37,38] The sustainability of these cataract programs after withdrawal of NGO support could pose a challenge in many centres, hence a long-term plan should be in place with adequate support from government and community ownership.

Human resources to improve cataract activity in Government hospitals

In this study, there was no correlation between having more surgeons per institution and increase in average number of surgeries ($P = 0.444$). Furthermore, the focus of tertiary institutions is training of residents in the various ophthalmology subspecialties and provide eye care services. This may be a reason for inadequate creation of demand for cataract services especially in rural areas and the low number of cataract surgeries performed per surgeon per year. Performing more surgeries per surgeon has been linked to competency and continuous monitoring of outcomes by self or peer performance evaluation has been linked to improvements in surgical skills and minimizing complications.[39,40] There is a positive correlation between having an eye manager and the number of surgeries performed per surgeon per year. The role of eye managers and outreach coordinators is to help in planning eye care programs to generate demand for eye care services especially cataract surgeries.[41]

In conclusion, the government-funded services in the 30 states included in this study are estimated to be contributing around one-third of the current national CSR, however if Nigeria is to rise to the CSR of 2000 cataract operations per million population per year, this will require an annual total of 400,000 operations per year for a population of 200 million. Current activity is a long way short of delivering this total and consideration needs to be given to changes that will increase output.

This study suggests that effective strategies to increase cataract surgical numbers might include conducting outreaches, having satellite centres and provision of funding for cataract surgeries.

The theory that socio-economic indicators such as state GNI dictates the cataract surgical activity in states was not demonstrated in this study, as higher GNI may not translate to ability to pay for cataract services by residents.

Limitations

The states that are not captured in this study may be a source of bias in the findings; therefore, more time is needed to do further research, with in-depth study of satellite centres as stand-alone institutions from the base institutions studied. Whilst we estimated numbers of cataract surgery done, there is was no evaluation of the quality of the surgery being performed such as data on cataract surgical outcome monitoring of post-operative visual acuity or complication rates, either at the level of the individual surgeon or at the hospital level.

Recommendations

(1) There is no comprehensive list of all eye surgical service providers in Nigeria. Further research is needed to map resources available for eye health in Nigeria.
(2) To improve surgeon's competency and cataract surgical outcome, performance evaluations should be a routine exercise in all institutions at both state and national level. This outcome data could be collected centrally to set audit standards and to look for predictors of poor outcomes and drive quality improvement.
(3) Personnel such as outreach coordinators and eye managers should be trained in institutions to manage the eye department and conduct effective outreach services and eye camps.
(4) Re-distribution of satellite centres to rural areas and underserved communities to increase uptake of cataract services.
(5) Advocacy to the government to increase funding for eye care in establishing satellite centres in rural areas, providing free surgeries and support training of surgeons and other allied health workers in eye care delivery.

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Conflicts of interest

The authors report no conflicts of interest.

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