Epidemiological aspects of paediatric cataracts in Kinshasa, Democratic Republic of the Congo

Ngoy JK[1], Ngoyi DM[2], Kamwanya BD[2], Mbaki SD[1], Okitosho SW[3], Amani TK[3], Hopkins A[1], Guthoff RF[4,5], Stahnke T[5]

[1]Eye Department, St Joseph Hospital / CFOAC, Kinshasa, Democratic Republic of Congo
[2]Institut National de Recherche Biomédicale (INRB), Kinshasa, Democratic Republic of Congo
[3]Université Officielle de Bukavu, Democratic Republic of Congo
[4]Rostock University Medical Center, Department of Ophthalmology, Rostock, Germany
[5]Institute for Implant Technology and Biomaterials e.V., Rostock-Warnemünde, Germany

Corresponding author: Dr. Janvier N. Kilangalanga, Eye Department, St Joseph Hospital Kinshasa, Central Africa Ophthalmology Training Center (CFOAC), DRC, P.O. Box 322, Kinshasa / Limete. Email: kilangalanga@yahoo.fr

ABSTRACT

Objective: To assess epidemiological aspects of paediatric cataracts among children who attended a secondary Eye clinic in Kinshasa, Democratic Republic of the Congo (DRC).
Methods: A cross-sectional study was conducted in the Eye Department in Kinshasa. One hundred and seventeen children with bilateral cataracts aged from 0.5 to 16 years and their mothers were recruited in the study. Children with unilateral and traumatic cataracts were not included in the study. Data were collected during the period from February 2021 to March 2021. A pre-tested questionnaire was administrated to mothers to evaluate socio-demographics, the history of pregnancy, and a perinatal history of the child. The blood samples for both children and their mothers were collected for antibodies titration. At the same time, the following parameters, namely: age at surgery, type of cataract, associated ocular and systemic lesions. Rubella and toxoplasmosis IgG results were recorded.
Results: The mean age was 7.37±4.28 years (min: 0.5 years, max:16 years). Cataract was congenital and infantile in 58.1% and 41.9% of children respectively. Aetiology of cataract was found idiopathic in 74 children, infectious in 16 children and genetic in 16 children . Then it was isolated in 50.4% and associated to one ocular abnormality in 34.2% of children. Rubella IgG antibody was positive in 26.5% of children.
Conclusion: Paediatric cataract was the mostly congenital, idiopathic and isolated. Rubella infection was present in almost a quarter of children with cataract. Rubella vaccination can be used to reduce the burden of childhood cataract in Kinshasa.

Key words: Epidemiology, Paediatric cataract, Children, Kinshasa, DRC

INTRODUCTION

Paediatric cataract is a total or partial opacification of the lens due to an embryological or developmental abnormality[1]. Congenital cataract is a rare finding in neonates and occurs in 4.24/10,000 live births[2]. Congenital and infantile cataract are responsible for a fifth of the world's blind children despite its treatable nature[3]. Cataract develops due to disruption of the normal lens protein structure or function, resulting in opacity. This may occur as a result of stressors applied to lens proteins including those acquired *in utero* or during childhood. However, a significant proportion is due to mutations in the genes encoding lens proteins that directly affect their role within the lens[4]. About half of the bilateral congenital cataracts are inherited, either as an isolated trait or as part of a multisystemic condition or chromosomal abnormality[2]. Most unilateral and a significant number of bilateral cataracts are of unknown aetiology, the diagnosis of such cases is made after excluding other causes. Congenital cataract is hereditary at 8.3%-25% of cases, with 75% being autosomal dominant inheritance[5]. The serology of the mother and child should be checked for toxoplasmosis, rubella, cytomegalovirus, herpes, but also varicella, Epstein-Barr virus, and syphilis at the context points to of an embryo-foetopathy[6].

Intrauterine infection with rubella virus, herpes simplex virus, and toxoplasmosis virus plays an important role in the development of congenital cataract[7]. Important environmental factors to consider include congenital infections such as toxoplasma, syphilis, varicella zoster, parvovirus B19, coxsackievirus, rubella, cytomegalovirus (CMV) and herpes simplex virus I and II (TORCH). Trauma and iatrogenic causes such as medications and radiation exposure are also relevant but rare in this age group[8]. A recent study conducted in Tanzania

(2020) suggested that congenital infection with rubella or HCMV (human cytomegalovirus) is an important cause of congenital bilateral cataract cases in infants/children[9]. In DRC, there is no published works focused on infectious and environmental aetiologic factors of paediatric cataract.

The aim of this study was to assess epidemiological and aetiological aspects of bilateral paediatric cataracts among children identified in the community in Kinshasa.

Research hypothesis: A high percentage of children with bilateral cataract screened by the community-based rehabilitation service and referred at the Eye Department at the Saint Joseph's Hospital in Kinshasa, is believed to be related to embryofetopathies of viral or protozoa origin considering the lack of rubella vaccination in the health system in DRC.

MATERIALS AND METHODS

Study design: This is a cross-sectional study of a case series carried out at St Joseph Hospital. We reviewed medical files of the children who were diagnosed with bilateral paediatric cataract during the period from January 2019 to December 2020.The register from the community-based rehabilitation program was consulted to identify the children with cataract identified during screening sessions, for whom the diagnosis of cataract in both eyes was confirmed by the ophthalmologist at the eye health center.The mothers were invited to come along with their children to the hospital where they were asked to complete a questionnaire used to collect information. Data and blood samples were collected from February 2021 to March 2021. Clinical and socio-demographic data collected were the following: age, sex, ethnical group, and family history of cataract. In addition, the following factors were considered: laterality of the cataract, the notion of consanguineous and endogamic marriage, the obstetrical history of the mother, the perinatal environment, the medical history of the mother, the associated ocular and systemic abnormalities, the serological results for rubella and toxoplasmosis of the child and the mother.

The aetiological and clinical classification of the cataract referred to the Fahkoury's categorizations[7] as follows: (i) Cataract was congenital when it appeared at birth or within 12 months after birth. (ii) It was infantile or developmental when it appeared after 1 year of age. (iii) It was idiopathic or of unknown aetiology when no evident aetiology was found. (iv) It was of genetic aetiology when there was a positive family history of paediatric cataract with a 1st degree relationship. (v) It was of infectious aetiology to rubella or toxoplasmosis when the serological test by ELISA was positive with presence of IgG in the child and his mother. (vi) Cataract was teratogenic when the mother was exposed during the first trimester of pregnancy to X-rays and if there was a notion of taking abortive drugs or chemotherapy during the same period and was categorized as either isolated or associated with ocular or systemic abnormalities, and (vii) It was isolated when it was not associated with any either ocular or systemic abnormality.

Inclusion criteria: All children who responded to the clinic invitation were received. A total number of 117 children with bilateral cataracts with their mothers were included in the study. Children with unilateral, secondary and traumatic cataract were not included in this study.

Blood samples collection: All individuals who met the inclusion criteria donated 5ml of blood in an appropriate tube. The blood samples were kept in the fridge at -60°C and antibody titration (IgG) of the rubella and toxoplasmosis panel was performed. Serological tests were performed at the Institut National de Recherche Biomedicale (INRB). Antibodies titration was carried out by using ELISA technique (Calbiotech, USA, rubella and toxoplasmosis Kit). Interpretations of serological results were as follows: (i) Titration < 0.9 (no IgG antibodies); (ii) Titration 0.9-1.1 (positive limit); (iii) Titration > 1.1 (rubella or/and toxoplasmosis antibodies); (iv) The case was considered positive when IgG antibodies were in positive limit in both child and mother.

Statistical analysis: Data were entered into EPI data and exported to an MS Excel file (Microsoft, Albuquerque, New Mexico, USA) and then analyzed with SPSS version 21.0 International Business Machines Corporation (IBM), *Armonk, New York, USA).* Statistics used to describe variables were the mean ± SD for continuous quantitative variables with a normal distribution and the median for those with a non-Gaussian distribution. Qualitative variables were described in terms of relative (%) and/or absolute (*n*) frequency**.** The search for associations to cataract was carried-out using Pearson's Chi Square or Fisher's exact test comparing proportions. A value of $p<0.05$ was considered as a threshold of statistical significance.

Ethical considerations: The study complied with the local laws and the principles of the Declaration of Helsinki. It was approved by the Ethics Committee of the School of Public Health of The University of Kinshasa on 3rd February 2021 (Approbation number ESP/CE/22/B/2021). An informed consent form written in French and Lingala (local language) was signed by parents or guardians of the children who were included in the study. We also obtained consent from children aged 7-16 years to collect their blood sample for the study. The ethical principle of beneficence of the participants in our research was also considered. For this purpose, children who have not been treated were taken care of and those with incurable pathologies were referred to visual rehabilitation structures in Kinshasa.

RESULTS

Socio-demographic characteristics of children and their mothers: We recruited 117 children with bilateral cataract and their mothers. All children with unilateral and traumatic cataract were excluded. The mean age was 7.37±4.28 years (min: 0.5 years; max: 16 years), 73 children were male (62.4%) with a sex ratio of 0.6 in favor of male. The age of the mother at the child's birth (*n*=117 mothers) was: < 20 years old: 3 (3%); 20-40 years old: 107 (91%); > 40 years old: 7 (7.3%). Consanguineous marriage was present in 2 (1.7%) children and endogamic marriage among parents was encountered in 34 (29%) children.

Maternal and obstetrical history: The following factors were encountered as personal history of children with bilateral cataract: low birth weight (45%), stay in the incubator (19%), prematurity (15%), neonatal infection (12%), neonatal hypoxia (6%), and overweight at birth (3%). Hypertension (50%), the use of skin whitening creams (26%), chronic alcoholism (8%), diabetes mellitus (8%), dystocic delivery (5.1%), hypothyroidism (4%) were encountered as main maternal factors. Dystocic delivery was the only obstetrical factor with high significant association with infantile cataract (p=0.00)**.**

Clinical and aetiological classification of cataract: Congenital cataract represented 68 (58.1%) and infantile cataract was 49 (41.9%). Cataract was of unknown origin in 74 (63%) children, genetic in 16 (14%) children, and infectious in 27 (23%) children. It was isolated in 50%, associated to one ocular abnormality in 34%. Strabismus and nystagmus were encountered in 46% and 38% of children respectively. The most common ocular abnormalities associated to cataract were microphthamia / microcornea (10%), lens subluxation (3%), persistent fetal vasculature (1%) and others. Systemic abnormalities were associated to cataract in 21 (17.9%) children. They consisted of multi-systemic disorders in (24%), growth retardation (21%), intellectual disability (17%), Marfan syndrome (5%), albinism (5%), deafness (5%); malnutrition (5%), heart abnormalities (4%), epilepsy (2%) and others.

IgG serology was positive for rubella (child and mother) in 30 (25.6%) children, among them 19 (63.3%) children were only positive to rubella and 11 (36.7%) children were positive for both rubella and toxoplasmosis. IgG serology was positive for toxoplasmosis (child and mother) in 20 (17.1%) children. Serological profile in titer associated cataracts was in favor of rubella in one quarter of all patients in our series. All findings are summarized in Tables 1-3. In contrast, Table 4 shows the distribution of children according to their serological titration for rubella and toxoplasmosis.

Table 1: Socio-demographic characteristics and clinical classification of paediatric cataracts

Parameters	Congenital cataract (n=68) (58.1%)	Infantile cataract (n= 49) (41.9%)	Total n (%)
Age of the children (years)			
Mean : 7.37 ± 4.28	5.9 ± 4.2	9.6 ± 3.5	
(min: 0.5; max: 16)	[1-16]	[2-16]	
Age of the mother at the child's birth (years)			
< 20	1	2	3 (3%)
20-40	64	43	107 (91%)
> 40	3	4	7 (7.3 %)
			p = 0.59
Sex			
Male	41	32	73 (62.4%)
Female	27	17	44 (37.6%)
(Sex ratio of 0.6 in favor of male)			p = 0.36
Clinical aetiology of cataract			
Isolated cataract	27	32	59 (50.4%
Cataract associated to ocular or systemic abnormality			
Children with cataract associated to one ocular abnormality	26	14	40 (34.2%)
Children with cataract associated to more than one ocular abnormality	2	1	3 (2.6%)

Children with cataract associated to one systemic abnormality	4	1	5 (4.3%)
Children with cataract associated to more than one systemic abnormality	1	0	1 (0.8%)
Combination of ocular and systemic abnormality - children with cataract associated to one ocular abnormality a one systemic abnormality	5	1	6 (5.1%)
Children with cataract associated to more than one ocular and systemic abnormality	3	0	3 (2.6%) p = 0.00

Table 2: Distribution of mothers according to their obstetrical and medical history

Determinants	Congenital cataract (n = 68)	Infantile cataract (n = 49)	Total n (%)
Obstetrical, medical history of the mother			
Dystocic delivery			
Yes	0	6	6 (5.1%)
No	68	43	111 (94.9%) p = 0.00
Skin rash in pregnancy			
Yes	1	1	2 (1.7%)
No	67	48	115 (98.3%) p = 0.66
Pre-eclampsia			
Yes	1	0	1 (0.8%)
No	67	49	116 (99.8%) p = 0.58
Hypertension			
Yes	8	5	13 (11.1%)
No	60	44	104 (88.9%) p = 0.52
Diabetes mellitus			
Yes	1	1	2 (1.7%)
No	67	48	115 (98.3%) p = 0.66
HIV positive serology			
Yes	1	0	1 (0.8%)
No	67	49	116 (99.2%) p = 0.58
Hypothyroidism			
Yes	1	0	1 (0.8%)
No	67	49	116 (99.2%) p = 0.58
Use of steroid skin creams			
Yes	4	3	7 (6.4%)
No	64	46	110 (93.6%) p = 0.63

Table 3: Distribution of children according to their neonatal history

Determinants	Congenital cataract (n = 68)	Infantile cataract (n = 49)	Total n (%)
Neonatal child history			
Prematurity			
Yes	6	4	10 (8.6%)
No	62	45	107 (91.4%)
			p = 0.59
Low weight at birth (≤ 2.500 kgs)			
Yes	19	10	29 (24.8%)
No	49	39	88 (75.2%)
			p = 0.24
Overweight at birth (> 4.500 kgs)			
Yes	0	2	2 (1.7%)
No	68	47	115 (98.3%)
			p = 0.17
Perinatal hypoxia			
Yes	2	2	4 (3.4%)
No	66	47	113 (96.6%)
			p = 0.56
Neonatal infection			
Yes	4	4	8 (6.8%)
No	64	45	109 (93.2%)
			p = 0.45
Staying in the incubator			
Yes	6	6	12 (10.3%)
No	62	43	105 (89.7%)
			p = 0.38

Table 4: Distribution of children according to their serological titration for rubella and toxoplasmosis

Determinants	Congenital cataract (n = 68)	Infantile cataract (n = 49)	Total n (%)
Serologic titration for rubella and toxoplasmosis			
Rubella IgG positive (child and mother)			
Yes	13	18	31 (26.5%)
No	55	31	86 (73.5%)
			p = 0.03
Toxoplasmosis IgG positive (child and mother)			
Yes	11	10	21 (17.9%)
No	57	39	96 (82.1%)
			p = 0.36
Rubella IgG and toxoplasmosis IgG positive (child and mother)			
Yes	5	6	11 (9.4%)
No	63	43	106 (90.6%)
			p = 0.28

DISCUSSION

This study observed that children arrived late at the time of surgery. Similar study in Cameroon reported the same delay at moment of diagnosis and surgery (mean age 7.6±7.22 and 6.6 years)[10,11]. This delay in diagnosis and surgery as well as the predominance of males among children with cataract are common in countries with limited resources. The key challenge for child eye program in a low and middle-income countries is to find and timely refer the visually impaired children. Gender and other barriers to having cataract surgical services are well documented in Africa and DRC[12,13]. The study noticed that mothers were very young, aged between 20 and 40 years, and endogamous marriage was frequent among parents. The association between age of mothers and endogamy marriage have never been studied in the literature, but it may initiate research into the genetic mechanisms of cataract in children to whom parents are members of the same ethnic group or tribe. A positive history of familial cataract was present in 14% of children. Our results are in line with those described by Bremond-Gignac *et al*[8], who found a frequency of 18% of positive history of familial cataract in their study series. Consanguineous marriage was rare in our series (1.7%) as an associated factor with paediatric cataract. A study in Switzerland found a frequency close to ours (just one family out of 25 families) of 4%[14]. Pandey *et al* [15] reported a high incidence of consanguinity (80%) in autosomal recessive cases of congenital cataract in India; while a study by Fahkoury *et al*[7] in France found 11% of consanguinity in their series. The frequency of consanguinity differs between countries and cultures. Globally, genetic disease is also a common cause of early life cataract with consanguineous marriage, relatively common in several countries across the world[16].

Low weight at birth was in this study the most common personal history factor associated with paediatric cataract in our study, however, we didn't find any significant association between paediatric cataract in relation with low weight at birth. The association between cataract and low weight at birth within a population is broadly in harmony with the association of paediatric cataract and under five mortality rates[17].

The dystocic delivery in this study was significantly associated to infantile cataract. A study by Shagufta *et al*[18] found that some environmental factors like hypertension and severe specific adverse perinatal events (hypoxia, hypothermia, hypoglycemia) were linked to congenital cataract. This study reported that congenital cataract was caused more by environmental than genetic factors[18]. Bilateral cataracts in children was predominantly congenital, idiopathic, isolated, and associated to one ocular anomaly. In fact, from the point of view of many studies, most of congenital cataracts are of unknown origin and isolated[8]. Strabismus and nystagmus were the most common ocular abnormalities associated with cataract. This has been reported lately in a publication on surgical outcomes of 298 children operated on for cataract at St. Joseph Hospital and is correlated to the delay at presentation[19]. Systemic abnormalities were associated with cataract in 21 children and consisted of psychomotor retardation, intellectual disability, and multisystemic impairment. Our results are similar to those that found by Fakhoury *et al*[7] who reported that congenital bilateral cataracts were associated to several systemic conditions. When a child presents a bilateral congenital cataract, a clinical assessment is compulsory to investigate systemic anomalies, especially galactosemia and Lowe syndrome, considering that both two conditions can be life-threatening for children.

The rubella serology titration (IgG) was positive in a quarter of the children and rubella-toxoplasmosis comorbidity was present in eleven children demonstrating that some children with cataract had a mixed congenital infection. Our results are similar to those reported in some developing countries (such as Tanzania and India), where approximately 25% of infantile cataracts were due to congenital rubella infection[9,15]. Another study in Pakistan found a frequency of 32.5% of rubella among children with cataract[18]. There should be a potential selection bias associated to the study design, and then a case control study will be needed to further confirm rubella and toxoplasmosis as aetiologies of paediatric cataract in Kinshasa. The expected spin-offs of this research are linked to an improvement in knowledge of the epidemiological and aetiological features of paediatric cataract and, in particular, the possibility of carrying out primary prevention of cataract by means of vaccination, which, moreover could be integrated into the current vaccination schedule for pregnant women, which is not yet carried out in the DRC. This could reduce the incidence of congenital cataract in the DRC and in Kinshasa environment.

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