RESEARCH ARTICLE

Systemic and local associated disorders in children with congenital cataracts-a retrospective analysis

Rashid Baig, Asma Rahman, Hamzah Jehanzeb, Khadijah Abid

Abstract

Objective: To assess the systemic and local disorders associated with congenital cataracts in children in a tertiary care setting.

Method: The retrospective study was conducted at the Department of Ophthalmology and Visual Sciences, Aga Khan University Hospital, Karachi, and comprised data from January 2014 to December 2019 of patients aged <12 months who underwent lens aspiration. Data on demographics, family history, maternal illness, and associated systemic and local disorders were collected through chart reviews. Unilateral and bilateral cataracts were stratified. Data was analysed using RStudio.

Results: Of the 84 cases evaluated, 81(96.4%) were analysed after excluding incomplete records; 41(50.6%) boys and 40 (49.4%) girls. The median age at presentation was 6 months (interquartile range: 4-11 months). Bilateral cataracts were more common (n=50, 61.7%) than unilateral cataracts (n=31, 38.3%). Only 2 (2.5%) cases had a family history of congenital cataracts. Systemic associations included cardiac abnormalities (n=4, 4.9%), central nervous system anomalies (n=3, 3.7%), hearing impairment (n=1, 1.2%), and genitourinary malformations (n=1, 1.2%). Chromosomal anomalies (n=3, 3.7%) and inborn errors of metabolism (n=3, 3.7%) were also noted.

Conclusion: The burden of congenital cataracts was significant and its aetiology was multifactorial, emphasising the need for early detection and a multidisciplinary approach to management.

Key Words: Blindness, Children, Congenital cataracts, Local disorders, Systemic disorders.

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Introduction

Congenital cataracts, characterised by opacification of the eye's natural lens, present at birth or develop early in childhood, and are a leading cause of childhood blindness, affecting a staggering 20,000 to 40,000 newborns globally each year.[1] The incidence varies significantly by region, with low- and middle-income countries (LMICs) disproportionately affected due to lower standard of living, regardless of gender or education.[2] In Pakistan, the prevalence of childhood blindness is estimated at 10 per 10,000 children, with almost 23% of children being blind due to congenital cataract or aphakia.[3] There is also a greater chance of developing amblyopia in these children that prompt treatment to prevent permanent vision loss.[4]

The aetiology of congenital cataract is multifactorial, encompassing genetic, metabolic, infectious and environmental factors. About 8.3% to 25% of congenital cataracts are due to genetic mutations, with hereditary forms exhibiting both autosomal dominant and autosomal recessive patterns.[5] Notably, mutations in genes such as Crystallin Alpha A(CRYAA), CRYBB2 (Crystallin Beta B2), and Gap junction alpha-8 protein(GJA8) have been implicated.[6] Metabolic disorders can also lead to congenital cataract which include Wilson's disease, hypocalcaemia, galactosaemia and diabetes.[7] Toxoplasmosis, other agents, rubella, cytomegalovirus and herpes simplex (TORCH) infections to mother during pregnancy are also considered among the causes of congenital cataract.[8,9] Additionally, environmental factors, such as maternal malnutrition, drug use, or exposure to ionizing radiation during pregnancy, further contribute to the risk.[7]

Among the systemic disorders commonly associated with congenital cataracts is Down syndrome, where an increased prevalence of cataracts has been documented.[8] Lowe syndrome, also known as oculocerebrorenal syndrome, presents with congenital cataracts along with other systemic anomalies.[9] Local ocular conditions often associated with congenital cataracts include congenital glaucoma, anterior segment dysgenesis and retinopathies.[10] Understanding these associations is crucial for ensuring comprehensive clinical management and improving outcomes for affected children.

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Despite the significant burden of congenital cataracts, there is limited literature on the local and systemic associations of this condition in LMICs, including Pakistan. The current study was planned to fill the gap by assessing the systemic and local disorders associated with congenital cataracts in children presenting at a tertiary care hospital.

Materials and Methods

The retrospective study was conducted at the Department of Ophthalmology and Visual Sciences, Aga Khan University Hospital (AKUH), Karachi, and comprised data from January 2014 to December 2019 of patients aged <12 months who underwent lens aspiration. After approval from the institutional ethics review committee, the sample size was calculated using the World Health Organisation (WHO) calculator[11] by taking the prevalence of cardiac diseases as 18.8% among infants with congenital cataracts[12], with 9%margin of error and 95% confidence level. The sample was inflated by 15% for missing or incomplete data files. The sample was raised using non-probability convenience sampling method. Patients with cataracts due to a secondary cause, such as trauma, were excluded.

The data was extracted using the hospital's electronic health registry. Data regarding the age at presentation, gender, family history, maternal illness, local and systemic disorders was noted using a predesigned form.

Data was analysed using RStudio. Data was expressed as either median with interquartile range (IQR) or as frequencies and percentages, as appropriate. Stratified analysis was performed to compare laterality (unilateral vs. bilateral cataracts) with age groups (≤6 months and >6 months), gender, presence of local and systemic disorders. Statistical comparisons between the strata were conducted using chi-square or Fisher exact test. Level of significance was set at $p<0.05$.

Results

Of the 84 cases evaluated, 81(96.4%) were analysed after excluding incomplete records; 41(50.6%) boys and

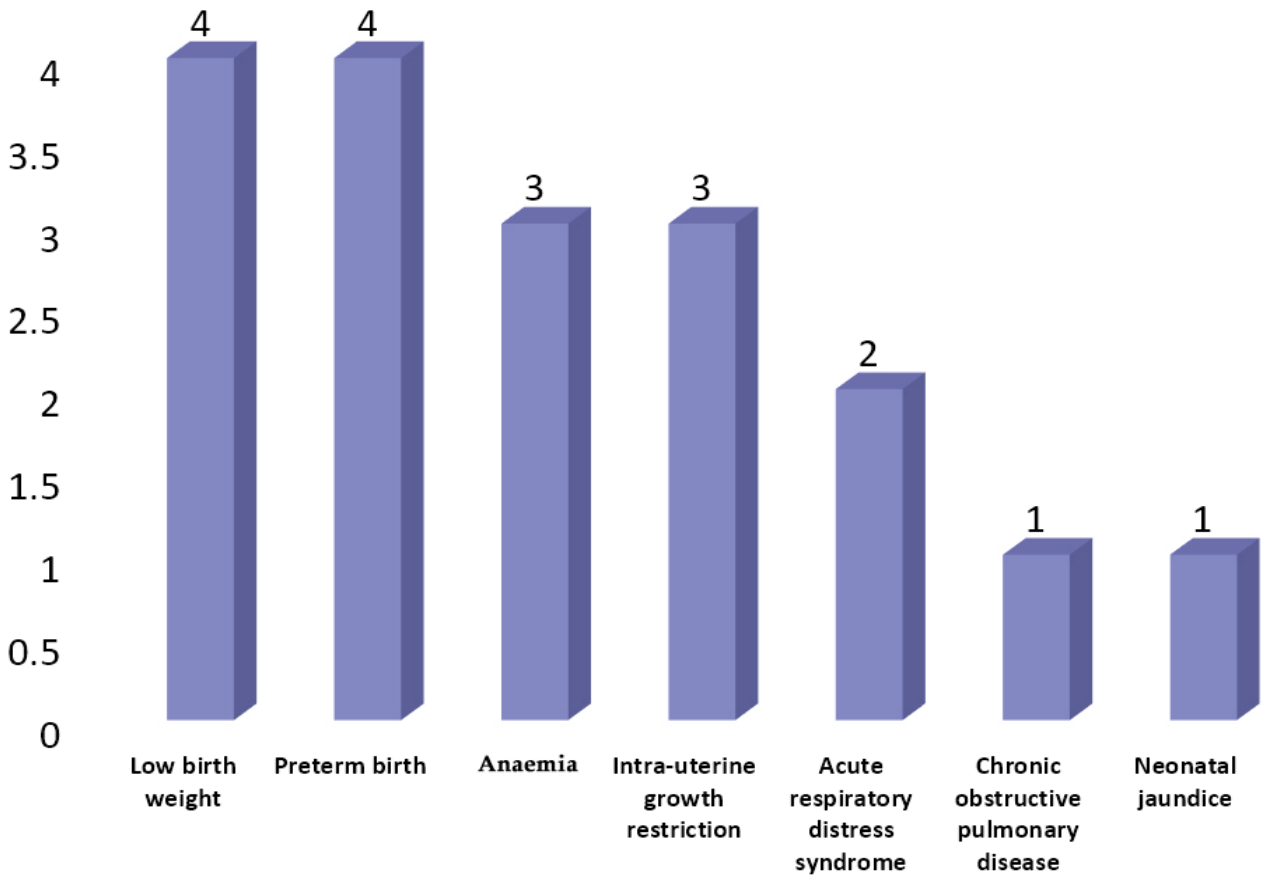

Figure-1: Complications at birth among infants with congenital cataract

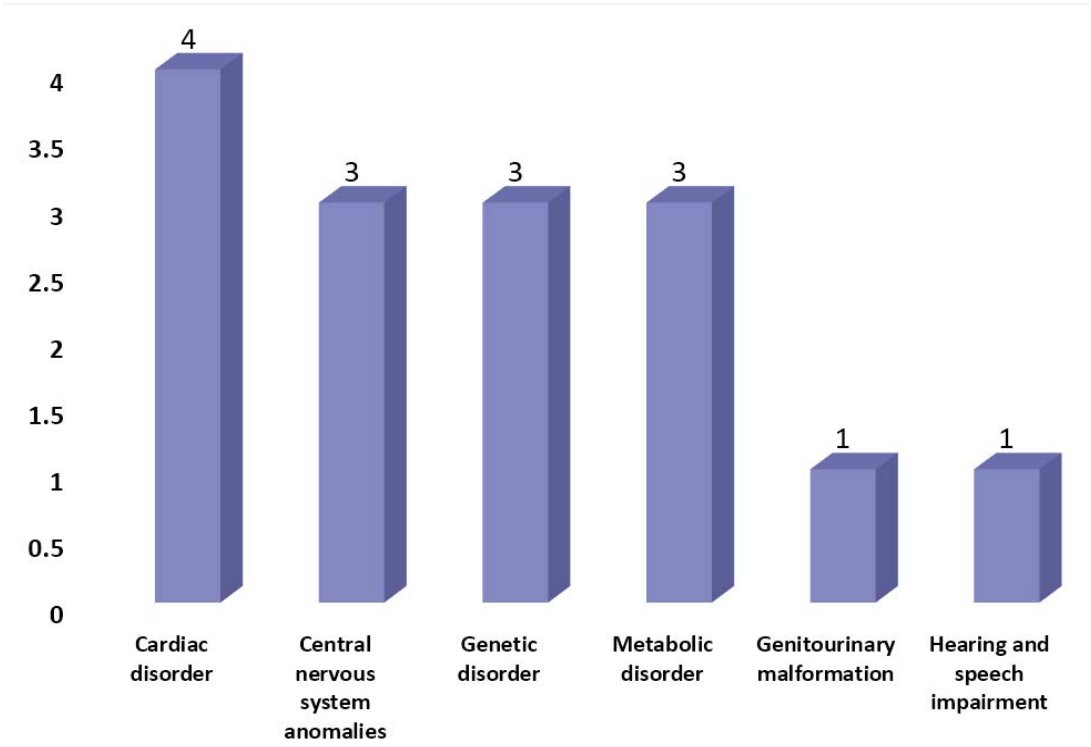

Figure-2: Frequency of anomalies among infants with congenital cataract.

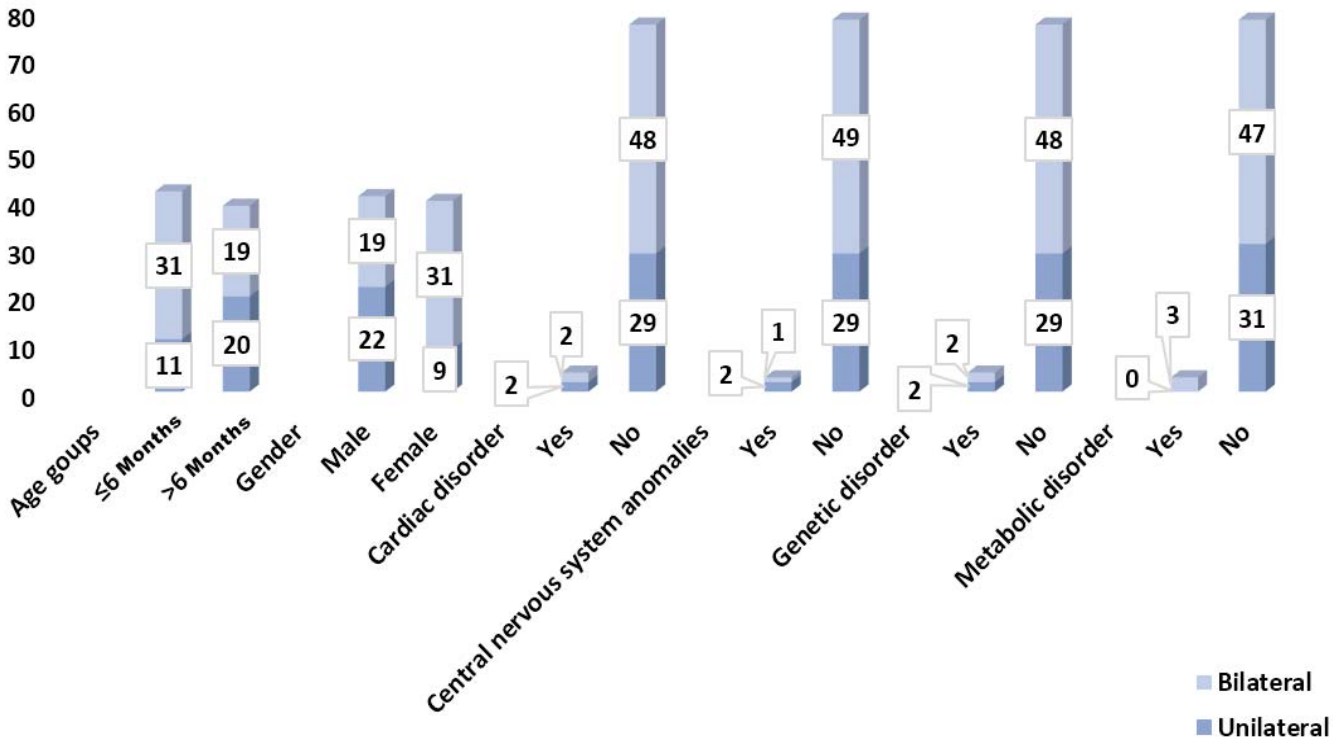

Figure-3: Comparison of age, gender, local and systemic factors with the side of the eye

40(49.4%) girls. The median age at presentation was 6 months (interquartile range: 4-11 months). Bilateral cataracts were more common (n=50, 61.7%) than unilateral cataracts (n=31, 38.3%). Only 2 cases (2.5%) had a family history of congenital cataracts, while 1(1.2%) patient had a history of visual loss in the mother since birth due to unknown aetiology. There was a very low prevalence of family history for diabetes (n=3, 3.7%), hypertension (n=4, 4.9%), asthma (n=1, 1.2%), albinism (n=1, 1.2%) and glaucoma (n=1, 1.2%).

There was 1(1.2%) case having a positive history of maternal illness during pregnancy, with the mother being screened for TORCH infections and testing positive. Overall, 4 (4.9%) of the infants were born prematurely and had low birth weight, 1(1.2%) had jaundice and 3(3.7%) were diagnosed with anaemia. (Figure 1)

Systemic associations included cardiac abnormalities 4(4.9%). Of these cases, 2(50%) involved an isolated atrial septal defect, while the other 2(50%) presented with both atrial septal defect and patent ductus arteriosus. Central nervous system (CNS) anomalies (n=3, 3.7%) manifested as microcephaly in 1(1.2%) case and seizure disorders in 2(2.5%). Hearing impairment was detected through screening in 1(1.2%) patient. There was 1(1.2%) case of genitourinary malformation (hypospadias). Chromosomal anomalies in 3(3.7%) case, and all of them had Down syndrome (trisomy 21). Inborn errors of metabolism were identified in 3(3.7%) patients. These included 1(33.3%) case each of G6PD deficiency and hyperhomocysteinemia, with 1(33.3%) patient had both Wilson's disease and hyperhomocysteinemia (Figure 2).

There was a significantly higher proportion of bilateral cataracts in those aged ≤6 months than unilateral cataracts (n=31, 73.8% vs n=11, 26.2%, p=0.002). There was a significant difference in the distribution of unilateral and bilateral cases in males, with a higher proportion of unilateral cases (n=22, 53.7%). For females, there was a higher proportion of bilateral cases (n=31, 77.5%) (p=0.004). (Figure 3).

Discussion

The current study reveals critical aspects of congenital cataracts, emphasising the importance of early diagnosis and a multidisciplinary approach in managing affected children. One of the most important parameters in terms of management is laterality. Unilateral cataracts tend to have a poorer prognosis due to a higher risk of amblyopia compared to bilateral cataracts. The visual outcome after cataract surgery for unilateral congenital cataracts heavily depends on the early clearance of the visual axis, aphakic correction, and aggressive amblyopia treatment.[7, 13,14]

The current data revealed that congenital cataracts contribute significantly to childhood blindness, with bilateral cases being more common than unilateral ones. This finding aligns with global trends, where congenital cataracts remain a major cause of preventable childhood blindness, especially in LMICs.[15,16] In a study conducted by Naz et al. in Pakistan, the prevalence of bilateral congenital cataracts was higher than unilateral cases (54% vs. 46%).[17] Sharma et al. found that 78.2% of infants in Nepal had bilateral congenital cataracts.[18] In an Indian study by Singh et al., 77.9% of patients presented with bilateral cataracts, while 22.1% had unilateral cataracts.[19] The earlier presentation of bilateral cataracts compared to unilateral cases may be due to the more severe symptoms associated with bilateral cataracts, prompting quicker medical attention. These findings emphasise the need for vigilant screening and prompt intervention to prevent long-term visual impairment in the affected children.

In the current study, the proportion of congenital cataracts in males was nearly equal to that in females. However, females had a significantly higher proportion of bilateral congenital cataracts than males. In contrast, a study by Naz et al. reported that 55% of congenital cataract cases were in male children, while 45% were in female children. The study observed both unilateral and bilateral congenital cataracts, with incidences of 46% and 54% in males and females, respectively.[17]

Another study by Rana et al. in Pakistan found that bilateral congenital cataracts were present in 53% of males and 47% of females. Additionally, males were more frequently affected than females in both bilateral and unilateral cataract groups, although this difference was not significant (p=0.093).[14] This gender disparity could be attributed to genetic and hormonal differences, though further research is needed to elucidate the underlying mechanisms. Additionally, the higher prevalence of bilateral cataracts in younger age groups suggests the importance of early screening and intervention to prevent long-term visual impairment.

Ideally, congenital cataracts should be operated on before 3 months of age to prevent long-term vision impairment. However, in LMICs, the detection of congenital cataracts is often delayed.[1,15,20] For instance, a study conducted in southwest Nigeria between 2011 and 2015 found that the median age at presentation for congenital cataracts was 18 months.[21] Similarly, a 2011 study in China reported that 41% of children with bilateral congenital cataracts and 12% of children with unilateral cataracts were <6months of age at presentation. Among these, 16% with bilateral cataracts and 1% with unilateral cataracts underwent surgery at 3-6 months of age.[22] In

the current study, the median age at presentation was 6 months, with 51.9% of the children presenting at or before 6 months of age. This included 11 cases of unilateral cataracts and 31 cases of bilateral cataracts. The higher number of bilateral cases presented earlier is likely due to the more noticeable reduction in vision in these children, prompting quicker medical attention. This early detection is crucial for timely surgical intervention and better visual outcomes.

The most common aetiological factor for bilateral cataracts reported in the literature is autosomal dominant inheritance, while unilateral cataracts are understood to be mostly idiopathic.[2] Despite most patients in the current sample having bilateral cataracts, only 2 had a family history of congenital cataracts. Notably, both cases involved bilateral cataracts. Since bilateral cataracts rarely arise idiopathically, this suggests that there is insufficient surveillance or testing for other causes of congenital bilateral cataracts.

Other important aetiological factors for bilateral cataracts identified in the current study included 1 case of a TORCH infection, 1 case of trisomy 21, and 3 cases of inborn errors of metabolism.[7] In the Pakistani setting, this might be a manifestation of poor antenatal care, with very few mothers getting screened for TORCH infections, or due to cost restrictions of further workup for aetiological factors, such as genetic testing or metabolic panels.

The current study also found occasional coexistence of congenital cataracts with anomalies of other organ systems. The prevalence of systemic associations included cardiac abnormalities (4.9%), CNS anomalies (3.7%), hearing impairment (1.2%), and genitourinary malformations (1.2%). These findings are consistent with the usual aetiological factors responsible for congenital cataracts. In cases of bilateral cataracts, which are mostly inherited in an autosomal dominant fashion as the only congenital anomaly, one would not expect to see other anomalies. Conversely, unilateral congenital cataracts are usually idiopathic and unrelated to other congenital anomalies.[23]

In the current study, where systemic anomalies were found, underlying syndromes were likely present. For example, 1 case with an atrial septal defect was a diagnosed case of trisomy 21, and another case of an atrial septal defect was associated with microcephaly, which commonly indicates an underlying disorder. Previous studies in Pakistani population, such as those conducted by Naz et al., have found that up to 38% of congenital cataract cases were associated with genetic factors.[23]

The current study's unique contribution is its focus on systemic associations, such as cardiac abnormalities and CNS anomalies, among congenital cataract patients. These findings add to the limited body of literature on systemic associations in LMICs, where congenital cataracts and associated disorders may often go undetected due to insufficient resources. However, it is crucial to acknowledge that while the study observed associations with systemic disorders, statistical analysis did not reveal significant differences in the distribution of these associations between unilateral and bilateral cases. Additionally, potential confounding factors, like prenatal care access and socioeconomic status, were not fully controlled in the retrospective analysis, which could have influenced the prevalence and type of systemic associations detected.

The current study has its limitations owing to its retrospective design, which limited causative interpretations, and the reliance on available patient records meant that confounding factors, such as maternal health conditions, prenatal screenings, and socioeconomic variables, could not be comprehensively assessed. This limitation restricted the ability to draw definitive conclusions about the aetiological relationships between congenital cataracts and systemic associations. Future studies would benefit from a prospective design with stratified sampling that considers these confounders for a more nuanced understanding of the factors contributing to congenital cataracts and associated systemic disorders.

In terms of clinical implications, the identification of systemic associations, including cardiac and CNS anomalies, emphasises the need for a multidisciplinary management approach. These associations highlight the potential presence of broader syndromic conditions, requiring timely referrals to paediatric cardiology, neurology, and genetic counselling. For clinicians, awareness of these common systemic associations with congenital cataracts can improve the screening and monitoring of at-risk infants, particularly in LMICs where congenital cataracts remain a major cause of preventable childhood blindness.

Conclusion

There is a critical need for early detection and a multidisciplinary approach in managing congenital cataracts, especially in settings with limited healthcare resources. Further research, ideally with larger, prospective cohorts and consideration of socioeconomic and prenatal factors, is needed to validate the findings and develop tailored interventions for improving the

visual and developmental outcomes for children affected by congenital cataracts.

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AUTHOR'S CONTRIBUTION:
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AR: Concept, writing, review, editing, formal analysis and final review.
HJ: Writing, original draft, data curation and final review.
KA: Methodology, statistical analysis, visualisation, writing, review and editing and final review.