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# Association between ocular abnormalities and systemic diseases in Down Syndrome patients

## *Associação entre achados oftalmológicos e comorbidades em pacientes com Síndrome de Down*

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### *ABSTRACT*

***Objectives:*** *Describe ocular findings and its correlation with systemic diseases in Down Syndrome (DS) pediatric patients. Methods: Quantitative and cross-sectional study of prevalence with children aged from 0 to 25 years. Standard ophthalmic examinations performed: visual acuity, slit lamp biomicroscopy, ocular motility, static refraction and indirect ophthalmoscopy. Ocular findings were associated with comorbidities available in pediatric records of patients in FURB Down Syndrome Outpatient clinic, in which they have regular follow-up. Results: A total of 76 patients were evaluated (33 males and 43 females). Of these, 72 patients (94.73%) had ocular abnormalities. Refractive errors were the most prevalent (94.73%), followed by alterations in indirect ophthalmoscopy (40.8%), biomicroscopy (15.8%), ocular motility (15.8%) and epiphora (9.2%). From the refractive changes 13.15% had myopia; 76.31% had hypermetropia and 47.36% had astigmatism. Sytemic abnormalities were observed in 73 children. The most prevalent was thyroid diseases presented in 65.79%, followed by heart disease 61.84%, gastrointestinal disease (15.79%); abdominal hernias (14.4%); respiratory changes (14.4%); genitourinary alterations (10.53%); musculoskeletal alterations (10.53%) and epilepsy (3.95%). There was statically significant association between the presence of myopia and hypothyroidism (p = 0.01); astigmatism and heart diseases (p = 0.003); and astigmatism and genitourinary alterations (p = 0.001). Conclusion: There was a high prevalence of ophthalmologic abnormalities in this study of children with Down Syndrome. Associations between myopia and hypothyroidism, astigmatism and heart diseases, and astigmatism and genitourinary disorders were found. More studies and increase of the sample are necessary to confirm the associations of ophthalmologic abnormalities with most common systemic diseases in this population.*

*Keywords: Down Syndrome; Refractive errors; Child; Comorbidity*

### RESUMO

**Objetivos:** Descrever as alterações oculares e sua correlação com outras comorbidades em pacientes pediátricos com Síndrome de Down (SD). Métodos: Estudo quantitativo de prevalência com delineamento transversal em crianças de 0 a 25 anos portadoras de SD. Realizados exames oftalmológicos de acuidade visual, biomicroscopia anterior, motilidade ocular, refração estática objetiva ou subjetiva conforme o nível de cooperação do paciente e oftalmoscopia indireta. Os achados foram correlacionados com as comorbidades disponíveis nos prontuários dos pacientes do Ambulatório de Síndrome de Down da FURB, no qual são acompanhados regularmente. Resultados: Foram avaliados 76 pacientes (33 do sexo masculino e 43 do sexo feminino). Dentre esses, 72 pacientes (94,73%) tiveram alterações oculares. Alterações refrativas foram as mais prevalentes (94,73%), seguidas de alterações na oftalmoscopia indireta (40,8%), biomicroscopia (15,8%), motilidade ocular (15,8%) e epífora (9,2%). Das alterações refrativas 13,15% tiveram miopia; 76,31% tiveram hipermetropia e 47,36% tiveram astigmatismo. Na amostra, 73 pacientes possuíam alguma comorbidade. A mais prevalente foi a alteração de tireoide, presente em 65,79% dos pacientes, seguido de alterações cardíacas (61,84%), alterações gastrointestinais (15,79%), hérnias abdominais (14,4%), alterações respiratórias (14,4%), alterações geniturinárias (10,53%), alterações osteomusculares (10,53%) e epilepsia (3,95%). Houve associações significativas entre miopia e hipotireoidismo (p = 0,01); astigmatismo e cardiopatias (p = 0,003); e astigmatismo e alterações geniturinárias (p = 0,001). Conclusão: Houve alta prevalência de alterações oftalmológicas na amostra. Foram encontradas associações entre miopia e hipotireoidismo, astigmatismo e cardiopatias, e astigmatismo e alterações geniturinárias. Mais estudos e aumento da amostra são necessários para confirmar os resultados das associações nessa população.

Descritores: Síndrome de Down; Erros de refração; Criança; Comorbidades

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## Introduction

Down syndrome is the most common known genetic disorder in the world, with a prevalence of 1: 700 to 1: 1000 live births. [1] In Brazil the incidence is 1.13: 1000 live births .[2] The syndrome results of the presence of an extra copy of chromosome 21 in the genetic material, with 95% being characterized by regular trisomy and 5% by mosaic translocation. The main factor for regular trisomy is high maternal age, affecting 1 in 30 live births with mothers older than 45 years.[3]

The phenotypic characteristics of the syndrome are variable, and among the clinical manifestations a large variety of dysmorphisms, congenital malformations and other general medical conditions are observed, being only the mental impairment present in all people with DS. Even though it is a constant in the syndrome, mental impairment varies in degree in each patient.[4] Hearing loss, obstructive sleep apnea, otitis media, ocular diseases and congenital cardiopathies are the most frequent systemic alterations and must be traced after birth of the baby with SD.[5]

According to the American Academy of Pediatrics, 60% of children with DS have visual abnormalities, 15% have congenital cataracts and 50% have refractive errors.[5] National data show that the main ophthalmologic changes detected were oblique palpebral fissures in 100% of patients, epicanthus in 70%, supernumerary vessels in the arches at retinal mapping examination in 100%, blepharitis in 42.85%, obstruction of the lacrimal excretory route in 25.71%, myopia in 14.28% and astigmatism in 22,85%.[2]

The early detection and correction of ophthalmologic abnormalities is fundamental for the visual development of these children.[6] This allows to improve and to develop the visual monocular or binocular efficiency, favoring a better neurological development; also allows increasing the quality of life, favoring their interaction with the environment and learning, as well as providing stimuli that guarantee the children the maximum development of their potentialities.[7]

Congenital cardiac malformation is one of the most common finding in DS patients and the most common forms observed include: defects in the ventricular septum, atrial septum, atrioventricular septum, pulmonary stenosis and pulmonary atresia. [8] Moreover, there is a report that already suggest an association between the myopia observed in some children with DS who had congenital heart defects.[9]

Studies have significantly associated myopia, nystagmus, and heart disease in patients with Down Syndrome.[8,10] Thyroid alterations may also be associated with ocular pathologies.[11] However, non-ophthalmological diseases are rarely included in the analysis of patients with Down Syndrome in the ophthalmologic literature.[8] The objective of this study was to evaluate ophthalmologic abnormalities in patients with Down Syndrome of the pediatric age group and to associate these results with the comorbidities of these patients.

## Methods

A quantitative study of prevalence with a cross-sectional design was conducted in the city of Blumenau, SC, Brazil. The study population was composed of children with Down Syndrome in the age group ranging from 0 to 25 years, users of the Brazilian Unified Health System (SUS – Sistema Único De Saúde), attended at the FURB Down Syndrome Outpatient Clinic. The sample group consisted of 76 patients. The inclusion criteria in the study were: patients with a diagnosis of DS, age ranging between 0 and 25 years old, who agreed to participate in the study voluntarily, by means of a free informed consent form for minor, and consent form for a minor - adolescent. Exclusion criteria involved individuals who did not meet the criteria above and patients with difficulties to perform more than three of the proposed tests.

Comorbid data, except for ophthalmologic findings, were collected from the records of these patients from the Regional University of Blumenau Down Syndrome Outpatient Clinic, in which these patients have a regular follow up. The ophthalmologic evaluation was performed at the Botelho Vision Hospital in Blumenau by ophthalmologists from May 2017 to September 2018.

Ophthalmic examination included visual acuity analysis, slit lamp biomicroscopy, ocular motility using standard methods, retinoscopy with cycloplegia and indirect ophthalmoscopy. All measures of strabismus were made with total correction of the refraction. Biomicroscopy in the slit lamp was done in patients over 12 months of age who had sufficient head control.

Visual acuity was determined by the Snellen E test or the visual preference test, depending on the patient's level of cooperation. As DS may have different levels of cognitive and also cooperation, impossibility to measure visual acuity was not an exclusion criteria for the study.

Evaluation of the eyelid fissure was done by the method described by Solomons and associates[12]. A transparent millimeter ruler was placed across the nasal dorsum at the level of the medial corner of both eyes, and a vertical misalignment of the lateral corner was recorded. Upper or lower misalignment of the eyelid fissure was defined as 2 mm or greater.

The diagnosis of nasolacrimal duct obstruction was based on the history of recurrent epiphora or mucopurulent secretion from birth. The patients submitted to biomicroscopy in the slit lamp for examination were evaluated: palpebral margin, conjunctiva, corneal thinning, iris abnormalities and evaluation of the lens.

Cycloplegia was performed in all patients regardless of age, 45 minutes after the application of one drop of anesthetic and one drop of cyclopentolate 1%. Emmetropia was defined as a refractive error between -0.50 to +0.50 spherical equivalents, myopia with less than -0.50 spherical equivalents, and hypermetropia as more than +0.50 spherical equivalents; astigmatism was defined as a refractive error greater than 0.50 cylindrical diopters. Severe myopia and hypermetropia were defined as more than 7.00 diopters of spherical equivalent and severe astigmatism as more than 3.00 cylindrical diopters. There was no undesirable reaction with the application of the topical anticholinergics used in the study for pupil dilation

Indirect ophthalmoscopy after mydriasis was used to examine the retina, optic disc and evaluate the vessels in relation to the optic disc.

The data were organized into descriptive tables containing absolute, relative, mean, standard deviation and estimates as 95% confidence intervals. Fisher's Exact Test was used to perform the associations, the test being most appropriate when the samples were small and / or presence of expected frequencies less than 5. In all cases, the statistical significance was considered if the value $p<0.05$. Data analysis was performed using Microsoft Excel 2016 software.

The present study was approved according to the norms of the committee of ethics in humans of the Fundação Universidade Regional de Blumenau number 64068216.6.0000.5370.

## Results

A total of 76 children with Down's Syndrome (33 males and 43 females) were evaluated. The ages ranged from 0 to 25 years and the mean age was 10.38. The mean age of the boys was 9.51 and the mean age of the girls was 11.05.

In the present sample, patients were divided into complete zero-to-five-year intervals, from six to ten full years, from eleven to fifteen full years, and from sixteen to twenty-five full years presenting similar numbers in each age group (Table 1).

Table 2 shows the ophthalmologic findings of this study. Indirect ophthalmoscopy examination showed: myopic fundus (6.57%), diffuse rarefaction of retinal pigment epithelium (9.21%), persistence of myelin fiber (2.63%), papillary enlargement (2.63%), supernumerary ocular vessels (15.78%), increased vascular tortuosity (1.31%) and papillary atrophy (2.63%). The findings in the previous biomicroscopy were blepharitis (2.63%), calazia (1.31%) and trichiasis (2.63%). Finally, changes in ocular motility were found: foria (1.31%), nystagmus (2.63%) and strabismus (11.8%).

Regarding the refractive changes described in table 3, there were 2 individuals with severe myopia, 1 with severe astigmatism and 1 with severe hyperopia. Two individuals assessed had myopia in one eye and hypermetropia in the other. Some patients had their first ophthalmologic diagnosis done in this research and others already had the diagnosis but had to adjust their corrective lenses.

Also concerning refractive changes, when these were distributed in relation to the age group, the percentage of each alteration was similar in all age groups (Table 4). Approximately 58.9% of the patients did not perform visual acuity tests due to non-cooperation

On the subject of comorbidities, of the 76 patients analyzed, 73 had some comorbidity. The most prevalent was the thyroid dysfunction being present in 65.79% individuals, in which only 1 presented hyperthyroidism and the other hypothyroidism. Cardiac alterations were identified in 61.84% of the individuals, followed by gastrointestinal alterations (15.79%); abdominal hernias (14.47%), respiratory changes (14.47%); genitourinary alterations (10.53%); orthopedic changes (10.53%) and epilepsy (3.95%). Among the cardiac alterations, it was observed that IAC (Interatrial Communication) was the most prevalent, present in 30 (39.47%) individuals, followed by ACP (Arterial Canal Patency) in 12 (15.79%); IVC (interventricular communication) in 11 (14.47%), DAVS (Defect in the Atrioventricular Septal) in 5 individuals (6.58%); PVS (Pulmonary Valve Stenosis) in only 2 subjects (2.63%) and TF (Tetralogy of Fallot) in 1 individual (1.32%). It is important to note that some patients had more than one concomitant cardiac defect and comorbidities as well, so the analysis was isolated.

The association between the presence of ophthalmological

**Table 1**
**Distribution of absolute, relative, averages and estimates with 95% confidence of the demographic characteristics of the patients**

| Characteristics | Number of patients n(%) | CI (95%) |
|---|---|---|
| Sex | | |
| Male | 33 (43.4) | (32.28-54.56) |
| Female | 43 (56.6) | (45.44-67.72) |
| Age (years) | | |
| ≤ 5 | 20 (26.3) | (16.42-36.22) |
| 5 < x ≤ 10 | 19 (25) | (15.26-34.74) |
| 10 < x ≤ 15 | 17 (22.4) | (13-31.74) |
| 16 < x ≤ 25 | 20 (26.3) | (16.42-36.22) |

SD: standard deviation; CI: confidence interval

**Table 2**
**Distribution of absolute, relative, mean and estimated frequencies with 95% confidence of patients' ophthalmological abnormalities**

| Ophthalmological abnormalities | Number of patients n (%) | CI (95%) |
|---|---|---|
| Biomicroscopy | | |
| Normal | 44 (57.9) | (46.79-68,99) |
| Changed | 12 (15.8) | (7.59-23,99) |
| Unrealized | 20 (26.3) | (16.42-36,22) |
| Indirect ophthalmoscopy | | |
| Normal | 43 (56.6) | (45.44-67.72) |
| Changed | 31 (40.8) | (29.74-51.84) |
| Unrealized | 2 (2.6) | (0-6.23) |
| Ocular Motility | | |
| Normal | 63 (82.9) | (74.43-91.36) |
| Changed | 12 (15.8) | (7.59-23.99) |
| Impaired | 1 (1.3) | (0-3.88) |
| Epiphora | | |
| No | 69 (90.8) | (84.29-97.29) |
| Yes | 7 (9.2) | (2.71-15.71) |

SD: standard deviation; CI: confidence interval

**Table 3**
**Distribution of absolute, relative frequencies and estimates with 95% confidence of refractive errors of patients**

| Type of refractive error | Number of patients n (%) | CI (95%) |
|---|---|---|
| Myopia | 4 (5.3) | (0.24-10.28) |
| Hypermetropia | 29 (38.2) | (27.24-49.08) |
| Myopic Astigmatism | 5 (6.6) | (1.01-12.15) |
| HypermopicAstigmatism | 27 (35.5) | (24.77-46.29) |
| Mixed Astigmatism | 4 (5.3) | (0.24-10.28) |
| Myopia and Hypermetropia | 2 (2.6) | (0-6.23) |
| Emmetropia | 4 (5.3) | (0.24-10.28) |
| Unrealized | 1 (1.3) | (0-3.88) |

SD: standard deviation; CI: confidence interval

**Table 4**
**Refractive errors according to the age of the patients**

| | | | | |
|---|---|---|---|---|
| ≤ 5 | 20(26.3) | 1(12.5) | 16(27.59) | 1(2.78) |
| 5 < x ≤ 10 | 19(25) | 2(25) | 16(27.59) | 10(27.78) |
| 10 < x ≤ 15 | 17(22.4) | 2(25) | 13(22.41) | 11(30.56) |
| 15 < x ≤ 25 | 20(26.3) | 3(37.5) | 13(22.41) | 14(38.89) |
| Total | 76 (100) | 8(10.53) | 58(76.32) | 36(47.37) |

**Table 5**
**Association between ophthalmologic abnormalities and hypothyroidism**

| Ophthalmological abnormalities | Hypothyroidis (N = 50) n(%) | No hypothyroidism (N = 26) n(%) | p-value |
|---|---|---|---|
| Myopia | 10 (20) | 0 (0) | *0.01631 |
| Hypermetropia | 38 (76) | 20 (80) | 0.69651 |
| Astigmatism | 27 (54) | 9 (36) | 0.14133 |
| Biomicroscospy | 11 (29.73) | 1 (5,26) | *0.03463 |
| Indirect ophthalmoscopy | 22 (44.9) | 9 (36) | 0.46309 |
| Ocular motility | 12 (24.49) | 0 (0) | *0,00590 |
| Epiphora | 5 (10) | 2 (7.69) | 0.74136 |
| Congenital cataract | 3 (6) | 0 (0) | 0.20252 |

*p-value of the Chi-square test of independence or the Fisher's Exact Test in cases of expected frequency below 5. If P <0.05 then significant association

**Table 6**
**Association between ophthalmologic abnormalities and cardiac anomaly**

| Ophthalmological abnormalities | Heart anomalies (N = 47) n(%) | No heart anomalies (N = 29) n(%) | p-value |
|---|---|---|---|
| Myopia | 7(15.22) | 3(10.34) | 0.54550 |
| Hypermetropia | 35(76.09) | 23(79.31) | 0.74541 |
| Astigmatism | 16(34.78) | 20(68.97) | *0.00391 |
| Biomicroscopy | 7(21.21) | 5(21.74) | 0.96229 |
| Indirect ophthalmoscopy | 21(46.67) | 10(34.48) | 0.29972 |
| Ocular Motility | 7(15.22) | 5(17.24) | 0.81589 |
| Epiphora | 5(10.64) | 2(6.9) | 0.58371 |
| Congenital cataract | 3(6.38) | 0 (0) | 0.16507 |

*p-value of the Chi-square test of independence or the Fisher's Exact Test in cases of expected frequency below 5. If P <0.05, then there is significant association

changes and hypothyroidism, as well as ophthalmologic associations and heart diseases are presented in tables 5 and 6. Within cardiac alterations, AIC was associated with astigmatism (p = 0.01).

Also concerning refractive changes, when these were distributed in relation to the age group, the percentage of each alteration was similar in all age groups (Table 4). Approximately 58.9% of the patients did not perform visual acuity tests due to non-cooperation

On the subject of comorbidities, of the 76 patients analyzed, 73 had some comorbidity. The most prevalent was the thyroid dysfunction being present in 65.79% individuals, in which only 1 presented hyperthyroidism and the other hypothyroidism. Cardiac alterations were identified in 61.84% of the individuals, followed by gastrointestinal alterations (15.79%); abdominal hernias (14.47%), respiratory changes (14.47%); genitourinary alterations (10.53%); orthopedic changes (10.53%) and epilepsy (3.95%). Among the cardiac alterations, it was observed that IAC (Interatrial Communication) was the most prevalent, present in 30 (39.47%) individuals, followed by ACP (Arterial Canal Patency) in 12 (15.79%); IVC (interventricular communication) in 11 (14.47%), DAVS (Defect in the Atrioventricular Septal) in 5 individuals (6.58%); PVS (Pulmonary Valve Stenosis) in only 2 subjects (2.63%) and TF (Tetralogy of Fallot) in 1 individual (1.32%). It is important to note that some patients had more than one concomitant cardiac defect and comorbidities as well, so the analysis was isolated.

The association between the presence of ophthalmological changes and hypothyroidism, as well as ophthalmologic associations and heart diseases are presented in tables 5 and 6. Within cardiac alterations, AIC was associated with astigmatism (p = 0.01).

There was also an association of alterations in ocular motility (p = 0.003) with respiratory changes. In this study the present motility alterations were: esotropia, exotropia, foria and nystagmus. We also found an association between astigmatism and genitourinary alterations (p = 0.001). There was no significant association of ophthalmologic alterations with the other comorbidities analyzed in the study.

Respiratory changes were asthma, rhinitis and recurrent tracheobronchitis. Genitourinary alterations are represented by cryptorchidism, hydrocele, testicular torsion, phimosis and hypospadias.

## Discussion

The prevalence of ophthalmological alterations in children with Down Syndrome in this sample was 94.73%. In a study of the American Society of Pediatrics, the prevalence was 60% [5], lower than the value found in this study. The high prevalence of ophthalmologic alterations is already known, even if it varies according to the region of study, this is extremely important, because the early diagnosis allows children with DS to develop their potential to the maximum, improving their quality of life.[13,14]

Among all the ophthalmological alterations, the most prevalent in the study was refractive alteration, among which, hypermetropia was the most prevalent, followed by astigmatism and myopia. A different result was found in another Brazilian study carried out in São Paulo (SP), in which the highest prevalence was astigmatism (22.85%), hyperopia (20%) and myopia (14.28%). however, such study was done with 2-month-old children.[2]

In a study by the American Society of Pediatrics, refractive changes (50%) were the most common among all ophthalmologic disorders,[5] as well as in this study. An explanation for this high refractive prevalence in these patients is the process of inactive emmetropization. Emmetropization is a change in refraction influenced by eye growth and this growth is, to some extent, guided by retinal blur. This is because both normal children and children with DS are born with similar levels of refractive error, but children with DS increase in quantity and amplitude of these errors.[15]

In this sample, 40.8% presented alterations in indirect ophthalmoscopy. Literature is scarce on the subject in this population, which is due to the challenge in the accomplishment of images of the retinas of the same ones. Retinal vessel abnormalities, fovea hypoplasia, retinal pigment epithelium hyperplasia (32%) [16] and 15% retinal changes were observed in 123 Asian patients with DS, 13% of which had an increase in number of vessels and 2% with focal pigment epithelial hyperplasia of the retina.[17] In addition, a Brazilian study of 35 two-month-old children with DS, in which 100% of them had increased vessels in retina,[2] and according to the literature, supernumerary vessels in the arches are pathognomonic of this syndrome, due to the deficiency of angiogenesis proven in these patients.[17]

Regarding the changes in biomicroscopy, blepharitis, chalazia and trichiasis were found (15.8%) in the sample. Blepharitis

is always the most present alteration in all studies. 16% in Asian studies had blepharitis [18]. In a Brazilian study 42.85% showed pathology. [2] Other absent alterations in this study are also cited as ptosis, hordeolum entropion, ectropion, trichiasis and Brushfield spots.[2,18,19]

Epiphora was found in 9.2% of the sample, as in other studies were found in 15%[18] and Brazilian labor in 2012 were found 27.27% of the sample.[2] Most of the causes of congenital epiphora in patients with Down syndrome are due to the functional block of the lacrimal pump, different from that occurring in patients without the syndrome, in which the main cause is the anatomical obstruction of the lacrimal pathways.[20]

In relation to cataract, in the present study the prevalence was 3.95%; in a study of the American Society of Pediatrics 15% of the children with DS analyzed had cataract[5] and in an Asian study, the opacity of lenses was 3% of the sample.[18] In another Brazilian study carried out in São Paulo (SP), 2.85% of the patients had cataracts.[2] The etiology of this pathology is still unknown in patients with Down syndrome, requiring further studies in the area. We also know that senile cataract occurs earlier in patients with DS, compared to patients without the syndrome, so the difference in prevalence is directly related to the age range of the patients in the studies.

Changes in ocular motility in this study occurred in 15.8% of patients. Of these, 1.31% presented foria, 2.63% presented nystagmus and 11.8% strabismus established. In other studies, strabismus was present in 25% of patients.[18] In European study 26.1% had esotropia.[15] Already in another study conducted in Brazil, 11,42% of patients had esotropia and 5.71% exotropia. [2] Nystagmus in this study was present in 7.89% of the patients. In a study in Asia, this change was present in 22% of the study population. [18] In European study 29.2% patients had the change. [15] In a Brazilian study of 2012, however, nystagmus was present in 2.85%, [2] being more similar to the results of this study.

About the cardiac malformations, that are more common in individuals with Down Syndrome compared to the general population.[21] The present study showed a prevalence of 61.84% (n = 47) of cardiac alteration, this prevalence corroborates with others, national and international studies (40-50%), besides the increased risk that this population has to develop cardiopathies (50%).[5,8,22-24] Previous studies have shown a prevalence of thyroid abnormalities from 4 to 18%,[5,25] being in the present paper, the most prevalent comorbidities (hypothyroidism). More than half of the causes of hospital admission of children with Down syndrome are respiratory problems, and of the total admissions, 10% are directly in the pediatric intensive care unit. [26] It is expected that 4-10% of children with DS in the general population will have a congenital anomaly of the gastrointestinal tract,[27] but in the present study the percentage found was higher (15.79%).

The literature reports scarcely about associations between comorbidities and ophthalmologic changes in pediatric patients with Down Syndrome. The present study reveals an association of cardiac abnormalities in general and specifically IAC that have been associated with astigmatism. The only two studies found on associations showed that the refractive change of myopia and astigmatism could be associated with heart disease.[8,10] Davies et al. [28] reported an association between ophthalmopathies and COL6A1 gene variation and cardiac congenital defects in DS. The COL6A1 gene encodes part of the collagen VI, a component of many ocular tissues. Bromham et al.,[10] notes that this type of association is more prevalent up to 9 years.

In this sample, 48.6% of the patients were older than 9 years of age, which may be the determining factor for the association outcome. A corneal topography was not performed in these patients, for example, in the search for keratoconus. This examination could aid in the justification of cardiac changes and astigmatism, due to changes in collagen, as shown in the studies previously mentioned.

The study found a statistically significant association between hypothyroidism and myopia. A study by Kurtul et al.,[11] associates congenital hypothyroidism with ocular pathologies. In the study by Afifi et al. no statistical correlation was observed between ocular abnormalities and thyroid findings.[8]

The importance of finding associations is to aid in guiding the clinician to progress from one disease to the next in his or her routine visits, enabling earlier referral.[10] This is because cardiac, thyroid and other changes are tracked earlier than eyepieces, which are sometimes delayed or forgotten. Ignore ophthalmopathies can mean serious impairment in cognitive development and, consequently, in the quality of life of this population.[7]

## Conclusion

The study demonstrates the need for screening for ophthalmologic changes in patients with DS. And it reinforces the importance of establishing associations with comorbidities, as described in this study, aiming at early diagnosis, neuropsychomotor development, interaction with the environment and consequently the learning of these children.

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