REFRACTORY PATHOLOGIES IN SCHOOL AGE

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Abstract

Introduction. Nowadays, the progressive increase of eye pathologies comes alongside genetic and individual factors, mostly from the so-called “internet game disorders,” as well as global warming and staying indoors for a long time. Early detection in the paediatric age is the right choice to minimise this pathology and the negative individual consequences, up to blindness and its economic ones. Our study aimed to evaluated the situation, emphasizing the importance of their early detection (from a paediatric age) in maximizing the success of treatment and performance for these children in the future.

Materials and Methods. As part of the project "Healthy Eyes for Successful Education," the eyes of 2583 kids in kindergartens, primary schools, and secondary schools near Tirana and Fushë-Krujë were checked. We also read new studies, primarily from PubMed, Elsevier, Lancet, MDPI, Nature, and Sage Journal, to gain a deeper understanding of refractive eye diseases.

Results. Refractive eye pathologies were about 10% (9.6%) of the studied population, with a doubling (about 2.2 times) from the age group 3-6 years to the age group 7-14 years, which indicates the necessity of medical monitoring and early intervention (first ophthalmological visit), with a prevalence of hyperopia (65%) versus myopia (35%), and a prevalence of accommodative hyperopia (80%) about four times versus congenital hyperopia (20%) (4:1 ratio).

Conclusions. Refractive eye pathologies should be caught as early as possible in order to minimise the consequences of education and life performance because if not treated in time, even in a very low percentage, they can lead to lifelong blindness.

Keyword. Refractive eye pathologies, artificial intelligence, early diagnosis

PATOLOGJITË REFRAKTARE NË MOSHËN SHKOLLORE

Abstrakt

Hyrje: Rritja progresive e patologjive të syrit vjen krahas faktorëve gjenetikë dhe individualë në kohët e sotme dhe nga të quajturat “internet game disorders,” si dhe ngrohja globale, qëndrimi për një kohë të gjatë mbyllur në shtëpi. Kapja e hershme dhe hulumtimi i duhur në moshën pediatrike është zgjedhja e duhur për të minimizuar këto patologji dhe pasojat negative individuale deri tek verbëria, si dhe ato sociale dhe ekonomike të tyre.

Qëllimi: Fotografimi i situatës, theksimi i rëndësisë së kapjes së hershme të tyre (që në moshën pediatrike), në maksimizimin e suksesit të trajtimit dhe performancës së këtyre fëmijëve në të ardhmen.

Materiali dhe Metoda: U realizuan vizitat e syve në 2583 fëmijë në kopshtet, shkollat fillore dhe nëntëvjecare në rrethinat e Tiranës dhe Fushë-Krujës , në kuadër të projektit "Sy të shëndetshëm, për arsimim të suksesshëm", si dhe u hulumtuan studimet më të fundit të literaturës, më së shumti në PubMed, Elsevier, Lancet, MDPI, Nature, dhe Sage Journal, për një parashtrim sa më të qartë të patologjive refraktare të syrit.

Rezultatet: Patologjitë refraktare të syrit ishin rreth 10% (9.6%) e popullatës së hulumtuar, me dyfishim (rrreth 2.2 herë) nga grupmosha 3-6 vjeç, në moshën 7-14 vjeç, që tregon domosdoshmërinë e monitorimit mjekësor dhe ndërhyrjes së hershme. (vizita okulistike e parë), me mbizotërim të hipermetropisë (65%), kundrejt miopisë (35%), dhe mbizotërim të hipermetropisë akomodative (80%) rreth katër herë kundrejt asaj kongenitale (20%) (raporti 4:1).

Përfundime: Problemat e refraktaritetit të syve duhet të kapen sa më herët, në mënyrë që të minimizohen pasojat e performancës arsimore dhe jetësore, sepse nëse nuk trajtohen në kohë, edhe përqindje shumë të ulët, mund të japin verbëri gjatë gjithë jetës.

Fjalë Kyç: Patologji refraktare të syrit, inteligjencia artificiale, diagnoza e hershme,

Introduction

The problems of visual impairment are becoming increasingly concerning worldwide, with an estimated 43.3 million people being blind and 295 million with visual impairment, expected to rise to 61 million blind and 474 million with visual impairment by 2050 (2). According to WHO, approximately 2.2 million people suffer from visual impairment (2). Refractive diseases are the second leading cause of visual impairment globally, according to WHO (2). The Global Action Plan for the years 2015-2019 states that in children aged 5-15 years, these pathologies are the leading cause of visual impairment (3). The attention paid to refractive eye diseases and the huge rise in studies around the world from 2000 to 2022 show that these diseases are becoming a bigger problem (1, 2). Industrialised countries like China, the United States, and Japan conduct the majority of studies (1). According to a study published in Lancet, medical interventions have contributed to avoiding a higher number of individuals becoming blind, but not those with moderate or severe visual impairment (4). However, a study from 2023 reports that cataracts, albinism, nystagmus, and retinal diseases are the main causes of decreased vision in children. Nevertheless, there are several risk factors and causes contributing to decreased vision in children (5). The causes of eye pathologies are also of genetic and environmental nature, among other individual factors (6-10). Some genes that may be involved in eye problems are OPA1, which is linked to ethambutol-induced neuropathy; BM4, which is linked to nearsightedness and farsightedness; FBN1, which is linked to congenital ectopia lentis; GJA8; LSS, which is linked to hereditary congenital cataracts; and more (6). Climate change and global warming have various negative impacts on health, including eye diseases. For example, high temperatures, especially in the summer,

can lead to retinal inflammation. Additionally, solar radiation can cause subcapsular or early cataracts and retinal pathologies, while environmental high temperatures and air pollution are responsible for glaucoma (7). The consequences are in social, psychological, and economic aspects (7-10). Aside from glaucoma and other biological, ophthalmological, and genetic factors, stress is also thought to cause and worsen vision loss (8-10).

In another study, although conducted with a relatively small number of cases (114 children), it is emphasised that 86% of them were bullied due to eye problems, with 64% experiencing verbal bullying, 21% experiencing physical bullying, and 50% being bullied in physical education class by the physical education teacher and 93% by their peers (9). As a result, these children may experience stress, anxiety, depression, and further consequences on academic achievements, personal development, social interaction, and self-esteem (10). Visual problems are significant causes of poor performance in children's schools, and their correction has improved their performance (10,11). In a meta-analysis study from 1990–2013, referring to 15 countries, conducted by the European Eye Association, it was observed that myopia accounted for 30.6%, with a higher prevalence in young people (25–29 years) at 47.2%, hyperopia at 25.2%, and astigmatism at 23.9% among the 61,946 individuals examined (12). Genetic, environmental, social, and individual factors are key factors in refractive eye pathologies (10-14, 19-21). Referring to refractive eye pathologies, especially severe myopia, is a major risk factor for future eye conditions (13). The study and use of computers or cell phones at work and school, or uninterrupted electronic games for more than 1 hour, affect the worsening of myopia. However, short breaks reduce this impact (14, 15). Recent technological developments and dependence on the internet, minimising outdoor activities and staying at home, are important social and individual risk factors for developing "internet game disorders" and are seen as risk factors for the development of refractive eye pathologies (14,15). Moderate light exposure slows the progression of refractive eye diseases. Doing activities outside, limiting electronic activities or games, and getting enough screen time have all been shown to slow or reverse refractive eye diseases (14-16). Homes with smaller spaces due to urbanisation are more likely to develop myopia than private homes with larger indoor spaces (16). Due to time and healthy exposure to natural light, myopia decreases in the summer and worsens in the winter (16). On the other hand, children with myopia may have a disruption in their sleep-wake rhythm and a delay in waking up compared to emmetropia (16). Recent studies do not show a correlation between the use of vitamin D, A, or specific diets and the reduction of myopia (16). However, studies show a positive correlation between high insulin levels and myopia (16). Hazardous industrial and environmental pollutants for human health such as carbon oxide, air pollutants like PM 2.5, PM10, O3, NO2, SO2, are significant factors in refractive eye diseases, through the mechanism of increased oxidative stress, promoting apoptosis, inflammation, necrosis, or ferroptosis (10,20,21). Furthermore, genetic-based studies have been conducted, identifying genes and epigenetic factors that influence the development of refractive eye pathologies (17, 18). Early detection and examination of risk factors using the latest technology and modern equipment, including artificial intelligence, along with raising public awareness of personalized medicine concepts, are important approaches to proper medical management of these pathologies (19-23). Given that the increase in refractive eye pathologies is a global concern, we conducted a project where we specifically investigated refractive eye pathologies in paediatric age in Tirana and the Kruja and Fushe Kruja region.

Aims and objectives

The aim was to assess the situation and evaluate the extent of the problem, as well as emphasise the importance of early detection (in paediatric age) to maximise treatment success and the performance of these children in the future. Our objectives were assessment and monitoring of eye diseases in schools with the aim of taking awareness and specific measures according to the disease.

Material and method

Kindergartens, primary schools, and eight-year schools in the districts of Tirana and Fushë-Kruja were reviewed as part of the project "Healthy Eyes for Successful Education," organised by the DAER association in collaboration with the municipalities of Tirana and Kruja and carried out in two phases: the first phase in 2017–2018 and the second phase in 2021.

In the first phase of the study, 2583 children aged 3 to 14 were investigated through an ophthalmic visit using a portable autorefractometer and a portable vision chart.

In the second phase, kids who might have refractive disorders like myopia, astigmatism, or hyperopia went to a clinic in Tirana to get a more thorough examination of the anterior segment using a Topcon KR-800 autorefractometer, a vision chart, and a Topcon SI-D4 slit lamp.

Results

Table 1. Gender variation is expressed in tables and graphs.

Female	1321(52%)
Male	1262(48%)

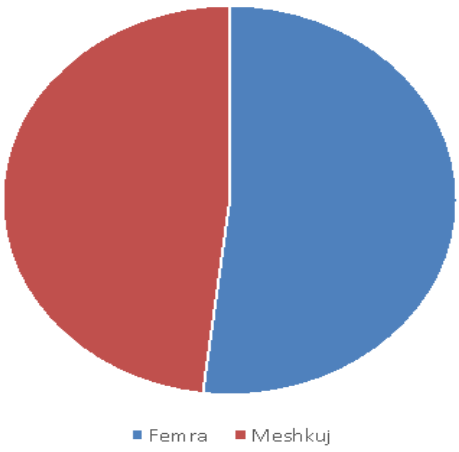


Table 2. Graphical and tabular expression of individuals with refractive pathologies

Individuals	Nr(%)
Total	2583
Individuals with refractive pathologies	250(9.6%)

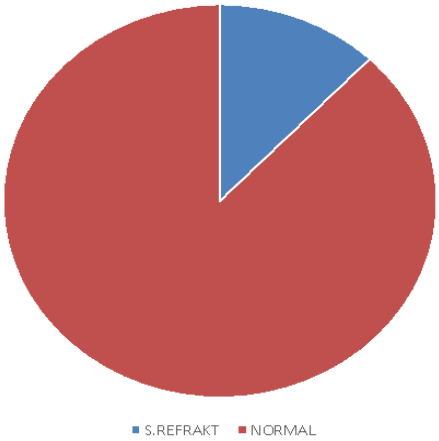


Table 3. Number of children with refractive pathologies according two age groups.

Age groups	Number of children with refractive diseases	Percentage
3-6 year old	78	31%
7-14 year old	172	69%

Table 4. Tabular and graphical representation of refractive pathologies of the eye according to the nature of myopia and hyperopia

	Number of children with refractive pathologies	Percentage
Hypermetropia	163	65%
Miopia	87	35%

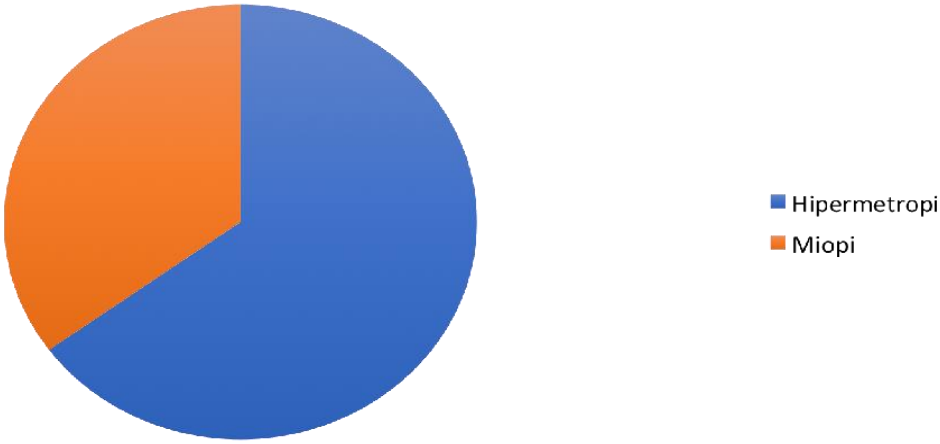
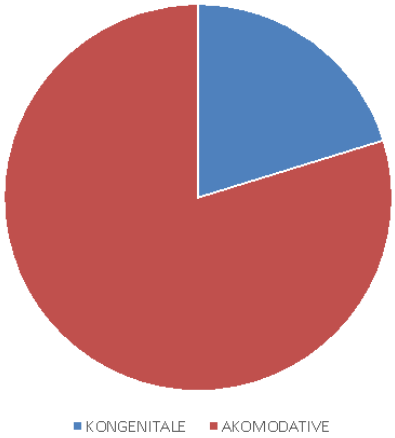


Table 5. Tabular and graphical presentation according to the nature of hypermetropia

Hypermetropia	Nr	(%)
Congenital	32	19.6%
Accommodative	131	80.4
Total	163	100%



Discussion

The findings of this study emphasize the critical importance of early identification and intervention in managing refractive eye pathologies among children, a population significantly impacted by these conditions. The prevalence of refractive issues in 9.6% of the examined population underscores the necessity of integrating ophthalmic evaluations into routine pediatric health care. The doubling of refractive pathologies from the 3–6 age group to the 7–14 age group (31% to 69%, respectively) signals an alarming trend, which aligns with global patterns indicating an increasing burden of visual impairment over time (2, 3).

Hypermetropia, constituting 65% of the detected cases compared to 35% for myopia, highlights the predominance of farsightedness among the surveyed cohort. Furthermore, the data revealing that accommodative hyperopia accounts for 80% of hyperopia cases emphasizes the potential for therapeutic interventions to mitigate its impact on children's vision and academic performance (16). These findings resonate with broader epidemiological studies, such as the meta-analysis from 1990–2013, which also highlighted the significant role of refractive errors in visual impairment (12).

This study brings to light the multifactorial nature of refractive eye diseases. Beyond genetic predispositions involving genes like OPA1 and FBN1, environmental and lifestyle factors play an equally crucial role (6, 7). Modern technological advancements, which increase screen exposure, reduce outdoor activities, and constrain living spaces due to urbanization, exacerbate the risk of myopia. Conversely, structured breaks during screen time and outdoor activities can mitigate these risks, as supported by recent studies (14, 15).

The social and psychological implications of visual impairment in children are profound. Reports of bullying affecting 86% of children with eye problems emphasize the urgent need for holistic interventions that address not only the medical but also the socio-emotional challenges faced by affected individuals (9). The associated stress, anxiety, and diminished self-esteem further underscore the ripple effects of untreated refractive errors on personal development and academic success (10).

Environmental pollutants such as carbon monoxide and particulate matter (PM2.5, PM10) have emerged as significant contributors to oxidative stress and inflammation, thus worsening refractive eye conditions. These findings highlight the intersection of public health and environmental factors, suggesting that strategies to reduce environmental pollution may concurrently benefit ocular health (10, 20, 21).

This study also points to promising advancements in the early detection of refractive errors. The integration of modern technology, including portable autorefractometers and slit lamps, facilitates precise diagnostics even in resource-limited settings. Such innovations, coupled with artificial intelligence and personalized medicine approaches, pave the way for more effective and tailored management of these pathologies (19, 22, 23).

The role of public health initiatives, such as the Healthy Eyes for Successful Education project, cannot be overstated. By targeting schools and collaborating with local municipalities, this initiative underscores the potential of community-based interventions in enhancing awareness and ensuring timely ophthalmic care. The observed gender parity in

refractive pathologies (52% female, 48% male) further supports the inclusivity of such programs.

Conclusion

This study reaffirms the critical need for early and sustained ophthalmologic care for children, particularly given the rising prevalence of refractive errors globally. By addressing modifiable risk factors, leveraging technological advancements, and fostering public health awareness, the burden of refractive eye diseases can be significantly reduced, thereby enhancing the quality of life and educational outcomes for affected children. Refractive eye problems should be detected as early as possible to minimise the consequences on educational and life performance, as if left untreated in time, although at a very low percentage, they can lead to blindness throughout life.

Compliance with Ethics Requirements:

"The authors declare no conflict of interest regarding this article"

"All procedures performed in this study were in accordance with the ethical standards of the institutional and/ or national research committee(s) and with the Helsinki Declaration (as revised in 2013), as well as the national law. Informed consent was obtained from the patients included in the study"

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