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EARLY DETECTION OF REFRACTIVE ANOMALIES IN PRESCHOOL AND SCHOOL-AGE CHILDREN USING MOBILE APPLICATIONS

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Abstract

The aim of this study was to evaluate the effectiveness of using mobile applications for the early detection of refractive errors in preschool and school-age children. The research was conducted in 2023–2024 at the Republican Specialized Scientific and Practical Medical Center of Eye Microsurgery and included 152 children aged 3 to 14 years. Participants were divided into two groups: the main group (mobile screening) and the control group (traditional ophthalmologic visits). The mobile application “Ko’zGuard” was used to assess visual acuity, color perception, and preliminarily detect refractive disorders.

The results showed that refractive anomalies were diagnosed significantly earlier and more frequently in the main group compared to the control group. Notably, the rates of myopia (47.4% vs. 35.5%) and hyperopia (19.7% vs. 14.5%) were higher in the mobile screening group. The average age of diagnosis was 1.5–2 years younger in the main group. The study also revealed that regular use of mobile apps and their gamified format increased parental engagement and children's motivation. A parent survey confirmed a high level of satisfaction with digital tools.

The findings support the integration of mobile applications into the preventive eye care system for children as an effective tool for preliminary screening and increasing parental awareness. Nevertheless, the role of the ophthalmologist remains essential for final diagnosis and clinical management.

Keywords: refractive errors, children, early detection, mobile applications, ophthalmologic screening, myopia, hyperopia, telemedicine.

Relevance. Refractive anomalies—including myopia, hyperopia, and astigmatism—remain among the leading causes of visual impairment in children. According to the World Health Organization, over 12 million children worldwide suffer from vision problems that could be prevented or corrected with timely diagnosis. The increasing visual load in modern education underscores the importance of early detection of ophthalmic disorders.

In recent years, mobile applications have become an important tool in medicine, including pediatric ophthalmology. They provide new opportunities for diagnosis, treatment and monitoring of the visual system in children. The development of solutions such as an application for diagnosing eye diseases in children shows the promise of using technologies based on artificial intelligence. This application has the ability to analyze more than 50 thousand photographs and identify diseases at an early stage, ahead of ophthalmologists

Recent technological advances, including mobile vision screening apps, offer new tools for early identification of visual problems at home or in primary care settings.

Purpose. To evaluate the effectiveness of mobile applications for early detection of refractive anomalies in preschool and school-age children.

Materials and Methods.

The study was conducted in 2023–2024 at the Pediatric Department of the Republican Specialized Scientific and Practical Medical Center of Eye Microsurgery (Tashkent, Uzbekistan). A total of 152 children aged 3 to 14 were examined.

Participants were divided into two groups:

Group 1 (intervention) – 76 children screened using a mobile application.

Group 2 (control) – 76 children examined only during routine ophthalmologist visits.

The «Ko'zGuard» mobile application was used to assess visual acuity, color vision, and approximate refraction. All children underwent standard ophthalmological examinations, including visual acuity testing, tonometry, autorefractometry, and fundus examination.

Results and Discussion

Effectiveness of Mobile Applications

Refractive anomalies were detected at an earlier stage in Group 1. Among the 76 children in the intervention group, 58 (76.3%) were diagnosed with refractive errors:

Myopia – 36 (47.4%)

Hyperopia – 15 (19.7%)

Astigmatism – 7 (9.2%)

In the control group, refractive errors were found in 44 children (57.9%):

Myopia – 27 (35.5%)

Hyperopia – 11 (14.5%)

Astigmatism – 6 (7.9%)

Mobile apps enabled earlier detection of vision disorders, often before symptoms appeared. In Group 1, 63% of cases were identified before noticeable complaints, compared to only 32% in Group 2.

Average age at diagnosis:

Myopia:

Group 1 – 6.4 ± 0.8 years

Group 2 – 8.1 ± 1.2 years

Hyperopia:

Group 1 – 4.6 ± 0.7 years

Group 2 – 5.9 ± 1.0 years

Timely diagnosis allowed early prescription of optical correction and reduced the risk of complications such as amblyopia or progressive myopia.

Parental Feedback and Perceptions

According to a structured survey:

87% of parents found the app easy to use

73% became more attentive to their child's vision

57% increased the frequency of visits to ophthalmologists

69% reported greater child engagement due to the app's gamified interface

However, 13% of parents faced difficulties interpreting results, indicating the need for professional consultation even when using digital tools.

Comparative Results Summary

Myopia detection: 32% in Group 1 vs. 24% in Group 2

Hyperopia: 28% vs. 22%

Astigmatism: 16% vs. 12%

Age-Related Trends

The mobile app showed the greatest benefit in children aged 4–6, where symptoms are often underreported. Among school-age children, although parents more often noticed visual problems themselves, mobile screening still improved early detection.

Factors Enhancing Screening Effectiveness:

1. Regular testing (every 3 months) increased detection rates by 25–27%.

2. Combining app screening with in-person exams improved diagnostic accuracy.

3. Gamified format boosted child cooperation and parental adherence.

Limitations and Future Directions

Mobile apps are not a substitute for professional eye exams. False positives may occur, particularly if testing conditions are suboptimal (lighting, distance, etc.).

Future prospects include:

Developing apps with automated interpretation and recommendations

Integration with telemedicine platforms

Large-scale studies to evaluate long-term impact on visual health outcomes

Conclusion

1. Mobile technologies are effective tools for early detection of refractive anomalies in children.

2. Refractive errors can be identified 1.5–2 years earlier compared to traditional methods.

3. Combining mobile screening with professional care yields optimal results.

4. Mobile apps have a strong potential for use in pediatric vision screening and preventive care.

The use of mobile applications in family ophthalmology practice increases the early detection of visual impairments and facilitates timely correction. They can become an effective tool for preliminary screening and raising parental awareness, especially when included in the general prevention system.

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