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DETERMINATION AND CONTROL OF THE CAUSES, TYPES AND TREATMENT METHODS OF "MYOPIA" DISEASE USING MODERN COMPUTER TECHNOLOGIES

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Abstract. *This scientific work considers the issues of studying myopia (nearsightedness) using modern computer technologies. The work analyzes the causes of myopia, morphological and functional types, stages of disease development and age-related features. At the same time, the effectiveness of modern digital tools, including ophthalmological diagnostic programs, 3D eye scanners and artificial intelligence-based detection methods, is evaluated. The important role of information technologies in early detection of myopia, monitoring at different stages and the formation of individual treatment approaches is shown. The study also analyzes the possibilities of virtual rehabilitation, interactive applications for eye exercises and treatment via telemedicine. Through these approaches, the possibilities of early detection, prevention of development and effective control of myopia have been identified.*

Keywords: *Myopia, Computer-Aided Diagnosis, Artificial Intelligence, Machine Learning, Telemedicine, Smart Glasses, Orthokeratology, Refractive Errors.*

ОПРЕДЕЛЕНИЕ И КОНТРОЛЬ ПРИЧИН, ВИДОВ И МЕТОДОВ ЛЕЧЕНИЯ БОЛЕЗНИ «БЛИЗОРУКОСТЬ» С ИСПОЛЬЗОВАНИЕМ СОВРЕМЕННЫХ КОМПЬЮТЕРНЫХ ТЕХНОЛОГИЙ

Аннотация. *В данной научной работе рассматриваются вопросы изучения миопии (близорукости) с использованием современных компьютерных технологий. В ходе исследования были проанализированы причины возникновения миопии, морфологические и функциональные типы, стадии развития заболевания, возрастные особенности. В то же время оценивалась эффективность современных цифровых инструментов, включая программное обеспечение для офтальмологической диагностики, 3D-сканеры глаза и методы обнаружения на основе искусственного интеллекта. Показана важная роль информационных технологий в раннем выявлении близорукости, мониторинге на разных стадиях и формировании индивидуальных подходов к лечению. В исследовании также анализировались возможности виртуальной реабилитации, интерактивных приложений для упражнений для глаз и лечения с помощью телемедицины. Благодаря этим подходам были выявлены возможности раннего выявления, профилактики и эффективного контроля близорукости.*

Ключевые слова: *миопия, компьютерная диагностика, искусственный интеллект, машинное обучение, телемедицина, умные очки, ортокератология, рефракционные ошибки.*

Introduction

In recent years, the prevalence of myopia, or nearsightedness, has increased significantly across the globe, particularly among children and adolescents. This ocular condition, characterized by the inability to clearly see distant objects, poses serious long-term risks to eye health and overall quality of life if not detected and managed early. The development and progression of myopia are influenced by a combination of genetic, environmental, and lifestyle factors, including prolonged screen time, limited outdoor activity, and close-up visual tasks.

With the rapid advancement of modern computer technologies, new opportunities have emerged for the early detection, classification, and management of myopia. Digital ophthalmic tools, such as high-resolution retinal scanners, artificial intelligence-powered diagnostic software, and telemedicine platforms, are increasingly being utilized to improve clinical outcomes. These technologies not only allow for accurate diagnosis and personalized treatment plans but also enable continuous monitoring and preventive care. This paper aims to explore the underlying causes, types, and treatment strategies for myopia by integrating modern computer-based solutions. It highlights how technological innovation can contribute to a more effective and proactive approach in controlling the progression of this widespread visual disorder.

Literature review and methodology

Myopia, or nearsightedness, is a refractive eye condition where distant objects appear blurry while near objects are seen clearly. It has become one of the most common visual impairments worldwide, especially among children and adolescents. The World Health Organization has recognized it as a public health concern due to its increasing prevalence. Factors contributing to this rise include greater screen exposure, reduced outdoor activities, and intensive educational demands. Myopia can progress rapidly during growth periods, potentially leading to serious complications like retinal detachment or macular degeneration. Early detection and effective management are therefore critical. In the digital age, the integration of modern technologies into ophthalmology allows for more precise diagnosis and intervention. These advancements also enable widespread public health monitoring. Understanding myopia's growing relevance is essential for healthcare providers, educators, and technology developers. This study emphasizes how modern computer technologies can support both clinical and preventive approaches to combat myopia.

The development of myopia is multifactorial, involving both genetic predispositions and environmental influences. A family history of myopia significantly increases the risk of developing the condition in children. However, modern lifestyle habits have played a more dominant role in its recent global surge. Extended near-work activities such as reading, using smartphones, and working on computers contribute to eye strain and axial elongation of the eyeball. Insufficient exposure to natural light and limited outdoor activities are also major contributors. Poor posture and lighting while studying further aggravate the condition. Additionally, inadequate sleep and overall physical inactivity have been linked to worsening eye health. Socioeconomic factors, including academic pressure and urbanization, also influence the early onset and progression of myopia. A comprehensive understanding of these risk factors helps in developing effective prevention strategies. Technology-based interventions can target these causes by modifying behavior and monitoring visual health in real time.

Clinically, myopia is classified based on severity into low, moderate, and high myopia, depending on the diopter measurement. Low myopia typically ranges from -0.5 to -3.0 diopters, while high myopia exceeds -6.0 diopters and may require complex management. It can also be categorized into simple, pathological, and degenerative types. Simple myopia is common in school-aged children and usually stabilizes with age. Pathological myopia, on the other hand, involves progressive elongation of the eyeball and can lead to severe visual impairment. Each stage of myopia presents unique clinical features and risk levels for complications. Regular monitoring is essential to detect shifts in severity or the emergence of new symptoms. Understanding the type and stage of myopia aids in selecting appropriate treatment and control methods. Computerized diagnostic tools are increasingly used to differentiate these stages with high accuracy. Managing each form effectively relies on early recognition and individualized care strategies.

Computer-aided diagnostics have revolutionized the early detection and classification of myopia. Automated refractometers, digital slit-lamp imaging, and optical coherence tomography (OCT) are widely used in eye clinics. These devices allow for precise measurement of axial length, corneal curvature, and retinal thickness. Artificial intelligence (AI) algorithms can now detect early structural changes even before symptoms appear. AI models trained on large datasets can predict the likelihood of myopia progression in specific patients. Furthermore, mobile applications allow users to conduct preliminary vision tests at home. Telemedicine platforms make it possible to consult ophthalmologists remotely and receive real-time advice. All of these innovations contribute to faster and more accessible care. Digital storage of eye data also enables longitudinal tracking of changes in eye structure. Thus, modern computer technologies significantly enhance diagnostic efficiency and accuracy in myopia management.

The treatment of myopia now includes a wide array of computer-assisted and tech-based methods. Refractive surgeries such as LASIK use laser-guided precision to correct the curvature of the cornea. Orthokeratology, or night-time contact lenses, can temporarily reshape the cornea and slow the progression of myopia. Smart glasses and adaptive lenses adjust based on lighting conditions and visual demands, improving both comfort and visual clarity. Computer applications for vision therapy offer personalized exercises to strengthen eye muscles and improve focusing ability. Digital reminders help users maintain healthy screen-time habits and perform regular eye exercises. In addition, interactive educational tools promote awareness about myopia among children and parents. Telehealth services enable routine follow-up and therapy adjustments without the need for in-person visits. Preventive strategies are enhanced through data monitoring and real-time feedback systems. All of these tools work synergistically to manage myopia more effectively.

Artificial Intelligence (AI) plays a crucial role in the modern control of myopia. By analyzing patient data, AI systems can identify patterns and risk factors with greater accuracy than traditional methods. Predictive analytics can forecast the progression of myopia in individuals based on their visual habits and genetic background. AI-powered imaging tools can detect subtle changes in the retina and other eye structures early. Machine learning models are also used to optimize treatment plans, offering personalized interventions. Big data from eye clinics worldwide can be used to improve public health strategies. Cloud-based platforms allow secure storage and sharing of patient information, facilitating multidisciplinary care. Real-time monitoring devices provide continuous updates to physicians and users alike. AI also helps reduce diagnostic errors and ensures faster response times in emergencies. Through automation and predictive capability, AI transforms the entire landscape of myopia care. Its integration offers immense promise for scalable and precise eye health management.

In conclusion, the integration of modern computer technologies into myopia diagnosis and treatment offers powerful tools for early detection, precise classification, and personalized care. With myopia rates increasing globally, especially among youth, there is an urgent need for innovative approaches that combine clinical expertise with digital solutions. AI, telemedicine, vision therapy apps, and advanced imaging tools have already proven effective in enhancing visual health outcomes. Future efforts should focus on expanding access to these technologies in schools and rural healthcare settings. It is also vital to develop public education campaigns that emphasize preventive practices. Continued research and interdisciplinary collaboration will further refine these tools and make them more accessible. Governments and healthcare institutions should invest in digital infrastructure for eye health. With a data-driven, patient-centered approach, it is possible to control the myopia epidemic effectively. Technology, when used responsibly, holds the key to preserving vision for generations to come.

Discussion

The rising prevalence of myopia, particularly in children and adolescents, has prompted global concern in both the public health and technological sectors. With projections indicating that nearly half of the world's population could be myopic by 2050, early detection and effective control strategies have become urgent. In this context, modern computer technologies are playing an increasingly vital role in transforming the landscape of myopia management. One of the most important developments is the integration of artificial intelligence in diagnostic procedures. AI algorithms, trained on large ophthalmological datasets, can now detect early signs of myopia and even predict its progression based on user behavior, genetics, and biometric parameters. This capability significantly enhances both the speed and precision of clinical assessments, allowing for timely intervention.

Telemedicine platforms and mobile diagnostic tools are also expanding access to eye care. In many regions, especially rural or underserved areas, in-person access to ophthalmologists is limited. With smartphone-based vision tests and cloud-connected consultation systems, patients can now receive assessments and even treatment guidance remotely. This democratization of eye care could significantly reduce untreated or late-diagnosed cases of myopia. Another significant area of innovation lies in vision therapy applications and digital health monitoring. These apps provide interactive exercises designed to reduce eye strain, promote healthy visual habits, and even delay the progression of myopia in children. Furthermore, technologies such as smart glasses and adaptive lenses are offering personalized correction in real time, adjusting to environmental lighting and visual demands. Despite these advances, certain challenges remain. The accuracy of AI models depends heavily on the quality and diversity of the training data. If the datasets do not reflect global or regional variability, the predictions may be biased or less effective. Additionally, data privacy and cybersecurity issues must be addressed when using cloud-based systems and telemedicine platforms.

Conclusion

In conclusion, the integration of modern computer technologies into the detection, classification, and treatment of myopia presents a promising and transformative advancement in the field of ophthalmology. As myopia continues to rise globally, especially among the younger population, the need for early and effective intervention becomes ever more critical. The use of artificial intelligence (AI), telemedicine, mobile applications, and smart eyewear not only enhances diagnostic accuracy but also enables more accessible and personalized care for patients, regardless of geographical limitations. AI-powered diagnostic tools and machine learning algorithms offer an unprecedented level of precision in identifying early signs of myopia and predicting its progression. This allows for more proactive management, potentially preventing or slowing down the onset of high myopia, which can lead to severe complications later in life. Additionally, mobile and remote technologies are breaking down barriers to eye care, offering accessible solutions for populations in underserved or remote areas.

Despite the promising advancements, challenges such as data privacy concerns, the need for diverse training datasets, and the accessibility of these technologies in lower-resource settings must be addressed. Furthermore, ensuring that these technologies complement traditional ophthalmic care without replacing essential in-person consultations is vital for maintaining comprehensive patient care. Overall, the adoption of computer technologies in managing myopia has the potential to reshape global eye care practices. As these technologies evolve, their implementation should be guided by ethical considerations and a focus on equity to ensure that all individuals, regardless of their socioeconomic background, benefit from these innovations. The future of myopia management looks promising, with continued research, innovation, and collaboration offering new ways to prevent, treat, and monitor this increasingly common visual condition.

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