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MYOPIA CONTROL COMBINATION TO SLOW THE PROGRESSION OF MYOPIA

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Abstract

Myopia is the most common refractive eye disorder in the world. Myopia is characterized by the inability of the eye to focus light on the retina, resulting in blurred distance vision. The purpose of this study is to understand the effectiveness of various methods or combinations of myopia control that can be used to slow or prevent the progression of myopia. This study used the Systematic Literature Review research method. The data collection technique in this study was carried out by literature study by exploring scientific journals, articles, books, and related publications contained in recognized databases, such as PubMed, Google Scholar, Scopus, and so on. The data that has been collected is analyzed through three stages, namely data reduction, data presentation and conclusion drawing. The results showed that the combination of controls to slow myopia include orthokeratology, environmental modification, low-level red-light therapy, antimuscarinic agents, increasing outdoor time and combination therapy.

Keywords: Combination Control, Myopia, Myopia Progression

Introduction

The eye is an organ that plays an important role in the human body. Its functions include vision and aesthetic aspects that contribute to a person's self-confidence. Almost all daily activities depend on this organ, such as reading, watching movies and learning. The eyes enable the sensing of light and color. When the eyes are healthy, one can perform various activities well. Eye health is crucial, especially when going about activities in the daily routine (Devara et al., 2019).

Eye disorders can have a significant impact on a person's daily life, one of the eye disorders is myopia. Myopia is a visual impairment that involves the focus of light from a distant object being focused at a point in front of the retina in the non-accommodating eye. This occurs due to a mismatch between the optical power of the eye and the length of the axis of the eyeball (Basri, 2014). Myopia is one of the most common eye health problems and a burden to people around the world (Fricke et al., 2018).

Globally, about 1.9 billion people, or about 28.3% of the world population, suffer from myopia in the range of about -0.5 diopters (D) to -5.00 D. Meanwhile, about 277 million people, or about 4% of the world population, suffer from high myopia with a diopters of -5.00 or heavier. Studies conducted on 12-year-old children show high prevalence rates of myopia in Asian cities, such as Singapore (62%), Hong Kong (53.1%),

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and Guangzhou (49.7%), compared to lower rates in the United States (20.0%), Australia (11.9%), India (9.7%), and Nepal (16.5%) (Saw et al., 2019).

Based on the cause, myopia can be divided into two groups, namely axial myopia and curvature myopia. Axial myopia occurs when the anterior-posterior distance (front-back distance) of the eye is too long. This can be congenital in macrophthalmus. Axial myopia can also occur if a person reads too closely, causing excessive convergence. When this happens, the medial rectus muscle (eye muscle) will contract excessively, compressing the eyeball by the extraocular muscles. This allows the posterior (back) polus of the eye, which is the weakest area of the eyeball, to lengthen. A wide face can also cause excessive convergence. Other conditions that can cause lengthening of the eyeball include fluid buildup, inflammation, weakness of the lining around the eyeball, and high pressure in the veins of the head (Al Dinari, 2022).

Symptoms of nearsightedness or myopia can appear in anyone, regardless of age. However, this condition generally first appears in school-aged children and teenagers. A person suffering from myopia will experience blurred vision when looking at objects that are far away from them. In children, this condition often makes it difficult for them to see the letters written on the blackboard when sitting at the back of the room. While in adults, complaints that often arise are difficulties in reading traffic signs or objects that are at a distance. Due to the difficulty in seeing objects that are far away, usually people with myopia will show several symptoms, such as experiencing headaches, feeling tired because of excessive work, often blinking or squinting, often rubbing their eyes and having difficulty realizing the existence of distant objects. In children, myopia can cause signs such as decreased school performance, difficulty concentrating in learning, and a tendency to bring objects or books closer to the face (Alodokter, 2022).

Efforts to prevent and control the progression of myopia are very important to reduce its negative impact. Therefore, this study focuses on discussing and evaluating the combination of existing myopia control methods to find the most effective approach in slowing myopia progression. The purpose of this study is to understand the effectiveness of different methods or combinations of myopia control that can be used to slow down or prevent myopia progression.

Research Methods

This study uses the Systematic Literature Review research method. Systematic Literature Review (SLR) is a method in which researchers identify, evaluate, and interpret all available research related to the problem formulation or topic area under investigation (Yuni et al., 2023). The data collection technique in this study was carried out by literature study by exploring scientific journals, articles, books, and related publications contained in recognized databases, such as PubMed, Google Scholar, Scopus, and so on. The data used in this study have several inclusion criteria including Indonesian or English language with a publication period of 2013-2023. Based on the predetermined criteria, the research flow and results that will be used in this study are described in the following PRISMA diagram:

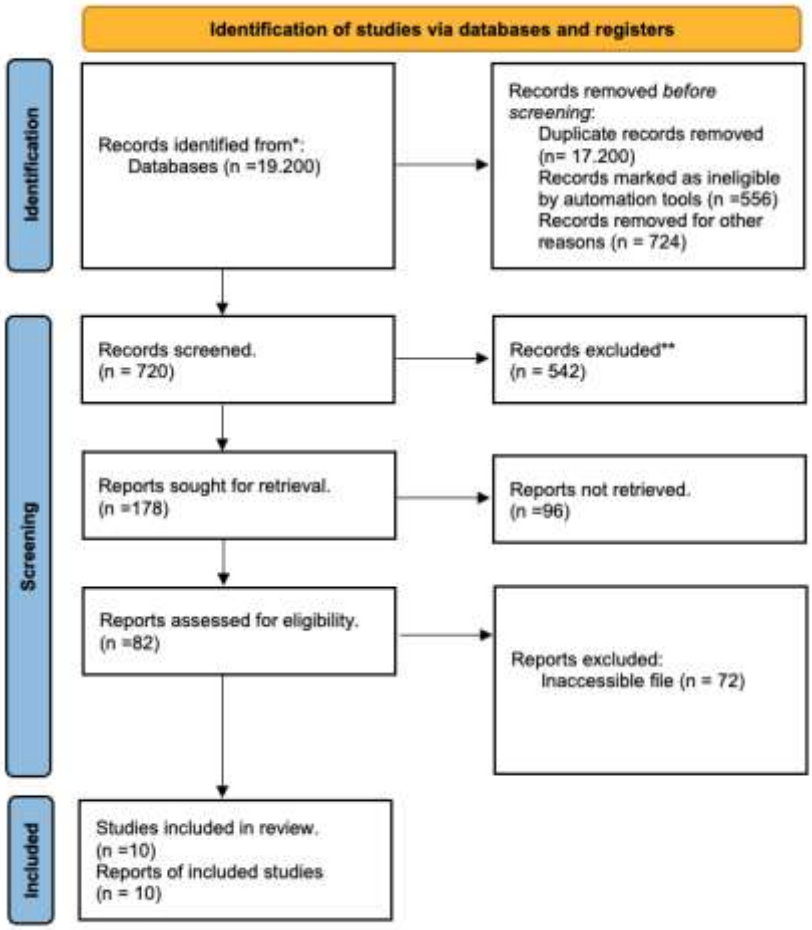

Figure 1. PRISMA diagram

The data that has been collected is analyzed through three stages, namely data reduction, data presentation and conclusion drawing.

Results and Discussion

Table 1
Research Results

No	Researcher Name & Year	Research Results
1	Ismail, A. (2022).	There are various methods to prevent myopia progression such as orthokeratology (Ortho-K), instrumentation (spectacle, contact lens), environmental modification such as increasing outdoor activities and sunlight exposure, low-dose atropine, and low-level red-light therapy are associated with preventing myopia progression. Low-dose atropine is the most effective intervention to slow the progression of myopia, but further studies with larger samples and long-term follow-up of myopia progression are needed.

2	Walline, J. J. (2016).	More effective methods to control myopia include orthokeratology, soft bifocal contact lenses and antimuscarinic agents. Orthokeratology and soft bifocal contact lenses are thought to provide myopic obscuration of the retina, which acts as a cue to slow the growth of myopic eyes. Each of these myopia control methods provides, on average, less than 50% slowing of myopia progression. All studies have shown clinically meaningful slowing of myopia progression, including several randomized clinical trials. The most studied antimuscarinic agents are pirenzepine and atropine. Pirenzepine slows myopia progression by about 40%, but is not commercially available in the United States. Atropine provides the best myopia control, but its cycloplegic and mydriatic side effects make it rarely prescribed as a myopia control agent in the United States. However, low concentrations of atropine have been shown to provide effective myopia control with significantly fewer side effects than 1.0% atropine. Finally, two agents, low-concentration atropine and outdoor time have been shown to reduce the likelihood of myopia onset.
3	Leo, S. W. (2017).	The myopia epidemic is characterized by an increasingly early onset, combined with a high rate of myopia progression. There are two ways to control myopia: first, to slow the onset of myopia and second, to reduce or prevent its progression. Increasing time outdoors can reduce the onset of myopia. A dose of 0.01% atropine offers an appropriate risk-benefit ratio, with no clinically significant visual side effects offset by a significant 50% reduction in myopia progression. Orthokeratology contact lenses may slow axial length elongation, but infective keratitis is a risk. Peripheral defocus lenses may have a role in slowing myopia progression in some children and further aid our understanding of the physiological control of ocular growth. Myopia control can be achieved by slowing the onset of myopia, which now appears to be possible by increasing outdoor time.
4	Suriadi, et al. (2023).	Outdoor activities will slow the progression and onset of myopia. Outdoor activities can eliminate blurring of the visual field and pupil constriction in bright light intensity so that optical blur is reduced and contrast in the eye is increased. In addition, outdoor activities trigger the release of retinal dopamine to inhibit the process of growth and deformation of the sclera, and balance the hyperopic defocus that often occurs with indoor activities and provide opportunities to see far distances.

5	Dinari, N. (2022).	Axial elongation of the eyeball can be further slowed with combination therapy, which in turn slows the progression of myopia.
6	Pramesti, N. (2022).	Myopia can be prevented and controlled by spending more time outdoors. It is useful to reduce or slow the progression of myopia including daily application of low-dose atropine eye drops, in concentrations ranging between 0.01% and 0.05%.
7	Siregar, W. F. (2021).	Management options such as myopia undercorrection, alignment fit gas-permeable contact lenses, and bifocal or multifocal spectacles have proven ineffective for myopia control. The most effective methods are the use of orthokeratology contact lenses, soft bifocal contact lenses, and topical pharmaceutical agents such as atropine or pirenzepine.
8	Aisyah, D. S., et al. (2023).	Orthokeratology contact lenses and soft bifocal contact lenses slow the progression of myopia in the same way, so the best modality should be determined by the eye care practitioner and the parents. Bifocal and multifocal spectacles are statistically significant in slowing myopia progression, but do not have a clinically meaningful effect.
9	Cooper J., et al. (2022).	After wearing these lenses for 6-72 months, the average myopia progression slowed by about 0.84 D or 85% compared to baseline, which was statistically significant at all times ($P < 0.0001$). The frequency distribution showed that 91% of wearers showed reduced myopia progression compared to baseline, with 79% of wearers showing ≥ 70% reduction in myopia progression. The mean change in axial length in a subset of the population over 47 months of follow-up was approximately 0.10 mm/year.
10	Dia, M., et al. (2016).	Ortho-k lenses are effective in controlling myopic progression in children in China, especially in younger children and in children with higher myopia.

Eyes that have an automatic and perfect way of working, all parts of the eye have important functions in the process of seeing, damage or absence of one of the functions of the parts alone will make the eye unable to see. A person's eye health can be seen from a person's lifestyle, ability to work, read, and carry out various social life activities and other activities (Suparti, 2020). One of the eye health disorders is myopia. In myopia or near vision, when the ciliary muscle is fully relaxed, light from distant objects is focused in front of the retina. This situation is usually due to the eyeball being too long, but can also be caused by the refractive power of the lens system being too strong (Lestari et al, 2020). Myopia is one of the causes of decreased visual acuity in children aged 8-12 years. Between the ages of 13-19 years, when the body experiences rapid growth, myopia worsens (Andrias, 2017). the scale in myopia disease is denoted on a diopter scale where (1-3 diopters) is mild, (3-6 diopters) is moderate and (6-10 diopters) is severe (Hidayarulloh et al, 2017).

Various factors can influence the progression of myopia at school age. Genetic factors and close reading habits or behavior with poor lighting are the main factors for myopia. Lifestyle factors support children's high access to visual media. Lack of outdoor activity also affects the growth of myopia. Vitamin D obtained when doing outdoor activities has a role in collagen formation which is the main component of the sclera. High light intensity can also affect the severity of myopia because it affects the operation of the pupil and lens of the eye (Sofiani & Santik, 2016). A person who is more indoors spending time reading and sitting in front of a screen was found to be more likely to sleep late and can also significantly increase the risk of myopia (Ramadhani et al, 2022). Children are more likely to suffer from myopia if one of their parents also has myopia. In addition, environmental factors also influence the development of myopia. In addition, myopia has a multifactorial etiology, with environmental factors playing a role (Zakiyah et al, 2023). Based on the analysis, it was found that there are methods or combinations of myopia control that can be used to slow down or prevent the progression of myopia, as follows.

1. Orthokeratology (Ortho-K)
   Orthokeratology is thought to provide myopic blurring of the retina, which acts as a cue to slow the growth of myopic eyes. Orthokeratology uses a corneal gas permeable contact lens designed to flatten the center of the cornea, causing mid-peripheral steeping and blurring of peripheral myopia, during overnight wear to eliminate daytime myopia (Jonas et al, 2021). Ortho-k lenses are effective in controlling myopic progression in children in China, especially in younger children and in children with higher myopia (Dia et al, 2016). This is also supported by the results of research by (Siregar, 2021) which shows that the most effective method options are the use of orthokeratology contact lenses, soft bifocal contact lenses, and topical pharmaceutical agents such as atropine or pirenzepine. Modern orthokeratology lenses have an important history ranging from attempts to flatten corneal curvature with spherical rigid contact lenses to advanced gas permeable lenses, which are designed to reshape the cornea. These lenses are commonly prescribed to children to slow the progression of myopia and limit axial elongation of the eye (Bullimore, 2020).
2. Environmental modification
   There is an association between outdoor activity and the incidence of myopia. outdoor activity is the time or length of activity used in open areas exposed to direct sunlight (Ramadhani et al, 2022). Outdoor activities can be used as a prevention of myopia by inhibiting the lengthening of AL in children. Providing interventions in the form of outdoor activities with objective monitoring of light intensity can be the method of choice in assessing the effect of lower AL lengthening in children due to outdoor activities (Tandean et al, 2022).
3. Low-level red-light therapy
   Reapeted low-level red-light (RLRL), characterized by increased energy supply and cell metabolism, thereby enhancing the metabolic repair process, has gained worldwide attention in recent years as a new scientific approach for therapeutic applications in myopia (Zhu et al, 2023). Supported by the research of Lin et al (2023), which stated that red light has an obvious effect on myopia control and low-level red-light therapy plays an important role in the treatment of severe myopia.
4. Antimuscarinic agents

The most researched antimuscarinic agents are pirenzepine and atropine. Pirenzepine slows the progression of myopia by about 40%, but is not commercially available in the United States. Atropine provides the best myopia control, but its cycloplegic and mydriatic side effects make it rarely prescribed as a myopia control agent in the United States. However, low concentrations of atropine have been shown to provide effective myopia control with significantly fewer side effects than 1.0% atropine. Finally, two agents, low-concentration atropine and time outdoors have been shown to reduce the likelihood of myopia onset.

A dose of 0.01% atropine offers an appropriate risk-benefit ratio, with no clinically significant visual side effects offset by a significant 50% reduction in myopia progression. Supported by research by Sander et al (2019) which states low-dose Atropine inhibits the short-term effects of hyperopia blur on choroidal thickness and, when used alone, causes slight choroidal thickening in healthy nearsighted young adults.

5. Increase time outdoors
   Spending more time outdoors can reduce the incidence of myopia. Outdoor activities trigger the release of retinal dopamine to inhibit the process of growth and deformation of the sclera, as well as balance the hyperopic defocus that often occurs with indoor activities and provide opportunities to see far distances.
6. Combination Therapy
   Axial elongation of the eyeball can be further slowed down with combination therapy, which in turn slows down the progression of myopia.

Thus, parents are expected to control the child's habits so that the minus eye does not increase again, and maintain a diet or provide nutritional intake such as giving carrots and others that can nourish the eyes (Ariaty et al, 2018). Parents are expected to limit children with a genetic history of myopia to do close looking activities for a long time and are directed to have a habit of reading in a sitting position (2018).

Conclusion

The combination of controls to slow myopia involves a series of strategies aimed at reducing the rate of progression of the eye condition. One such strategy is orthokeratology, which involves wearing special contact lenses during sleep to alter the shape of the eye's cornea. Environmental modifications are also important, including lighting and viewing distance adjustments, to reduce pressure on the eyes and minimize the risk of myopia progression. Low-intensity red light therapy during sleep has also been shown to help slow the progression of myopia in children. In addition, antimuscarinic agents in the form of certain medications are also used to control pupil dilation and reduce the focusing demands of the eyes, thus helping to reduce the rate of myopia progression. Increased time spent outdoors, exposed to natural sunlight, is also a recommended strategy as this exposure has been shown to reduce the risk of developing myopia. Combination therapy, where several of these strategies are used simultaneously, is also an option being explored to control and slow the progression of myopia. It is important to discuss which strategy is most suitable with an eye care professional before implementing any combination of these controls.

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