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THE EFFECTS OF FULL CORRECTION VERSUS UNDER-CORRECTION ON THE PROGRESSION OF EARLY ONSET OF MYOPIA

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Abstract

BACKGROUND

One of the most common eye conditions in the world today is myopia, with an especially sharp rise in early-onset instances in youngsters. Because early-onset myopia is firmly linked to faster axial elongation and a higher likelihood of developing high myopia and accompanying sight-threatening problems later in life, it is particularly concerning.

OBJECTIVE: *To compare the effect of under-correction vs full correction on the progression of early onset of myopia*

METHODOLOGY: *The study involved 40 myopic youngsters between the ages of 6-12. A completely corrected group (n = 20) and an under-corrected group (n = 20) were formed from the participants. Lenses with +0.50 D under-correction were recommended for the under-corrected group in order to provide a slight residual blur. At the start of the study and after a six-month follow up period, optometric exams were performed. Refractive error variations were measured to evaluate the progression of myopia.*

INTRODUCTION

One of the most prevalent refractive problems affecting children and young people worldwide is myopia, sometimes referred to as nearsightedness. Myopia has become much more common in recent years, particularly among school-age children. Because it tends to proceed more quickly and can result in high myopia in later life, early-onset myopia which typically manifests before the ages of 6 to 10 is especially

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concerning. Serious ocular problems such retinal detachment, glaucoma, and myopic maculopathy are linked to high myopia and can cause irreversible vision impairment. The elongation of the eyeball, which causes light rays to focus in front of the retina rather than directly on it, is the primary cause of myopia's growth and progression. This disorder is influenced by both environmental and hereditary factors. Reduced outdoor exposure and increased near-work activities, such reading and extended digital device use, are thought to be significant risk factors for children's myopia progression. The most popular approach to treating myopia is spectacle correction. The best prescription strategy for slowing its growth, however, is still up for discussion. Full correction and under-correction are two often employed tactics. In order to provide crisp far vision, full correction entails prescribing lenses that fully correct the refractive problem. Conversely, under-correction is prescribing lenses with somewhat less power than necessary, allowing a tiny bit of residual myopia.

In the past, under-correction was sometimes advised because it was thought to slow the development of myopia by lowering the accommodative demand during near tasks. However, new research indicates that under-correction may actually accelerate the development of myopia because of persistent retinal haze, which may encourage more eye elongation. Full correction, on the other hand, offers clear vision and may lessen visual stress; however its ability to delay the advancement of myopia is still being investigated.

Early-onset myopia develops more quickly, thus it's critical to identify the best corrective technique for slowing its advancement. Early intervention can help lower the chance of acquiring high myopia and the problems that come with it.

Thus, this study aims to examine the effects of under-correction versus full correction on the development of early-onset myopia. The results of this study may contribute to better clinical decision-making and better visual outcomes for myopic youngsters. Regarding the impact of full correction versus under-correction on the development of myopia in children, recent studies have produced contradictory findings. According to some research, under correction may not be helpful and may even hasten the development of myopia. For instance, a research on kids ages 6 to 15 found that, over the course of 18 months, under-correction led to a somewhat higher rate of myopia development than full correction, suggesting that under-correction is an ineffective method of managing early-onset myopia.[1]

Similarly, under-correction has no preventive effect against the advancement of myopia, according to a systematic review of several researches. In fact, under-corrected individuals progressed more quickly than those receiving full correction, according to a number of studies included in the analysis. [2]

However, some research has found no discernible difference between under-correction and full correction. Myopia advancement and axial elongation did not differ statistically significantly between the two groups in a one-year study of school-age children.[3]

It's interesting to note that some research indicates that the impact of myopic defocus on the retina may cause under correction or even no correction to slow down the growth of myopia. For example, a two-year study found that children who were not entirely corrected exhibited less axial elongation and slower growth than children who were properly corrected. [4]

Although the changes were not always statistically significant, a meta-analysis comparing complete correction versus under-correction found that fully corrected eyes may be less susceptible to myopia development, underscoring the need for additional research.[5]

Although there is no proof that FDA (United States Food and Drug Association) authorized medications decrease the advancement of myopia, some research raises concerns about the potential impact of some medications, including atropine, on this process [6,7] .Atropine is an efficient way to reduce the progression of myopia, according to several studies [8,9,10]. However, in a study that examined the various atropine

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concentrations, negative effects were warned about both long-term use and the 1% atropine concentrate.[10] Chia et al. also examined three atropine concentrations and found that the 0.01% concentration had fewer adverse effects than the 0.50 and 0.1% concentrations [11]. Even yet, it has been demonstrated that rebound myopic development is less common at lower atropine dosages.[12] In China, the percentage of school-age myopic children using glasses who are under corrected is 21.1% in urban areas [13] and 48.8% in rural regions [14]. Other developing nations have experienced similar circumstances [15, 16]. At their initial clinic visit, just 57% of children with refractive problems in Nepal wore spectacles.[17] Just 9.4% of African students with low vision wore corrective eyewear [18]. However, the majority of youngsters in Western nations who use glasses have received appropriate correction depending on their visual acuity [19, 20]. For instance, only 8.3% of Australian children aged 12 have under corrected refractive error. It is intriguing to investigate if under correction of myopia has accelerated the course of myopia, given the greater frequency of under correction of myopia in children in developing nations. In this study, we examine the impact of under correction on axial elongation and myopia progression in a group of 12-year-old Chinese children following a year of observation. The ophthalmologist or optometrist recommended and decided whether or not to under correct children's myopia, and the parents and kids agreed. The kids were chosen from a cohort that we had created.

It has recently been discovered that under correction accelerates the pace of myopia growth. This conclusion was deemed contentious since it deviated from both the results obtained with progressive addition lenses and expectations based on animal studies. The current study's objective was to once more ascertain the impact of under correction on the development of myopia in a randomly selected group of kids who are known to be extremely vulnerable to the condition. [21] Children's myopia development and progression have been found to be significantly influenced by a number of environmental and behavioral factors, in addition to the impact of prescription glasses. Spending more time outside has been repeatedly linked to a decreased incidence of myopia. More outdoor exposure was linked to a lower incidence and prevalence of myopia, according to an overview of systematic reviews with over 63,000 participants, while its impact on the advancement of children who were already myopic seemed to be negligible. [22]

Another element that could affect the course of myopia is near-work behavior. Maintaining a longer working distance, taking more pauses while near work, and spending more time outside were linked to lower myopia prevalence and slower refractive advancement over a two-year period, according to a prospective population-based research of schoolchildren. These results imply that childhood refractive development may interact with visual behavior. [23]

The importance of near work and exposure to the outdoors has also been supported by objective studies of visual behavior. Research employing wearable technology to track children's visual behavior has shown that traditional schooling and online learning environments differ in terms of near-viewing time and outdoor exposure. Reduced outside exposure and increased close-up gazing may hasten the development of myopia. [24]

Concern over childhood myopia has increased due to the growing use of computers, tablets, smart phones, and other electronic gadgets. Exposure to digital smart devices was linked to a higher risk of myopia, according to a systematic review and meta-analysis, despite significant heterogeneity and exposure measurement issues among the included studies. [25]

METHADOLOGY

This study was conducted as a prospective, randomized, controlled clinical trial to compare the effect of full refractive correction versus under-correction on the progression of early-onset myopia in children. The

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study was carried out in the Eye Care Department of DHQ Hospital, Vehari, Pakistan, over a period of four months following approval of the synopsis. A total of 40 children aged 6 to 12 years were enrolled. The sample size was calculated using G-Power software at a 95% confidence level and 5% margin of error. Participants were recruited from the hospital OPD using consecutive sampling. Inclusion criteria included children aged 6–12 years with early-onset myopia diagnosed during the study period, who were willing to wear spectacles and attend follow-up visits, with written informed consent obtained from parents or guardians. Exclusion criteria included children with any ocular disease or abnormality other than myopia, history of ocular surgery or significant eye trauma, strabismus or amblyopia affecting visual assessment, and those unable to comply with the study protocol or follow-up schedule. Data collection tools included a visual acuity chart for unaided and best-corrected visual acuity, auto refractor for objective refractive error, trial frame and trial lenses for subjective refraction, retinoscope where required, cycloplegic eye drops for cycloplegic refraction, A-scan ultrasonography to measure axial length as an objective parameter of myopia progression, and single-vision spectacle lenses for correction. For recruitment, eligible children were screened based on pre-established criteria. After obtaining informed consent, baseline demographic, clinical, visual acuity, ocular examination, and refractive evaluation including cycloplegic refraction were performed. Eligible participants were then randomly allocated into two groups: Group A: Full correction and Group B: Under-correction. To minimize bias, single masking was employed where the outcome assessor was unaware of group allocation. In the experimental group, under-corrected single-vision spectacles were prescribed with +0.50 D less negative power than the full cycloplegic/subjective refraction to maintain functional visual acuity. For example, if the required correction was -3.00 D, the prescribed power was approximately -2.50 D. In the control group, fully corrected single-vision spectacles were prescribed based on the best clinically determined refractive error. For example, a -3.00 D requirement received a -3.00 D correction. All participants were instructed to attend follow-up visits and adhere to the recommended spectacle wear schedule, with compliance and any adverse events documented throughout the study period.

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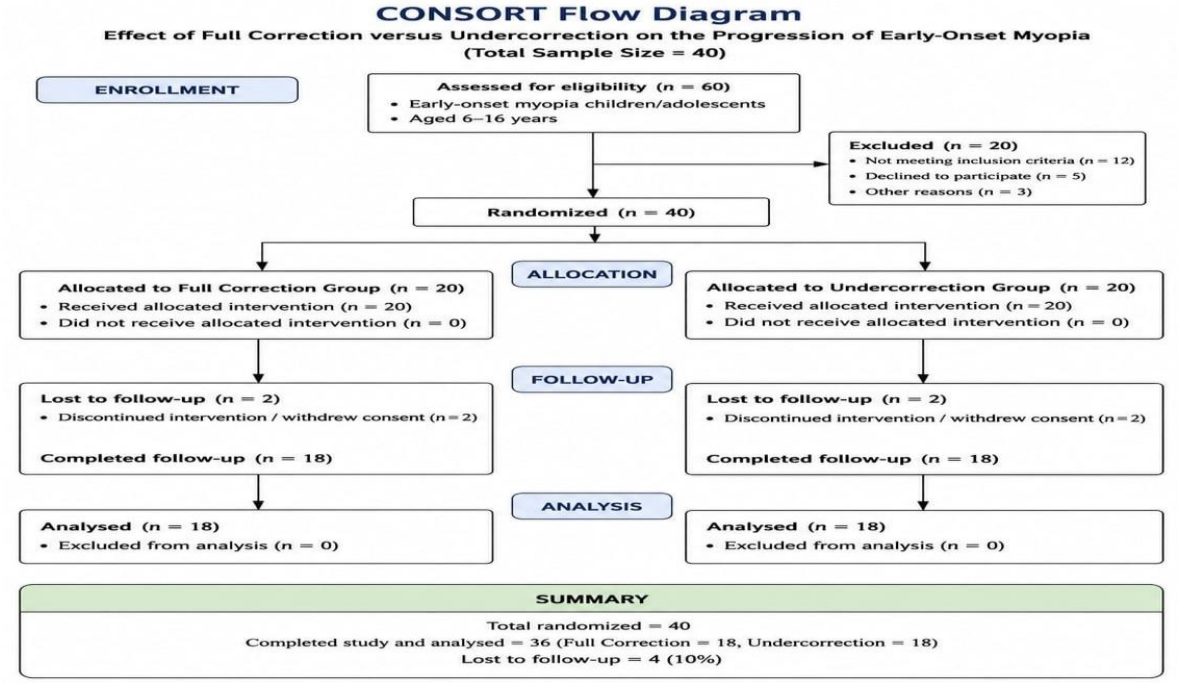

RESULTS

This randomized controlled trial evaluated the effect of full correction versus under-correction on early-onset myopia progression. Conducted at DHQ Hospital Vehari, Pakistan over 4 months, the study included 40 children aged 6–12 years randomly divided into two groups: full correction and under-correction (20 each). Inclusion criteria were early-onset myopia and parental consent; children with ocular disease or strabismus were excluded. Baseline and follow-up assessments included cycloplegic refraction and axial length measurement. The under-correction group received spectacles with +0.50 D less than full correction. Changes in spherical equivalent and axial length were the primary outcomes. Participants in the study had their "age at myopia onset" recorded. Of the 42 instances, 40 participants (95.2%) had valid data, while 2 participants (4.8%) had missing data. Therefore, 40 genuine instances served as the basis for the analysis of age at myopia onset

Table 1. Shapiro–Wilk tests for normality

Variable	W	df	p-value
Baseline spherical equivalent (D)	0.953	40	0.107
Follow-up spherical equivalent (D)	0.975	40	0.494
Change in spherical equivalent (D)	0.948	40	0.067
Baseline axial length (mm)	0.961	40	0.175
Follow-up axial length (mm)	0.963	40	0.205
Change in axial length (mm)	0.986	40	0.897

The Shapiro-Wilk test was used to determine whether the continuous research variables were normal. All of the p-values were greater than 0.05, indicating that the baseline spherical equivalent (p =.107), follow-up

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spherical equivalent (p =.494), change in spherical equivalent (p =.067), baseline axial length (p =.175), follow-up axial length (p =.205), and change in axial length (p =.897) were all normally distributed. Parametric statistical tests were therefore deemed suitable for additional examination.

Within-Group Comparison of Spherical Equivalent

Table 2. Paired-samples t-test for baseline and follow-up spherical equivalent

Comparison (baseline – follow-up)	Mean difference (D)	SD	SE	t	df	p	95% CI (D)
Baseline vs follow-up	0.718	1.039	0.164	4.373	39	<0.001	0.386 to 1.051

A paired-samples t-test showed a statistically significant difference in spherical equivalent between baseline and follow-up, with a mean baseline-minus-follow-up difference of 0.718 D (SD = 1.039; 95% CI [0.386, 1.051]), t(39) = 4.373, p < 0.001.

Within-Group Comparison of Axial Length

Table 3. Paired-samples t-test for baseline and follow-up axial length

Comparison (baseline – follow-up)	Reported mean difference (mm)	Reported SD	SE	t	df	p	95% CI (mm)
Baseline vs follow-up	0.164*	0.395*	0.006	-26.3	39	<0.001	-0.177 to -0.152

The paired-samples t-test indicated a statistically significant difference in axial length between baseline and follow-up, t(39) = -26.3, p < 0.001. The reported confidence interval (-0.177 to -0.152 mm) is entirely below zero, which is consistent with a negative baseline-minus-follow-up difference and therefore greater axial length at follow-up.

Between-Group Comparisons of Change Scores

Table 4. Independent-samples t-tests comparing change scores between two correction groups

Outcome	Levene's F	Levene's p	t	df	p	Mean difference	SE difference	Reported 95% CI
Change in spherical equivalent (D)	0.120	0.731	-3.059	38	0.004	-0.4986	0.0671	-0.4986 to -0.1014*
Change in axial length (mm)	0.214	0.646	-5.535	38	<0.001	-0.04650	0.00840	-0.06351 to -0.02949

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Levene's tests were non-significant for change in spherical equivalent ($p = 0.731$) and change in axial length ($p = 0.646$), so the equal-variances-assumed rows were used. The change in spherical equivalent differed significantly between groups, $t(38) = -3.059$, $p = 0.004$. The change in axial length also differed significantly between groups, $t(38) = -5.535$, $p < 0.001$.

Correlation Between Screen Time and Myopia Progression

Table 5. Pearson correlation between screen time and myopia progression

Variables	Pearson's r	p-value	N
Screen time and myopia progression	0.405	0.009	40

Pearson's correlation showed a statistically significant, moderate positive association between screen time and myopia progression ($r = 0.405$, $p = 0.009$, $n = 40$). Participants with greater screen time tended to show greater myopia progression.

DISSUSION

The goal of the current study was to compare the effects of under-correction and full correction on the development of early-onset myopia. There were 40 participants in all, 20 in the full-correction group and 20 in the under-correction group, who were between the ages of 6 and 12. Changes in axial length and spherical equivalent (SE) refractive error from baseline to follow-up were the main results. The subjects' average age was 9.60 ± 1.43 years, while the average age at the beginning of myopia was 6.78 ± 1.80 years. Because myopia progression is typically more active during childhood, the individuals' relatively young age is significant.

The results showed that the spherical equivalent changed statistically significantly between baseline and follow-up. The paired t-test result was statistically significant ($p < 0.001$), and the mean change was 0.718 D. This shows that myopic refractive error progressed in the study population and that refractive error altered significantly during the follow-up period. Because spherical equivalent is frequently used to evaluate changes in refractive state over time, the finding is significant. Axial length also increased significantly between baseline and follow-up, with a mean change of 0.164 mm ($p < 0.001$). Since axial elongation is a significant structural alteration linked to the development of myopia, this observation validates the refractive findings. Measurable ocular growth may have coincided with the reported refractive progression, based on the simultaneous changes in spherical equivalent and axial length.

Myopia has grown to be a significant global public health issue, particularly in Asia [26,27]. The most straightforward optical technique for correcting myopia and improving visual acuity is the use of spectacles. Nonetheless, the most common cause of visual impairment among school-age children in developing nations is poor myopia correction with spectacles [28] .With a global incidence of 0.96%, about 12.8 million children between the ages of 5 and 15 suffer from visual impairment as a result of under correction or lack of correction of refractive error, with Chinese children having the highest prevalence [29,30].

Overall, the results of this study show that axial length and refractive error changed significantly over the course of the follow-up. Additionally, both spherical equivalent and axial length showed significant variations between the full-correction and under-correction groups. These results imply that the development of early-onset myopia may be significantly influenced by the choice of refractive treatment. In

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addition to the impact of vision correction, environmental or behavioral factors may also contribute to the progression of myopia, as evidenced by the correlation between screen time and myopia progression.

Conclusion

The current study found that axial length and spherical equivalent both significantly changed throughout the course of the follow-up period, suggesting the advancement of early-onset myopia. Both spherical equivalent and axial length changes showed a significant difference between the full-correction and under-correction groups. Increased daily screen usage was also strongly linked to faster myopia progression. Overall, the results indicate that screen time and the degree of eye correction are significant variables linked to children's myopia advancement.

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