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Influence of Ocular Exercises on Eyestrain and Refractive Error among School Children

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Abstract **Objectives:** Refractive errors, which include myopia, hyperopia and astigmatism, can lead to visual impairment if left uncorrected, ultimately affecting academic performance and quality of life. This study aims to evaluate the influence of ocular exercises on eyestrain and refractive error among school children. **Methods:** The study consisted of 170 school children with refractive error from Government schools around Aundi Patti Taluk. Permission was obtained for conducting this study from Block Medical Officer and Principals of the Government schools. The study proposal was approved by the Institutional Ethics Committee of Government Theni Medical College. Voluntariness and confidentiality were ensured. The inclusion criteria were children of 8 to 15 years, with eyestrain and refractive error of <3.00 diopters. Any congenital eye defect children were excluded. The children were divided in to 85 for control and 85 for experimental groups by random numbers. The sample size was estimated by power analysis using computer software and found to be adequate for 90 % power and 5 % confidence level. The study was carried out from February 2022 to April 2023. **Results:** The data on the eyestrain questionnaire reveal that symptoms such as stinging, itching, redness, headache and blurred vision were moderate to severe in the pre-test for both groups. Post-test results showed significant improvement in the experimental group, with symptoms reduced to none or slight compared to the control group ($p<0.001$), indicating the effectiveness of eye exercises. The refractive index data showed significant improvements in the experimental group's median dioptres for both right and left eyes in post-tests (-1.0) compared to pre-tests (-1.5), while the control group showed no significant change. Between-group comparisons were significant in post-tests ($p<0.001$) but not in pre-tests. These findings confirm that the intervention is effective in alleviating eye symptoms and improving vision. **Conclusion:** The study provide evidence supporting the effectiveness of ocular exercises in reducing eyestrain symptoms among school children.

Key Words Digital strain, preventive care, refractive errors, visual impairment, eye exercises

INTRODUCTION

Refractive errors, which include myopia, hyperopia and astigmatism, can lead to visual impairment if left uncorrected, ultimately affecting academic performance and quality of life [1]. The World Health Organization (WHO) estimates that uncorrected refractive errors are responsible for a substantial proportion of visual impairment globally, with children being particularly vulnerable due to their developmental needs and educational requirements [2].

The influence of ocular exercises on eyestrain and refractive error among school children in India is a multifaceted issue that encompasses various aspects of ocular health, the prevalence of refractive errors and the potential benefits of targeted interventions such as ocular exercises. The prevalence of ocular morbidity among school children in India is notably high, with studies indicating that refractive errors are the most common ocular disorders affecting this demographic. A study conducted in Vijayawada reported a prevalence of refractive errors at 17.36%, contributing to an overall ocular morbidity rate of 29.35% among school children. Similarly, research from the Jawadhi hills found a prevalence of ocular morbidity at 2.6% among tribal children, emphasizing the need for effective screening and intervention strategies [3].

The relationship between ocular exercises and refractive errors has been explored in various contexts. For example, a study in China demonstrated that children who engaged in eye exercises, particularly those involving acupoints, exhibited a lower score on the Convergence Insufficiency Symptom Survey (CISS), suggesting a reduction in visual symptoms associated with refractive errors [4]. This finding aligns with the notion that ocular exercises may alleviate symptoms of eyestrain, which is particularly pertinent given the increasing screen time and near-work activities among children today. The impact of ocular exercises on reducing eyestrain and improving visual comfort has been documented in other studies as well, indicating that such interventions could be beneficial in managing refractive errors [5].

In the Indian context, the prevalence of refractive errors is compounded by factors such as prolonged screen exposure and inadequate eye care awareness among parents and educators. A study highlighted that the continuous use of computers and smartphones has detrimental effects on ocular health, leading to increased instances of eyestrain and refractive errors among school children. The COVID-19 pandemic exacerbated refractive errors and eyestrain in children due to prolonged screen exposure, reduced outdoor activity and poor eye care practices during online learning. This increased digital strain led to a rise in ocular complaints such as blurred vision, headaches and myopia progression. Implementing ocular exercises as a preventive measure could help mitigate these adverse effects by reducing strain and improving visual comfort [6].

Moreover, the role of ocular exercises in enhancing visual performance and reducing symptoms of eyestrain has been substantiated by various studies. Research conducted among university students indicated that regular practice of eye movement training significantly improved sleep quality and reduced headache symptoms associated with refractive errors [7].

The integration of ocular exercises into school health programs could be a valuable approach to combat the rising prevalence of refractive errors among children. A study conducted in rural China found that children who regularly practiced eye exercises showed a significant improvement in uncorrected visual acuity over time. This underscores the potential of structured ocular exercise programs to enhance visual health outcomes in school-aged children [8].

Alternative methods for managing refractive errors include increased outdoor exposure to slow myopia progression, orthokeratology (Ortho-K) lenses for corneal reshaping, low-dose atropine eye drops to control eyeball elongation and vision therapy to enhance eye coordination and reduce strain. These approaches, alongside ocular exercises, offer complementary strategies for improving visual health [9].

Uncorrected refractive errors not only impair academic performance and quality of life but also pose a significant public health challenge, increasing healthcare burdens and economic dependency. While global studies highlight the benefits of ocular exercises, their applicability to Indian school children remains underexplored, given disparities in healthcare access, screen exposure and lifestyle factors. Rural areas face acute challenges due to limited awareness, financial constraints and a shortage of ophthalmic care, making preventive strategies like ocular exercises a cost-effective solution. This study addresses these gaps by examining the public health impact, socioeconomic barriers and feasibility of integrating ocular exercises into school health programs to improve visual outcomes in underserved communities.

The need for further research into the efficacy of ocular exercises specifically tailored for school children in India is evident. While existing studies provide a foundation for understanding the benefits of such interventions, localized research focusing on the unique challenges faced by Indian children is essential. This would facilitate the development of culturally relevant and context-specific ocular exercise programs that can be effectively implemented in schools across the country. This study aims to evaluate the influence of ocular exercises on eyestrain and refractive error among school children.

METHODS

The study consisted of 170 school children with refractive error from Government schools around Aundi Patti Taluk (Theni District, Tamil Nadu, India). Permission was obtained for conducting this study from Block Medical Officer (Director of Health services at Theni) and Principals of the Government schools. The study proposal was approved by the Institutional Ethics Committee of Government Theni Medical College (Theni, India) Saveetha Medical College and Hospital (No. 1515/MEIII/21; dated 28 February 2022). Written informed consent was obtained from the parents and accent from the children. Voluntariness and confidentiality were ensured. The inclusion criteria were children of 8 to 15 years, with eyestrain and refractive error of < 3.00 diopters. Any congenital eye defect children were excluded. The children were divided in to 85 for control and 85 for experimental groups by random numbers. The sample size was estimated by power analysis using computer software and found to be adequate for 90 % power and 5 % confidence level. The study was carried out from February 2022 to April 2023.

Tools

For all 170 children, pre-test eyestrain levels were assessed using a validated eyestrain questionnaire based on a 5-point Likert scale (1-2 none/slight, 3 moderate and 4-5 severe). The questionnaire, consisting of 12 symptoms (stinging, itching, gritty sensation, aching, double vision, redness, headache, dryness, watery eyes, blurred vision, eye fatigue and burning sensation), was pre-tested for reliability and demonstrated a Cronbach's alpha of >0.80, indicating high internal consistency.

Visual acuity and refractive error assessment for myopia, hypermetropia and astigmatism were conducted using Snellen, Jaeger and Landolt Charts, which are internationally recognized and standardized tools for vision assessment. These charts have been previously validated in pediatric populations and were administered by a certified optometrist. Additionally, fundus examination was performed using an ophthalmoscope by an ophthalmologist, ensuring a comprehensive evaluation of ocular health.

Intervention

Ocular Exercises: The experimental group received the ocular exercises (30 min, twice a day, 5 days a week for 6 weeks). The eye exercises consisted of up, down, side view gaze, clockwise and anticlockwise rolling, near and far focus (20 feet), open and close the eyes, blinking and gentle eye muscle massage. Finally, lying down and relaxing the eyes. During the procedure the participants were closely observed. The control group children were given routine care. The variables were recorded for the control and experimental group, before and after the completion of the study.

Statistical Analysis

The analysis was conducted using SPSS version 26. Descriptive and inferential statistics were applied to the data. Descriptive statistics were used to summarize demographic characteristics, refractive error prevalence and eyestrain levels among the participants. For inferential statistics, the chi-square test of independence was applied to examine the association between categorical variables. Frequency tables were generated to present the distribution of responses from the eyestrain questionnaire, categorizing symptoms based on the 5-point Likert scale (none/slight, moderate, severe). Frequency tables were used to present the findings from the eyestrain questionnaire and visual acuity and the chi-square test was employed to assess goodness of fit or independence. All statistical analyses were conducted with a 5% significance level ($p<0.05$) to determine meaningful associations and intervention effects.

RESULTS

The data on the eyestrain questionnaire (Table 1) reveal that symptoms such as stinging, itching, redness, headache and

Table 1: Comparison of on eyestrain between the groups

		Control (85)		Experiment (85)		
Variable	Category	Pre	Post	Pre	Post	Statistics
Stinging eyes	None/Slight	0	0	0	85	$\chi^2 = 354.348$
	Moderate	45	31	52	0	p<0.001
	Severe	40	54	33	0	
Itching	None/Slight	12	20	29	85	$\chi^2 = 177.377$
	Moderate	34	31	44	0	p<0.001
	Severe	39	34	12	0	
Gritty feeling	None/Slight	10	15	10	85	$\chi^2 = 214.460$
	Moderate	38	32	23	0	p<0.001
	Severe	37	18	52	0	
Aching	None/Slight	09	27	0	85	$\chi^2 = 291.325$
	Moderate	54	44	22	0	p<0.001
	Severe	22	14	63	0	
Double vision	None/Slight	44	33	53	85	$\chi^2 = 121.891$
	Moderate	15	18	32	0	p<0.001
	Severe	26	34	0	0	
Redness	None/Slight	0	0	21	85	$\chi^2 = 270.002$
	Moderate	33	28	20	0	p<0.001
	Severe	52	57	47	0	
Headache	None/Slight	0	0	0	85	$\chi^2 = 364.907$
	Moderate	29	40	13	0	p<0.001
	Severe	56	35	72	0	
Dryness	None/Slight	0	0	0	85	$\chi^2 = 363.575$
	Moderate	45	48	23	0	p<0.001
	Severe	40	37	62	0	
Watery eyes	None/Slight	0	0	0	85	$\chi^2 = 358.738$
	Moderate	27	35	13	0	p<0.001
	Severe	58	50	72	0	
Blurred vision	None/Slight	0	0	0	85	$\chi^2 = 398.158$
	Moderate	25	55	15	0	p<0.001
	Severe	60	30	70	0	
Eye fatigue	None/Slight	0	0	0	85	$\chi^2 = 367.935$
	Moderate	20	38	12	0	p<0.001
	Severe	65	47	73	0	
Burning eyes	None/Slight	04	12	10	85	$\chi^2 = 246.079$
	Moderate	41	46	54	0	p<0.001
	Severe	40	27	21	0	

Table 2: Comparison on refractive index of right and left eye between the group

Groups	Tests	Right Median	Statistics	Left Median	Statistics
Control	Pre-test	-1.5 (-2.0 to -0.75)	H = 29.354, p<0.001	-1.5 (-2.0 to -0.75)	H = 32.178, p<0.001
Control	Post-test	-1.25 (-1.875 to -0.75)		-1.25 (-2.0 to -0.75)	
Experimental	Pre-test	-1.5 (-1.75 to -1.0)		-1.5 (-1.75 to -1.0)	
Experimental	Post-test	-1.0 (-1.25 to -0.5)		-1.0 (-1.25 to -0.5)	
Comparison within Control (Pre-test and Post-test)			q = 0.588		q = 0.502
			P = 0.976		P = 0.985
Comparison within Experimental (Pre-test and Post-test)			q = 6.575		q = 6.700
			P < 0.001		P < 0.001
Comparison between Pre-test (Control and Experimental)			q = 0.319		q = 0.502
			P = 0.996		P = 0.985
Comparison between Post-test (Control and Experimental)			q = 5.668		q = 6.128
			P < 0.001		P < 0.001

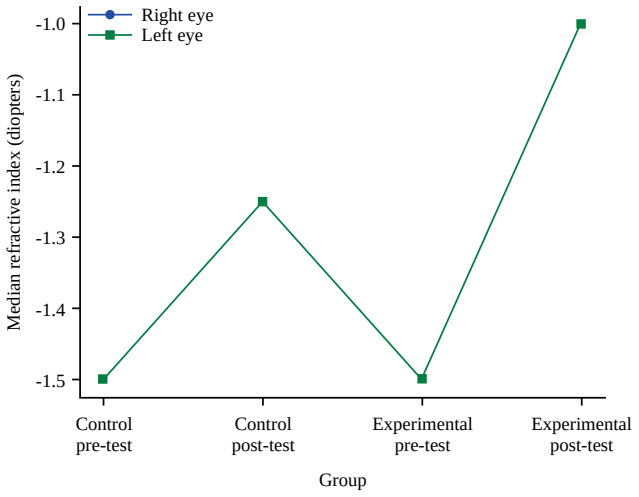

Figure 1: Refractive index changes in control and experimental groups

blurred vision were moderate to severe in the pre-test for both groups. Post-test results showed significant improvement in the experimental group, with symptoms reduced to none or slight compared to the control group (p<0.001), indicating the effectiveness of eye exercises.

The refractive index data Table 2 and Figure 1 showed significant improvements in the experimental group's median for both right and left eyes in post-tests (-1.0) compared to pre-tests (-1.5), while the control group showed no significant change. Between-group comparisons were significant in post-tests (p<0.001) but not in pre-tests. These findings confirm that the intervention is effective in alleviating eye symptoms and improving vision.

DISCUSSION

The results of this study provide evidence regarding the efficacy of ocular exercises in alleviating eyestrain symptoms among school children. The data from the eyestrain questionnaire (Table 1) indicate that symptoms such as stinging, itching, redness, headache and blurred vision were reported at moderate to severe levels in the pre-test phase for both the experimental and control groups. However, the post-test results reveal a reduction in these symptoms within the experimental group, with many participants reporting either no symptoms or only slight discomfort. This improvement was statistically significant (p<0.001) when compared to the control group, underscoring the effectiveness of the eye exercises implemented in this study [10].

The findings align with previous research that has highlighted the positive impact of ocular exercises on visual comfort and symptom relief. Tiwari et al. conducted a comparative study on the effects of various non-pharmacological techniques, including eye exercises and found a notable reduction in myopia symptoms among participants who engaged in regular ocular exercises. Similarly, Joshi and Retharekar reported that eye exercises could significantly enhance visual acuity and reduce refractive errors in myopic individuals, further supporting the notion that such interventions can yield substantial benefits for ocular health [10,11].

In terms of refractive error, the data presented in Table 3 demonstrate significant improvements in the median for both the right and left eyes in the experimental group post-tests (-1.0) compared to pre-tests (-1.5). In contrast, the control group exhibited no significant change in refractive error measurements. The between-group comparisons were also significant in post-tests (p<0.001), indicating that the ocular exercises not only alleviated symptoms of eyestrain but also contributed to a measurable improvement in refractive status. This finding is consistent with the work of Ln *et al.* [4] who reported that eye exercises had a positive impact on refractive error and visual symptoms in children [12].

The observed reduction in refractive error among the experimental group can be attributed to several factors. Ocular exercises are believed to enhance the flexibility and strength of the eye muscles, thereby improving the eye's ability to focus and reducing the strain associated with prolonged near work, such as reading or using digital devices [4].

The psychological benefits associated with engaging in structured exercises, such as reduced anxiety and increased focus, may also play a role in enhancing visual performance [8].

It is important to note that the control group did not exhibit any significant changes in refractive error or eyestrain symptoms, which reinforces the notion that the improvements

observed in the experimental group can be directly attributed to the ocular exercises. This highlights the necessity of incorporating such interventions into school health programs, particularly in light of the increasing prevalence of refractive errors and eyestrain among children due to the rise in screen time and digital learning environments [13]. Moreover, the implications of these findings extend beyond individual symptom relief. By addressing eyestrain and refractive errors through ocular exercises, there is potential for improved academic performance and overall quality of life for school children. The ability to see clearly and comfortably is crucial for effective learning and engagement in educational activities. Therefore, implementing ocular exercise programs in schools could serve as a proactive measure to combat the rising incidence of visual impairments among children [14,15].

CONCLUSION

The results of this study provide evidence supporting the effectiveness of ocular exercises in reducing eyestrain symptoms among school children. The significant improvements observed in both subjective symptoms and objective refractive measurements highlight the potential of these interventions as a valuable component of ocular health strategies in educational settings. Future research should continue to explore the long-term effects of ocular exercises and their integration into school health programs to promote better visual health outcomes for children.

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Ethics Committee Approval

The study protocol was approved by the Institutional Ethical /22Committee Govt Theni Medical College, Theni. Ref No 1515/MEIII/21 28/02/22

Conflict of Interest

The authors declared no conflicts of interest with respect to the authorship and publication of this article.

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