

EFFECTIVENESS OF OCULAR EXERCISES WITH NUTRITIONAL SUPPLEMENTATION ON VISUAL ACUITY AND BIOCHEMICAL PARAMETERS AMONG REFRACTIVE ERROR CHILDREN

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Abstract

Objective: The study aimed to evaluate the Ocular exercises and relation to the Nutritional supplementation intake on visual acuity and Biochemical factors among refractive error children. **Materials and Methods:** A true experimental study was adopted with 170 participants who met the inclusion and were randomly allocated in to the study group (n=85) and the control group (n=85). Food frequency questionnaire was evaluated Visual acuity and refractive error Bio chemical retinol level was assessed. **Results:** Majority (>70%) of the participants were school children with a mean age group of 10.62 socio economic factors associated with Nutritional impact and used mobile phones and computers with improper ergonomics. Findings from this study will help to make appropriate recommendations to identify and treat the visual impairment on early stage. There were significant (P<0.001) changes after 6 weeks of Intervention like Ocular Exercises and regular intake of Nutritional supplements in experimental group experimental and control groups compared by chi-square test. The mean retinol level of pre-test and post-test were 20.302 and 23.348 ug/dl respectively. It was found to be statistically significant (P<0.001) Though both the values are within clinical range, still there was 15% improvement in the retinol level showing the beneficial effect of the intervention. **Conclusion:** This finding concludes that the outcome effectively improves the visual acuity and reduced the refractive power could be incorporated with regular intake of Vita min Sources and reduce the eyestrain thereby improves the quality of vision.

Keywords: Eyestrain, Visual Acuity, Refractive Error, Nutritional Deficiency, Vitamin Sources

INTRODUCTION

Eye sight is a crucial sign of one's wellbeing and level of living.. Effective communication and learning depend on vision. Education must include developing good vision. Refractive error is still one of the major causes of vision impairment in children on a global scale. Children with significant uncorrected refractive defects consistently score poorly on a range of vision-cognitive and vision-motor tests when compared to kids without significant refractive issues (1) Balanced nutrition is crucial for a healthy eye and vision many Nutritional deficiency can result in vision impairment including Vitamin A, Vitamin B1 an and B12, Vitamin C, Vitamin D and Vitamin E and minerals such as Zinc Elise. Vitamin A plays a crucial role in vision by maintaining a clear cornea which is the outside covering of the eye. This vitamin also a component of rhodopsin a protein in our eyes that allows to see in low light conditions. (2)

Vit A known as retinol has several important functions. These include helping the body's natural defense against illness infection helping vision in dim light. Beta carotene is a precursor to vitamin A and helps the eyes to adjust in dim conditions. Beta carotene converts to retinol. These include lycopene, lutein, and zeaxanthin. Vit

A plays an important role in your vision see the full spectrum of light eye needs to produce certain pigments for our retina to work properly. Vitamin A deficiency stops the production of these pigments leading to night blindness. (3)

Eyes rely on a complex network of cells including photoreceptor cells in the retina to capture and process visual information without proper nutrition these cells may not function optimally potentially leading to reduced visual acuity impaired night vision or even vision loss, Vitamin B1 deficiency will cause toxic optic neuropathy and can cause blurred vision. Vitamin B12 deficiency may cause retinal bleeding and nerve tissue damage lead to permanent vision. Vitamin supplements reverse dry eye (Vit A impact on refractive error, 2017) symptoms and restore severe peripheral vision loss over a short time period. Vit A improves the smoothness of the tear film this is the thin layer of fluid on the eye. it also supports the formation of tears Vit c plays a critical role in consuming oxygen maintaining low levels of oxygen within the eye. Replenishing vit C in the lens and vitreous is a viable for minimizing oxidative stress and reducing the risk of cataract formation this has an impact on overall development and academic success. There are 1.4 million blind youngsters in the world, according to estimates. In the age range of 7 to 15 years, 13% of Indians have uncorrected refractive errors. Vitamin deficiency reported ocular manifestations include impaired vision uveitis, and dry eye disease.(4) Computer use by children especially school-aged children is growing rapidly, they are using computers or laptops not only for education purpose but also, for playing online games for a prolonged period. (5) Visual impairment in children negative impact on socio emotional competences and academic development. Uncorrected refractive error is the leading cause of vision loss. (6)

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

MATERIALS AND METHODS

A randomized controlled trial was adopted to conduct the study by investigator at Government schools around Aundipatti Taluk Theni District between 2022 February to 2023 April after obtaining formal permission from the Block medical officer in Director of Health services at Theni, Formal permission obtained from the Head masters of the Government schools. The study group (n=85) and control group (n=85) were selected from randomization method after the Eye screening. The samples were selected based on the inclusion criteria Children with Myopia, Hyperopia, Astigmatism Children who are wearing spectacles, contact lenses. Children who are cooperative. History of strabismus or refractive surgery, High refractive error: Myopia $\geq 6.00D$ sphere (in any meridian); Hyperopia $\geq 5.00D$ sphere (in any meridian); Astigmatism $\geq 4.00D$ Children with any other eye disorders, color blindness, squint eye, Not more than 15yrs children and congenital eye defect children were excluded in the study. The participants explained the purpose of the study in their regional language and clarified the doubt. Written informed consent was obtained from the participants after assuring confidentiality. Pre-test level Visual acuity and Refractive error Myopia, Hypermetropia, Astigmatism was assessed by using Snellen chart, Jagger's chart, Landolt chart with the help of Optometrist using of Refractometer (1) The fundus examination done by ophthalmoscope observe the Bitot's spot ,conjunctival xerosis in anterior chamber of the eye. Torch light examination done assessed the dryness

(Xerophthalmia) of the eye. Food frequency questionnaire was assessed intake of vit A and other vitamin sources weekly basis. The investigator administer the Ocular exercises was weekly five days to the participants. Before administer the eye exercises position was maintained by participants. ocular exercises such as up and down side view gaze, rolling anticlockwise direction, near and far focus tightly open and close the eyes, blinking the eyes, eye muscles massage, palming exercises each exercises was demonstrated by investigator 5 seconds finally lie down relax the eyes (4) Nutrients supplements through the fruits like papaya, Goa, banana, vegetable like carrot, green leafy vegetable soup given weekly three days up to 6 weeks During an intervention the participants were observed for any compliance. Post-test assessment done by after the 6 weeks of intervention using of same tool.

ANALYSIS

The data were analysed by descriptive and inferential statistics methods using sigma plot 14.5 version Inc., USA software statistical package. Pre-test post-test level of Visual acuity and refractive error. The effectiveness of Intervention within the group was calculated by chi-square test and the effect of intervention between the experimental and Control group was compared by. Kruskal Wallis one-way ANOVA on ranks with Tukey's multiple comparison test and paired t test .The probability of $P < 0.001$ was taken as statistically. Bio chemical retinol level were described as mean median standard deviation and paired t test. It was found to be statistically significant.

RESULTS

Majority (>70%) of the participants were school children with a mean age group of 10.62 and used mobile phones and computers with improper ergonomics. In experimental group in pre-test some Vit A sources only taken by participants in once in a week. Most of the vit A sources not taken regularly by the participants. Vit A deficiency symptoms such as Xerophthalmia Bitot's spots identified in children with refractive error.

While comparison of experimental and control group Nutritional deficiency identified to the participants in refractive error children in control group. In control group participants were not taken vit A sources regularly. Visual acuity between the experimental and control group. p value is by Chi-square and Fisher exact test, visual acuity between the groups. Bio chemical retinol value assessed in Experimental group.

Biochemical retinol in blood value assessed in each sample in experimental group. Pre and post-test value assessed in after the intervention $p < 0.001$ significant visual acuity level improved. Between group comparison of post- test of control and experimental showed significance ($P < 0.001$). (10) This shows that the interventions is beneficial in correcting the vision of the right and left eye.

There were significant ($P < 0.001$) changes after 6 weeks of intervention like Ocular exercises like up down, side gaze, anticlockwise rotation blinking in every 15 minutes, near and far focus eye muscle massage, relaxation of eyes along with regular screening wearing of eye glasses between the experimental and control groups compared by chi-square Kruskal Wallis one-way ANOVA on ranks with Tukey's multiple comparison test. The probability of $P < 0.001$ was taken as statistically.

The mean retinol level of pre-test and post-test were in experimental group n= (73) sample 20.302 and 23.348 ug/dl respectively. It was found to be statistically significant (P<0.001) Though both the values are within clinical range, still there was 15% improvement in the retinol level showing the beneficial effect of the intervention. Parents are recommended to provide their children with intake of Nutritional sources to improve eye health.

Vitamin A intake through daily diet is insufficient while vit A stored and utilized gradually. Findings from this study minimal insufficient Vit A deficiency identified in pre-test and post-test level Vit A retinol values within normal range clinically after the 6 weeks of intervention. Regular intake of Nutritional sources among school children over all improve eye health.

Study conducted by Maduka-Okafor, F. C., Okoye, O., Ezegwui, I., et al., (2021), revealed that refractive error is not common. Refractive error primarily affects females and occurs more frequently in metropolitan schools (2) Refractive error is the primary source of visual impairment, and the majority of children who required corrective glasses did not have them. **In a study conducted Zhong Lin Balamurali vasudevan ishal Jhani (2013)** questionnaire included duration and daily activities living environment study motivation and diet The activities were grouped into near work and outdoor activities average hours spent reading handled on mobile and computer (9)

20 Items of Vit A sources and its described as weekly intake of Vit A sources by participants. Food frequency questionnaire assessed in children how many times vit a sources taken in the weekly (11) Vit A deficiency indicates in biochemical retinol level in blood. Among the participants most of of them taken Vit A sources weekly once only. Lack of Nutritional deficiency influences the eye health. While comparison of experimental group in pre-test some Vit A sources only taken by participants in once in a week. Most of the vit A sources not taken regularly by the participants. Vit A deficiency symptoms such as Xerophthalmia Bitot's spots identified in children with refractive error.

Nutritional supplements such as yellow like fruits and carrot and green leafy vegetables provided weekly twice a day to the participants. Also disseminate the awareness about importance of vitamin sources and benefits for health eyes (6) in the post- test vit A sources carrot papaya. Banana, green leafy vegetable like Drumstick leaves also yellow like fruits were taken by the participants twice or three times in a week. Also Biochemical retinol level was assessed in blood.

Food frequency questionnaire contains vit a sources assess the participants in control group. Vit A sources taken by the participants how many times taken in a weekly basis.. Most of the participants had taken the Vit A sources such as Tomato and carrot green leafy vegetables once in a week once in pre- test, 60% of the participants were not aware of the vitamin sources and its benefits for healthy eyes Vit A deficiency symptoms such as Xerophthalmia Bitot's spots identified.in children with refractive error.

Biochemical retinol level in blood assessed for control group. While comparison of experimental and control group Nutritional deficiency identified to the participants in refractive error children in control group. In control group participants were not taken vit A sources regularly. **(Fig: 1)**

Fig 1: Types of Refractive error

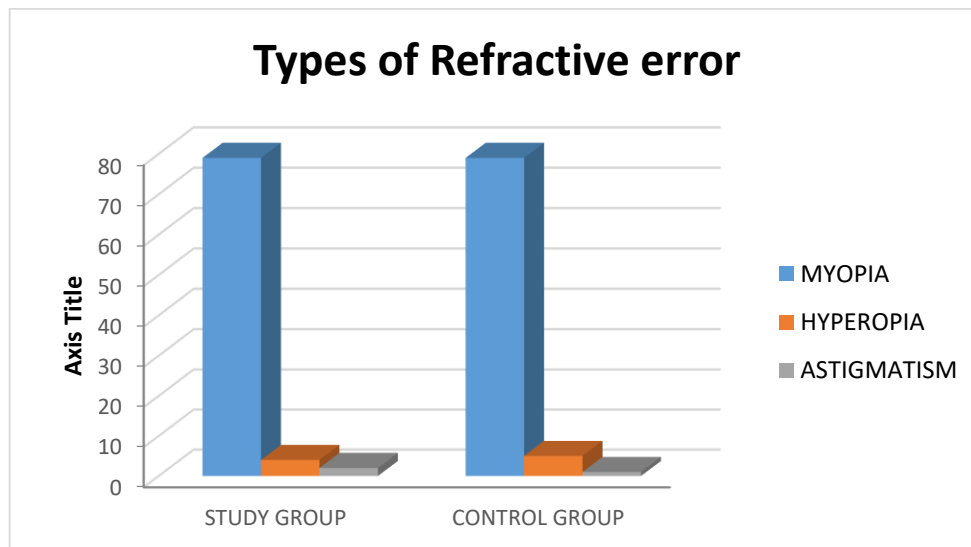


Fig 2: Visual Acuity pre and post-test in Experimental & Control group

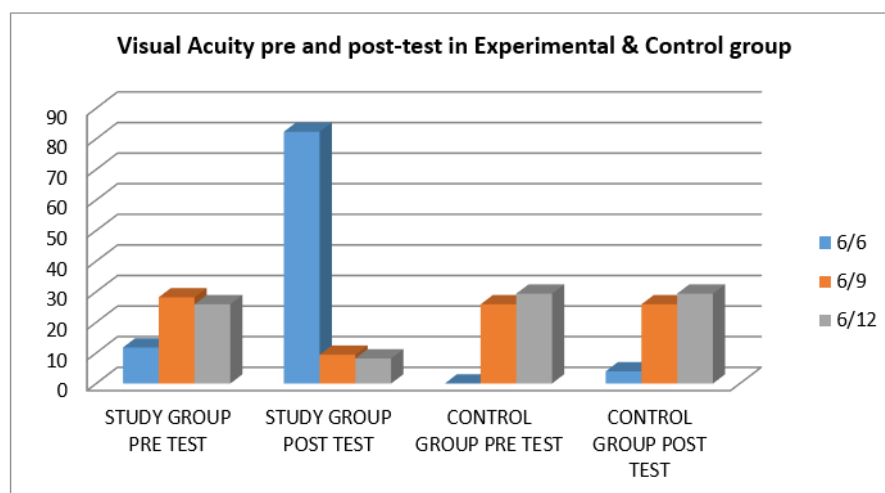


Table: 3 shows that 3.1 the mean, SD and SE of retinol level of the experimental group pre-test and post-test is given in Table 4. The mean retinol of pre-test and post-test were 20.302 and 23.348 ($\mu\text{g/dL}$), respectively. It was found to be statistically significant ($P < 0.001$). Though, both the values are within clinical range, still there was 15 % improvement in the retinol level showing the beneficial effect of the intervention.

Table 3: Comparison of pre-test and post-test of experimental group on blood retinol level

S. No.	Test	Mean	SD	SE	Statistics
1	Pre-test	20.302	3.921	0.459	t = 20.046 P < 0.001
2	Post-test	23.348	3.793	0.447	

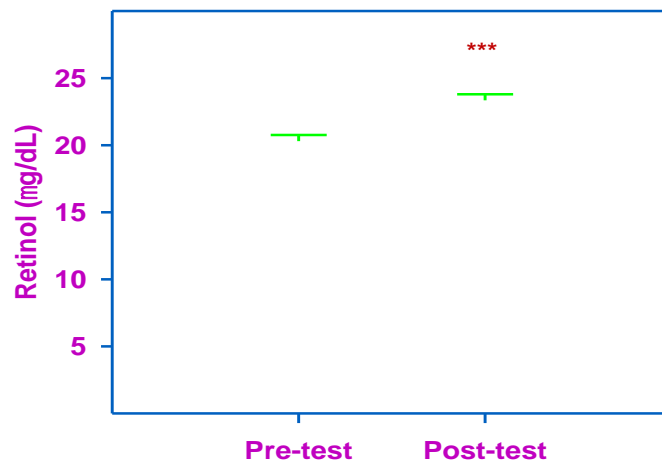


Fig 3: Comparison of Retinol ug/dl level in pre - test and post- test in Experimental group

Comparison of experimental and control group types of refractive error myopia had 79 (93%) Hyperopia had 5 (6%) Astigmatism 1 (1%) and Myopia had same frequency were analysed. Hyperopia had 4(5%) Astigmatism had 2 (2%) Data were analysed by frequency table and chi-square test (**Table: 4**)

The median and percentile of refractive index of right eye is median of control pre-test, control post-test, Experimental pre-test and post-test were -1.5,-1.25,-1.5 and -1.0 2.0,2.5, 2.75 <0.001).dipters respectively. It was found to be statistically significant (<0.001) within group comparison of control pre - test and post-test did not show significance, P= 0.0976.). within group comparison of Experimental pre-test and post test showed significance (P< 0.001) between group comparison of pre-test of control and Experimental did not show significance (P=0.996) Between group comparison of post- test of control and experimental showed significance (P<0.001). This shows that the interventions is beneficial in correcting the vision of the right eye. (**Table: 5**)

Table 5: Comparison of control and experimental groups on refractive index of right eye

S. No.	Groups	Tests	Median	Percentiles	Statistics
1	Control	Pre-test	-1.5	-2.0 to - 0.75	H = 29.354 P < 0.001
	Control	Post-test	-1.25	-1.875 to - 0.75	
	Experimental	Pre-test	-1.5	-1.75 to - 1.0	
	Experimental	Post-test	-1.0	-1.25 to - 0.5	
2	One-way ANOVA on ranks				
3	Comparison within Control (Pre-test and Post-test)				q = 0.588 P = 0.976
	Comparison within Experimental (Pre-test and Post-test)				q = 6.575 P < 0.001
4	Comparison between Pre-test (Control and Experimental)				q = 0.319 P = 0.996
	Comparison between Post-test (Control and Experimental)				q = 5.668 P < 0.001
n = 85 each in Control and Experimental groups. The percentiles are 25 and 75. The 'H', 'q' and 'P' values are by Kruskal Wallis one-way ANOVA on ranks with Tukey's multiple comparison test.					

Table 6 represents the median and percentile of refractive index of left eye of the median of control pretext, control post-test, Experimental pre-test and post-test were -1.5,-1.25,-1.5 and -1.0 2.0.2.5, 2.75 <0.001). Diopters respectively. It was found to be statistically significant P <0.001) within group comparison of control pre-test and post-test did not show significance, P= 0. 985.). within group comparison of Experimental pre-test and post test showed significance (P< 0.001) between group comparison of pre-test of control and Experimental did not show significance (P=0. 985) Between group comparison of post-test of control and experimental showed significance (P<0.001) This shows that the interventions is beneficial in correcting the vision of the Left eye. Above the results shows the refractive index between the groups. After the intervention p=0.001 significant refractive power reduced. Before the intervention in the study groups 0.05 refractive power had (8.2%), 0.75 (10.6%) - 1.0 refractive power had (11.8%), -1.25 refractive power had (14.1%)- 1.5 refractive power had (25%), -1.5 refractive power had (25%) -1.75 refractive power had (14.1 %), -2.0 refractive power had (7%) -2.5 refractive power had (5.9%) After the intervention refractive power resolved (9) and refractive power 0.05 to 1.0 reduced in each participants In the control group 0.05 had 13 (15.2 %1.25 had (9.41,) 0.75 had (11.8%)-1.0 had (11.8%) -1.25 had 8((9.41%),-1.5 had11 (13%), -1.75 had11 (13%) - 2.0 had 9 (10.67)-2.0 had 9 (10.67%) -2.5 had 8(9.41%) 2.75 had 5(5.9%) in the post-test reduced in refractive power.(8)

Table 6: Comparison of control and experimental groups on refractive index of left eye

S. No.	Groups	Tests	Median	Percentiles	Statistics
1	Control	Pre-test	-1.5	-2.0 to - 0.75	H = 32.178 P < 0.001
	Control	Post-test	-1.25	-2.0 to - 0.75	
	Experimental	Pre-test	-1.5	-1.75 to - 1.0	
	Experimental	Post-test	-1.0	-1.25 to - 0.5	
2	One-way ANOVA on ranks				
3	Comparison within Control (Pre-test and Post-test)				q = 0.502 P = 0.985
	Comparison within Experimental (Pre-test and Post-test)				q = 6.700 P < 0.001
4	Comparison between Pre-test (Control and Experimental)				q = 0.502 P = 0.985
	Comparison between Post-test (Control and Experimental)				q = 6.128 P < 0.001
n = 85 each in Control and Experimental groups. The percentiles are 25 and 75. The 'H', 'q' and 'P' values are by Kruskal Wallis one-way ANOVA on ranks with Tukey's multiple comparison test.					

DISCUSSION

Visual problems have negative effects in learning and social interactions thus affecting the natural development of academic and social abilities .Refractive error occurs when the optical system of the non-accommodating eye fails to bring parallel rays of light to focus on the retina. (John H Kempen, 2005) They have been identified as a cause of public health and economic concern.. Studies also provide evidence supporting by Maduka-Okafor, et al., (2021), revealed that refractive error is not common. Refractive error primarily affects females and occurs more frequently in metropolitan schools. Refractive error is the primary source of visual impairment, and the majority of children who required corrective glasses did not have them. In a study conducted by Lin, Z.,.

et al., in 2013 the questionnaire included duration and daily activities, living environment, study motivation and diet. (8). The activities were grouped into near work and outdoor activities, average hours spent reading handled on mobile and computer. Vit A deficiency indicates in biochemical retinol level in blood. Among the participants most of them taken Vit A sources weekly once only. Lack of Nutritional deficiency influences the eye health. While comparison of experimental group in pre-test some Vit A sources only taken by participants in once in a week. Most of the vit A sources not taken regularly by the participants. Vit A deficiency symptoms such as Xerophthalmia Bitot's spots identified in children with refractive error. Nutritional supplements such as yellow like fruits and carrot and green leafy vegetables provided weekly twice a day to the participants. Also disseminate the awareness about importance of vitamin sources and benefits for health eyes (9) in the post- test vit A sources carrot papaya. Banana, green leafy vegetable like Drumstick leaves also yellow like fruits were taken by the participants twice or three times in a week. Also Biochemical retinol level was assessed in blood. Proteins and Vitamins incorporate with the visual acuity and refractive error. (B. Thomas. E. Umapathy and J. Iputo (2008) (10) .The ability for a person to read or see the last line on the Visual chart is recorded (at least distance of 20 feet or 6 metres) . 6/6 means see at 6 metres and letter size 6. Children are not aware of the problem and usually do not complain of defective vision. This necessitates early detection and treatment of ocular morbidity and .visual impairment to prevent permanent visual defects. Studies show that lack of vitamin A impairs a variety of physiological functions. Xerophthalmia is a condition that affects the immune system and the body's epithelial tissues, including the cornea and retina. Due to the need for vitamin A, the retina is impacted. Night blindness, also known as nyctalopia, is caused by vitamin A deficiency (11). Dryness of the corneal surface puts a person at risk for keratomalacia, which causes diffuse keratinization of the corneal surface and irreversibly impairs vision, as well as ulceration, an ophthalmic emergency. These pathologies are classed depending on the percentage of the cornea affected. Keratomalacia and ulcers cause corneal scarring that is permanent.(12) Uncorrected refractive error is recognised as the principal cause of visual impairment in school children. A comparative study of ocular exercises with Nutrient supplements increase the quality of vision may be considered)

CONCLUSION

In conclusion the Ocular exercises outcome is effective in the resolved the eyestrain. Balanced nutrition is crucial for a healthy eye and vision many Nutritional deficiency can result in vision impairment including Vitamin A, Vitamin B1 an and B12, Vitamin C, Vitamin D and Vitamin E and minerals such as Zinc. Vitamin A plays a crucial role in vision by maintaining a clear cornea which is the outside covering of the eye. Ocular exercises associated with Nutritional supplements outcome is effective in the resolved the eyestrain and visual acuity level improved, refractive power reduced. The selected participants became comfortable and compliance to practice. It also found this exercise is very safe as it did not cause adverse effects during the study period and should still be clinically correlated. Ocular exercises and Nutritional diet intake could teach to school children to practice and incorporate them into their daily routine to reduce the eye strain improves the eye health. Lack of proteins high carbohydrate diet and, lack of fruits and vegetables intake influence on poor visual acuity refractive error in school children. Periodic screening programme identify the refractive error and visual acuity among school children. Low visual acuity impact on education and

academic development of children. It is also important to educate the parents and children about the importance of intake of fruits and green leafy vegetables and vegetables. It can improve visual acuity and refractive power reduced.

Participant Consent for Publication: A written informed consent was obtained from the participants.

Data sharing statement: The data that support the findings of this study are available from the Corresponding author upon reasonable request.

Author Contributions: was involved in background and research design, participant's recruitment, data analysis, writing and editing of the manuscript intervention protocol reviewing of related literature, intervention, data collection, writing, and editing of the manuscript.

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