

# Application of Lutein in Relieving Digital Eye Fatigue in Adolescents

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**Abstract:** This paper studies the application of lutein in relieving digital eye fatigue in adolescents. Through in-depth discussion of the causes and effects of digital eye fatigue, as well as the mechanism and effect of lutein, the method of applying lutein through dietary intake and supplements was proposed. Combined with the change of living habits, the positive effect of lutein in relieving digital eye fatigue was verified by case analysis. The results show that lutein has potential value in improving the eye health of adolescents.

**Keywords:** digital eye fatigue; adolescents; lutein; eye health

## 1. Introduction

With the widespread popularization of electronic devices, it has become a common phenomenon for teenagers to use these devices for a long time, which leads to the widespread problem of digital eye fatigue. Digital eye fatigue not only has a negative impact on the eye health of adolescents, but also may pose a long-term threat to the overall vision. In this context, this paper aims to explore the application of lutein in relieving digital eye fatigue, and provide a feasible solution for adolescent eye health.

## 2. Causes and effects of digital eye fatigue

### 2.1 Trends of adolescents' long-term use of electronic devices

With the rapid development of science and technology, the popularization of electronic equipment in teenagers' life has become an inevitable trend. Young people's long-term use of mobile phones, tablet computers, computers and other electronic devices has become the norm of daily life. Behind this trend lies the crisis of digital eye fatigue, because staring at the screen for a long time is not only a way of entertainment and learning, but also the main inducement of digital eye fatigue [1].

### 2.2 Main symptoms and long-term effects of digital eye fatigue

Digital eye fatigue shows a series of eye discomfort symptoms, including dry eyes, visual fatigue, headache, etc. These symptoms tend to become more obvious after using electronic devices, seriously affecting the individual's life and work efficiency. In the long run, digital eye fatigue may also cause more serious problems, such as deepening myopia and vision loss, which will have a far-reaching long-term impact on the vision health of adolescents.

### 2.3 Potential threats to adolescent vision health

The developmental stage of adolescents' vision is critical, and digital eye fatigue poses a potential threat to their vision health. Because the eyeball structure of teenagers is not yet fully developed and mature, long-term use of electronic equipment may lead to eye muscle fatigue, and then affect the normal development of the eyeball. This potential threat is not only related to eye health, but also may have a negative impact on the normal function of the overall visual system, and then affect the quality of study and life of adolescents.

## 3. Mechanism and effect of lutein

### 3.1 Distribution and function of lutein in eyes

The antioxidant effect of lutein in retina has profound physiological significance. The retina is a key component of the eye, responsible for sensing light and converting it into neural signals. However, because it is located in the outermost layer of the eyeball, it is often attacked by UV and free radicals, which is easy to cause oxidative stress. Lutein, as an antioxidant, can neutralize free radicals, reduce the damage of oxidative stress to retinal cells, and maintain their normal physiological functions. This antioxidant effect helps to delay the process of retinal aging and improve the stability and health of the visual

system. The protective effect of lutein on lens is crucial in preventing eye diseases. The lens is the transparent structure of the eye, which is responsible for adjusting the focal length so that the image can be clearly presented on the retina. However, with the growth of age, the lens is prone to oxidation, leading to cataract and other problems. Lutein can inhibit the oxidation process of the lens, slow down its aging speed, help maintain the transparency of the lens, delay the occurrence of cataract, and thus protect the overall health of the visual system. The absorption function of lutein to blue light also plays an important role in relieving digital eye fatigue. In modern life, people are often exposed to blue light released by electronic devices, and excessive exposure to blue light may lead to eye fatigue and other eye discomfort. Lutein can effectively absorb part of the blue light, reduce its stimulation to the retina, reduce the risk of digital eye fatigue, and make the eyes feel more comfortable [2].

### **3.2 Protective effect of lutein on retina**

The importance of lutein as an antioxidant is reflected in its interaction with free radicals. Free radicals are highly active molecules with unpaired electrons, which often cause cell damage through oxidative reactions. As the photoreceptor of the eye, the retina is constantly stimulated by external light, and is vulnerable to oxidative stress. Lutein can react with free radicals, neutralize their activity, and prevent the oxidative damage of free radicals to retinal cells, thus maintaining the stable state of retinal cells. Lutein plays an important role in protecting the retina from light damage. Especially under strong light irradiation, the damage to retinal cells caused by ultraviolet and blue light in the light cannot be ignored. Lutein can absorb part of the light, reduce the intensity of the light, form a light barrier, effectively reduce the risk of retinal cell damage caused by light, and provide an additional protective layer for the visual system.

Lutein also plays a key role in maintaining the integrity and repair of retinal cell membranes. The cell membrane is an important part of cell structure and is essential for normal visual conduction. Lutein keeps the integrity and elasticity of the cell membrane by inhibiting the oxidation process of phospholipids in the membrane, effectively preventing the invasion of retinal cells by external stimuli and ensuring the normal operation of the visual system. In addition, lutein maintains the number and function of retinal cells by participating in cell signaling and slowing down the process of apoptosis. Apoptosis is a controlled cell death process that is essential for maintaining tissue homeostasis and function. Lutein can slow down apoptosis by regulating relevant signaling pathways, ensuring the persistence and normal function of retinal cells, and providing key support for maintaining the normal work of the visual system for a long time.

### **3.3 How lutein alleviates digital eye fatigue**

The antioxidant effect of lutein has a far-reaching impact on relieving digital eye fatigue. Digital eye fatigue usually causes the eyes to be exposed to continuous light due to the long-term use of electronic equipment, which is prone to produce a large number of free radicals, resulting in oxidative stress reaction in eye tissues. Lutein, as an antioxidant, can effectively slow down the oxidation process of ocular tissues by reacting with free radicals and neutralizing its activity. This not only helps maintain the healthy state of retinal cells, but also reduces the ocular discomfort caused by digital eye fatigue and improves the stability and tolerance of the eye. The absorption function of lutein to blue light is another important mechanism to alleviate digital eye fatigue. Blue light released by electronic equipment has high energy in the spectrum, and excessive exposure to blue light may lead to eye fatigue and visual discomfort. Lutein plays a natural barrier role by absorbing part of blue light and reducing its direct impact on the retina, effectively reducing the degree of digital eye fatigue and making the eye feel more comfortable [3].

Lutein also further alleviates digital eye fatigue by maintaining the health of retina and ocular tissues. By inhibiting the oxidation process, lutein helps maintain the integrity of the retinal cell membrane and reduce eye fatigue. In addition, the presence of lutein helps to regulate the normal function of ocular tissues, including the support of ocular muscles, improve its stability, and thus slow down the feeling of ocular fatigue caused by digital eye fatigue. In addition to the above effects, lutein helps relieve digital eye fatigue by promoting ocular blood circulation and increasing the supply of oxygen and nutrients. In addition, it can also slow down the fatigue of eye muscles, improve the flexibility of eye movement, and further reduce the risk of digital eye fatigue.

## **4. Application of lutein in adolescents**

### **4.1 Dietary intake of lutein**

Teenagers are recommended to eat more green leafy vegetables rich in lutein, such as spinach, mustard, amaranth, etc. These vegetables are not only rich in lutein, but also rich in vitamins, minerals and fiber, which are beneficial to overall health. You can make colorful salads, make vegetable soups with a variety of vegetables, or add these leafy vegetables to

other dishes to diversify your diet and ensure sufficient lutein. Teenagers are encouraged to choose lutein rich fruits, such as orange citrus fruits and yellow tomatoes. These fruits not only contain lutein, but also provide rich vitamin C and other antioxidant substances, which help maintain eye health. These fruits can be eaten as snacks or with staple foods to increase the intake of lutein and enjoy the delicious fruit at the same time.

Seafood is another lutein rich option, especially dark fish and kelp. These foods not only contain lutein, but also provide high-quality protein, unsaturated fatty acids and minerals. Moderate consumption of these seafood rich in lutein can ensure the intake of lutein and obtain other nutrients beneficial to eye health. You can choose to cook with light salt and less oil to better retain the nutritional value of food. For some vegetarians, although seafood is one of the options rich in lutein, they can still meet the demand for lutein by eating a large number of dark vegetables, fruits and lutein rich plant foods. For example, spinach, cabbage and mustard in vegetables are excellent sources of lutein, while citrus fruits and tomatoes in fruits also contain lutein that can be used by the body. In addition, beans, nuts and some whole grains are also good choices for vegetarians to obtain lutein. Vegetarians can also get enough lutein to provide adequate support for eye health by reasonably matching plant-based foods [4].

## **4.2 Selection and use of lutein supplements**

In order to ensure the effect of lutein supplements, products specially designed for teenagers should be selected. These products usually consider the growth and development characteristics of adolescents, including the demand for lutein and the absorption capacity of the body. It is recommended to consult the advice of doctors or health professionals to understand the health status of individuals and ensure that the supplements selected meet their needs. Doctors can provide personalized suggestions according to the individual's physical condition, lifestyle and dietary habits to ensure that the lutein supplements selected are not only suitable for the characteristics of the age group, but also meet the individual's overall health needs. When purchasing lutein supplements, it is important to pay attention to the quality of products and the reputation of manufacturers. Selecting well-known brands can improve the reliability of product quality, while viewing the composition table and production information of products can ensure that they meet the standards and obtain relevant quality certification. In addition, you can consult the evaluation of other users and the evaluation of professional institutions to obtain more information about the product effect and reliability.

When using lutein supplements, you must carefully read and follow the instructions for use of the product. The instructions for use contain information about dosage, frequency of administration, and possible precautions. Taking it at the recommended dose and frequency helps ensure the safe and effective use of lutein. Exceeding the recommended intake may cause adverse reactions, so it is important to follow the instructions to ensure that lutein supplements are used within a safe range. It is best to consult with a doctor before considering starting lutein supplements. Doctors can assess an individual's health status, medical history, and potential risk factors to provide personalized lutein supplementation recommendations. Doctors can also provide information about possible interactions between lutein supplements and other drugs according to the individual's special needs, such as the presence of other chronic diseases or being treated with other drugs. Through communication with doctors, lutein supplementation can be ensured to be correctly and safely applied in the overall health management. It is important to have regular eye health checks after starting lutein supplements. Ophthalmology professionals can evaluate the ocular health status through fundus examination, vision test and other means. This helps monitor whether lutein supplementation has a positive impact on improving vision and alleviating digital eye fatigue. Doctors can adjust the dosage of lutein according to the examination results or give further suggestions to ensure the effective maintenance of eye health.

## **4.3 Combined with lifestyle changes to enhance the effect**

Reducing the frequency and duration of using electronic devices for a long time is one of the key lifestyle changes. Take regular breaks, stay away from the screen at regular intervals, and carry out eye relaxation activities, such as closing your eyes to rest and looking out of the window, which can help reduce eye fatigue. This habit and the role of lutein complement each other, and together help alleviate digital eye fatigue. In addition, regular blinking is also a simple and effective eye health care method, which can reduce the dryness of the eye surface and improve eye comfort. Ensuring sufficient light without dazzling is an important factor in maintaining the eye environment. Avoid using electronic devices in a dim environment, and adjust the brightness and contrast of the screen to adapt to the surrounding light. The use of anti blue light glasses and other auxiliary tools can effectively reduce the irritation of blue light to the eyes and alleviate the discomfort of the eyes. These practices complement the protective effects of lutein and jointly maintain vision health.

Eye exercises can help to enhance the flexibility of eye muscles and reduce eye fatigue. In addition to simple far and near focus switching and eye rotation, you can also try eye massage and acupoint pressing around the eyes to promote blood

circulation and improve the oxygen supply of eye tissues. Such exercise echoes the mechanism of lutein to promote eye health, and helps to comprehensively improve the ability of eye anti fatigue. Sleep has a non negligible impact on eye health. Good sleep can help effectively restore eye fatigue and improve the resistance to digital eye fatigue. Ensure enough sleep time every night, maintain a healthy biological clock, and help promote the repair and renewal of ocular tissues. Combined with lutein supplementation, eye health can be improved more comprehensively, so that eyes are clearer and sharper when awake, and can fully recover when resting. Adequate water intake is essential to maintain the moist surface of the eye. Dry environment and long-term use of electronic equipment may lead to dry and astringent eyes. Maintaining an appropriate amount of drinking water is helpful to alleviate this discomfort and promote the distribution and absorption of nutrients such as lutein in the eyes. Replenishing water not only helps to lubricate the surface of the eye, but also promotes the metabolism inside the eye and maintains the normal function of eye tissues.

## 5. Case analysis

Background: Xiao Ming, a 14-year-old junior high school student, often feels eye fatigue and dryness due to long-time use of electronic equipment, and shows a decline in reading and attention at school.

Diagnosis: according to the examination of ophthalmologist, it is diagnosed as digital eye fatigue. It is recommended to take comprehensive measures to alleviate it, including lutein supplementation.

Treatment plan: the doctor suggested that Xiao Ming take an appropriate amount of lutein supplements every day to support eye health. Control the screen time, conduct eye relaxation activities at regular intervals, maintain a good eye environment, and conduct eye exercises regularly. Adjust the schedule to ensure adequate sleep every night. Encourage an appropriate amount of water to relieve the dry feeling of the eyes.

Effect: after several weeks of comprehensive treatment, Xiao Ming's digital eye fatigue symptoms were significantly reduced. His attention and reading performance at school improved, and his eye fatigue decreased significantly. Ophthalmic examination also showed good ocular health, and lutein supplementation played an active role in the overall treatment [5].

Conclusion: through scientific diet and lifestyle adjustment, combined with lutein supplementation, digital eye fatigue can be alleviated more comprehensively and effectively, and the vision health of adolescents can be protected. In practice, it is suggested that individuals should make corresponding adjustments according to their own conditions and under the guidance of doctors, in order to achieve the best digital eye fatigue relief effect.

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