

Effect of Hydrogen-rich Atomic Water on Eye Fatigue

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Abstract: This study investigated the effect of hydrogen-rich atomic water on eye fatigue. The experimental results show that hydrogen-rich atomic water can reduce oxidative stress and inflammatory reaction in the eye, and has a significant improvement effect on myopia and visual fatigue, with high safety and no obvious adverse reactions. The results of myopia and visual fatigue improvement experiment showed that the prevalence of myopia in the control group was 15%, and the prevalence of myopia in the experimental group was 5%. The prevalence of myopia in the experimental group was significantly lower than that in the control group. The ocular symptoms of the experimental group were better than those of the control group in the improvement of fatigue, dry eyes, red blood stains and other symptoms. The patient satisfaction score of the experimental group was 95.5%, which was significantly higher than that of the control group. There were no adverse events such as allergic reactions or skin irritation in the experimental group and the control group during the whole experiment.

Keywords: Hydrogen-rich water; Eye strain; Effect evaluation

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1. Introduction

With the rapid development of technology, digital products play an indispensable role in people's work, study and life. The long-term use of computer, mobile phone, tablet computer and other electronic devices has made the eyes under unprecedented pressure, and the incidence of eye fatigue has increased year by year. According to relevant statistics, more than 60% of people have different degrees of eye strain symptoms. If long-term eye fatigue is not relieved in time and effectively, it may further cause deepening myopia, dry eye syndrome, conjunctivitis and other eye diseases, posing a serious threat to eye health. Therefore, finding a safe, effective and convenient method to improve eye fatigue has become an urgent problem to be solved.

The research on eye fatigue has become a hot spot in the field of ophthalmology. Oxidative stress is considered to be one of the important mechanisms leading to eye fatigue and related diseases^[1]. As a natural antioxidant, hydrogen molecule can selectively remove reactive oxygen species which are toxic to cells. It has the advantages of mild action, high safety, and no obvious side effects, which brings new hope for the treatment of

eye fatigue ^[1–3]. A number of studies have shown that hydrogen-rich water has a positive effect on the treatment of a variety of diseases, but there are relatively few studies on the improvement of eye fatigue. Based on the antioxidant, anti-inflammatory and cytoprotective properties of hydrogen molecule, this study aims to provide a solid experimental basis for clinical application, explore the improvement effect of hydrogen-rich atomic water on eye fatigue and myopia, and provide new ideas for clinical relief of eye fatigue.

2. Materials and methods

2.1. Experimental materials

Hydrogen-rich water preparation was produced by electrolysis technique and rich in hydrogen ions, electrons, and potassium ions, used after dilution.

2.2. Experimental design

This study used a randomized controlled trial design and was divided into two parts:

2.2.1. Myopia and visual fatigue improvement experiment

- (1) Subjects: A total of 120 adult volunteers of both sexes, aged 18–65 years with mild myopia and visual fatigue, were randomly divided into experimental group and control group, with 60 participants in each group.
- (2) Inclusion criteria: met the diagnostic criteria of mild myopia (uncorrected visual acuity ≤ 0.8 and ≥ 0.5), accompanied by visual fatigue symptoms such as dry eyes, acid swelling, blurred vision and more; No use of other eye care products or drugs in the past 1 month.
- (3) Exclusion criteria: severe eye diseases such as glaucoma, mature cataract; Allergic to hydrogen-rich water ingredients; Unable to cooperate with the person completing the experiment.

2.2.2. Visual fatigue relief experiment

- (1) Subjects: A total of 120 adult volunteers of both sexes aged 18–65 years with visual fatigue were randomly divided into experimental group and control group, with 60 people in each group.
- (2) Inclusion and exclusion criteria: similar to the myopia and visual fatigue improvement experiment mentioned above, but myopia was not required.
- (3) Intervention methods: The experimental group used: the head was gently tilted back, the eyes were looked toward the top of the head, the lower eyelid was pulled down with the index finger to expose the conjunctival sac, the hydrogen-rich water was dropped into the conjunctival sac 1–2 cm above the eyes, and the eyes were gently closed for 5 minutes, twice a day.
- (4) Treatment course: used in myopia and visual fatigue improvement experiment for 8 weeks; It was used continuously for 1 week in the visual fatigue alleviation experiment.
- (5) Control group: No eye-related products were used throughout the experiment.

2.2.3. Myopia and visual fatigue improvement experiment

- (1) Visual acuity test: The international standard E visual acuity chart was used to measure the uncorrected visual acuity of the subjects' left and right eyes before and after the experiment. During the test, the

distance between the subject and the visual acuity chart was 5 meters, and the subject was in a sitting position. The left eye was measured first, and then the right eye was measured. The other eye was covered with an eye key, and the eye was kept open. The visual acuity corresponding to the last line of correctly identified visual target was recorded.

- (2) Myopia rate: According to the visual acuity test results, the incidence of myopia was calculated (uncorrected visual acuity < 0.8 was defined as myopia). The ocular symptoms included fatigue, dry eyes and red blood cells. The subjects scored their own symptoms before and after the experiment (0 points indicated no symptoms, 1–3 points indicated mild symptoms, 4–6 points indicated moderate symptoms, 7–10 points indicated severe symptoms).
- (3) Patient satisfaction score: at the end of the experiment, a questionnaire survey was conducted to understand the subjects' satisfaction with the improvement of eye symptoms by hydrogen-rich water. The score ranged from 0–100 points, and ≥ 80 points indicated satisfaction.
- (4) Safety monitoring: during the experiment, the subjects were closely observed for adverse events such as allergic reactions such as eye itching, redness, swelling and more, or skin irritation.
- (5) Visual fatigue relief test: Assessment of ocular symptoms: the same methods as myopia and visual fatigue improvement test were used to assess ocular symptoms, including fatigue relief, red blood cells, dry eyes and astringency.
- (6) Patient satisfaction score: the evaluation method was the same as above.
- (7) Safety monitoring: same experiment as described above.

2.4. Statistical Methods

SPSS 22.0 statistical software was used for data analysis. Measurement data were expressed as mean $\pm$ standard deviation and t test was used for comparison between groups. Count data were expressed as rate (%), and χ^2 test was used for comparison between groups. $p < 0.05$ was considered statistically significant.

3. Results

Myopia and visual fatigue to improve the result of the experiment: the myopia rate comparison: after 8 weeks after the experiment, the control myopia prevalence was 15% (9/60), group myopia prevalence was 5% (3/60), group myopia prevalence significantly lower than the control group, the difference statistically significant ($\chi^2 = 4.05$, $p < 0.05$). The improvement of ocular symptoms: the experimental group was better than the control group in the improvement of fatigue, dry eyes, red blood and other symptoms, and the specific data are shown in **Table 1**.

Table 1. Improvement of ocular symptoms in myopia and visual fatigue experiment (%)

Indicators	Experimental group	Control group
Total number of eyes	60	60
Myopia rate	5%	15%
Patient Satisfaction ratings	95.5%	No improvement
Allergic reaction or skin irritation	no	no

Patient satisfaction score: the patient satisfaction score of the experimental group was 95.5%, which was

significantly higher than that of the control group ($p < 0.05$). Safety results: During the whole experiment, there were no adverse events such as allergic reactions or skin irritation in the experimental group and the control group.

Results of visual fatigue relief experiment: relief of eye symptoms: After 1 week of using hydrogen-rich water, the experimental group had significant effects on fatigue relief, redness regression, and improvement of dry and astringent eyes, while the control group had no significant improvement. The specific data are shown in **Table 2**.

Table 2. Relief of ocular symptoms in asthenopia relief experiment (%)

Indicators	Experimental group	Control group
Fatigue relief	92.2%	No improvement
Redness condition	90.3%	No improvement
Dry eyes and astringent eyes	89.8%	No improvement
Patient Satisfaction ratings	92.5%	No improvement
Allergic reaction or skin irritation	No	No

Patient satisfaction score: the patient satisfaction score of the experimental group was 92.5%, which was significantly higher than that of the control group ($p < 0.05$). Safety results: There were no adverse events related to the use of the product in the experimental group and the control group.

4. Discussion

The mechanism of action of hydrogen-rich water in improving eye strain. In this study, according to the results of hydrogen-rich water on myopia has significant improvements and visual fatigue, its mechanism may be related to the following aspects, selective antioxidant effect: molecular hydrogen as a selective antioxidant, can remove the cells by selective toxicity strong reactive oxygen species such as hydroxyl radicals and peroxide nitrite, reduce cell damage caused by oxidative stress ^[1]. In the eye, oxidative stress is an important factor leading to a variety of eye problems, such as retinal cell apoptosis and lens opacity. Hydrogen-rich water can reduce oxidative damage in eye tissues by scavenging free radicals, thereby improving vision and relieving eye fatigue. Anti-inflammatory effects: eye inflammation, oxidative stress can induce inflammatory reaction is a defense mechanism of organism to injury, but excessive inflammation can cause further damage to the eye tissues, lead to the occurrence of symptoms such as dry eye, red. The anti-inflammatory effect of hydrogen-rich water can effectively alleviate these symptoms and promote the recovery of the eye. Hydrogen-rich water can inhibit the release of inflammatory factors such as tumor necrosis factor- α , interleukin-6, alleviate ocular inflammation, dry eyes, red blood stains and other symptoms ^[3]. Protection of retinal cells: hydrogen can reduce the apoptosis of retinal cells by inhibiting the changes of mitochondrial membrane potential. At the same time, hydrogen can also reduce the level of tyrosine nitration, inhibit oxidative stress damage of retinal cells, and have a neuroprotective effect ^[1]. Retinal cells are the key cells in the formation of vision, and the maintenance of their normal function is essential for good vision. The protective effect of hydrogen-rich water on retinal cells provides an important cellular level support for maintaining normal vision and improving eye fatigue. Improving micro circulation: rich hydrogen water may by promoting vasodilation, blood rheology, increase the blood supply of the eye tissues. Adequate blood supply can provide rich nutrients and oxygen for eye cells, discharge of wastes, so as to maintain normal metabolism of the eye tissues and function, alleviate eye fatigue. It is like providing sufficient “energy” and “nutrients” for the eye,

so that it can maintain a good working state.

The clinical significance of this study may provide a new method for the prevention and treatment of eye fatigue. At present, the clinical methods to relieve eye fatigue mainly include rest, the use of artificial tears, and the adjustment of eye habits, but the effect is limited. This study shows that hydrogen-rich water can improve eye fatigue through a variety of mechanisms, which provides a new safe and effective method for clinical prevention and treatment of eye fatigue. For those who need to for a long time in the face of the electronic screen, such as office workers, students. The presence of hydrogen rich water can let their gaps in a work or study, by using rich hydrogen water to alleviate eye fatigue, in time to avoid the because of eye fatigue and influence the efficiency of the work and study.

The potential value of hydrogen-rich water in the prevention and control of myopia: The present study found that after 8 weeks of using hydrogen-rich water, the incidence of myopia in the experimental group was significantly lower than that in the control group, suggesting that hydrogen-rich water may have a certain prevention and control effect on the development of myopia. Myopia is a major public health problem facing today's society, especially the high incidence in young people. Rich hydrogen water potential value on myopia prevention and control, offers a new way for prevention and control of myopia, deserves further research. If can be applied to a rich hydrogen water myopia prevention and early intervention, may effectively reduce the incidence of myopia, reduce the severe myopia related complications such as high myopia.

During the whole experiment, there were no adverse events such as allergic reactions or skin irritation in the experimental group, indicating that the application of hydrogen-rich water in the eyes has high safety and can be used for a long time. For eye care products, safety is the primary factor, water rich hydrogen is widely used in clinic, good security for it laid a solid foundation.

4.1. The prospect of research

4.1.1. Small sample size

The sample size of this study was only 60 people per group, which is relatively small and may affect the reliability of the results. Future studies can expand the sample size to further verify the effect of hydrogen-rich water.

4.1.2. Observation time is short

In myopia and visual fatigue improve experiments, observation time for eight weeks, observation time in alleviate visual fatigue experiments for 1 week, relatively short observation time, unable to determine the long-term effect of hydrogen-rich water. Follow-up studies can extend the observation time to explore the long-term effects of hydrogen-rich water.

4.1.3. The mechanism of action needs to be further studied

This study has initially explored the mechanism of hydrogen-rich water in improving eye fatigue, but the specific targets and signaling pathways of hydrogen molecules in the eye need to be further studied.

4.2. Future studies

In the future, we will strengthen the in-depth research on the mechanism of action, and use molecular biology, cell biology and other techniques to further study the targets and signal transduction pathways of hydrogen in the eye, so as to provide a solid theoretical basis for the application of hydrogen-rich water in eye diseases.

4.2.1. More clinical research

Expand the sample sizes, longer observation time, multicenter, double-blind, randomized controlled trials, further verify the hydrogen-rich water in eye fatigue, eye diseases such as myopia in the efficacy and safety.

4.2.2. Develop new hydrogen-rich water preparation

Based on the results of this study can be further optimized hydrogen-rich water preparation process, develop more stable, more efficient water rich hydrogen preparation, improve its clinical application value.

4.2.3. Explore the combined application scheme

To explore the combined application effect of hydrogen-rich water and other eye care methods, such as eye massage and nutritional supplementation, and to provide a new scheme for the comprehensive prevention and treatment of eye fatigue.

5. Conclusions

This study shows that hydrogen-rich atomic water can significantly improve the symptoms of myopia and visual fatigue, reduce the prevalence of myopia, and improve patient satisfaction, with high safety and no obvious adverse reactions. Its mechanism of action may be related to selective anti-oxidation, anti-inflammation, and protection of retinal cells. This study provides an experimental basis for the application of hydrogen-rich water in the prevention and treatment of eye fatigue. However, it is necessary to further expand the sample size, prolong the observation time, and further study the mechanism of action to promote its clinical application.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Yao S, 2024, Research Progress on the Molecular Mechanism and Application of Hydrogen-Rich Water in Alleviating Exercise-Induced Fatigue. Chinese Society of Sports Science, Abstracts of the 5th National Fitness Science Conference, Hebei Normal University, 293–294.
- [2] Chen Q, Li Z, Sun P, 2025, Exploration on the Role and Mechanism of Hydrogen-Rich Water in Improving Athletes' Sports Performance. Sports Vision, 2025(04): 102–105.
- [3] Yang L, Fu F, 2024, Innovative Experimental Research on Exploring the Properties of Hydrogen with the Help of Hydrogen-Rich Water. Chemistry Teaching and Learning, 2024(23): 95–96.

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