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## Ergonomic aspect of eye health



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### ABSTRACT

The eye is one of five senses that provide information about the condition of the surrounding environment in the form of electromagnetic waves. Electromagnetic waves received by the eye and focused to the retina in visual system. The retina converts electromagnetic waves into nerve impulses, then the optic nerve is delivered to the center and visual associations cortex to form visualization. The eye is able to see objects quickly because it has an accommodation mechanism and eye muscles which will move according to the movement of objects. Various factors can affect the function of the eye, one of them is near work without implementation of ergonomic aspect.

In clinical ergonomics there are three aspects which influence the eye health, namely task, organization and environment. Task, related to what is seen, its size, the contrast of objects with the background, and how it works. Organizational aspect related to working hours, rest hours, work shifts. Environment related to the intensity of lighting, various harmful residues to the eyes, chemical hazard, work accidents, etc. Application of ergonomics working principles such as standardized operating procedure (SOP), rest hours, the use of personal protective equipment (PPE) are important to maintain good visual function.

**Keywords:** Ergonomics, task, organization, environment, visual function

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### INTRODUCTION

The eye is one part of the five senses to receive information from surrounding environment. The eye is able to receive information in the form of electromagnetic waves. The electromagnetic waves can be accepted because the eye has: 1) an optical system that focuses electromagnetic waves in the form of objects falling directly on the retina, 2) the retina which will convert electromagnetic waves into nerve impulses, 3) eye nerves (optic nerve) to deliver nerve impulses to the visual center, and 4) the visual center and the visual association so that what is seen is known. The four elements are presented in **Figure 1**.<sup>1</sup>

The eye is able to focus the image of objects that are seen quickly because it has pupils whose width can be adjusted to the needs and also has a lens that can be adjusted so that the object's shadow falls right on the retina (fovea centralis). Adjustment of pupil width and lens convexity are called accommodation mechanisms. Pupil width regulation is regulated through the iris and lens convexity is regulated by the ciliary muscles, which are small muscles in the eye that will work during literacy let alone do activities.<sup>1</sup>

The eyes also move which is moved by the external muscles of the eye. The eyes move following the movement of the object being seen. The faster

the movement of objects that are seen the faster the movement of the eye follows it.

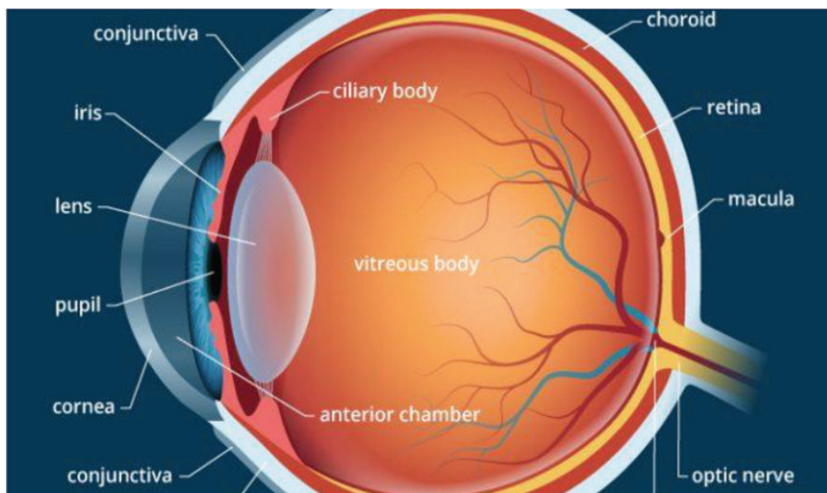
The function of the eye or sense of sight is very dependent on the structure of the four elements. However, eye function is also influenced by several other factors, such as:

1. Health conditions in the womb, especially nutritional status, due to poor nutritional status, eye health decreases, as a result of lack of vitamin A which is very important in vision function.
2. Age, because the older the function of the sense of sight decreases, which is called presbyopia.
3. Diseases suffered during growth and development.
4. Activities and the environment in which the activity is carried out.

Nearly 90% of daily activities are controlled by the sense of sight, therefore the function of the sense of sight is very important for life. For this reason, the eyes or the sense of sight must be kept healthy and functioning well let alone to work.

Before the development of science and technology (IPTEK) especially the development of lighting technology (electricity) worked only during the day and at night resting, so the time for work and rest was almost balanced. So, the chance of recovery from the ciliary muscle is very

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**Figure 1.** Eyeball structure: cornea, aqueous humor, pupils, lenses, vitreous humor, retina, nerve of the eye.<sup>1</sup>

sufficient. But with the progress of the development of science and technology, a lot of equipment was created to help work get done faster, be able to work longer, better work results. The rapid development of electric lighting at night is getting better, work activities up at night, the longer use of the eyes so that the ciliary muscles work longer while the time to rest is less.<sup>2</sup>

Almost all jobs require good eye function to be able to produce quality products and more. The development of micro technology, computer technology, digital technology, cell phones, more and more use of computers and cellphones. Increased use of micro and computer technology is clearly the burden of the eye to focus on objects that are seen increasingly heavy. Increased use of the eye as a result of doing various types of work that requires high research with long periods of time without adequate rest time is very risky for impaired eye function.<sup>3</sup>

In addition, work environment conditions that do not meet the requirements such as lighting intensity, dust, exposure to ultraviolet light (UV), chemicals that are harmful to the eye, splashes of residue that can hit the eye will and cause eye irritation and interfere with eye health.<sup>3</sup>

To prevent and reduce occupational risks to eye health, various efforts are needed, one of which is the application of the principle of ergonomics to be a necessity.<sup>4</sup>

Ergonomics comes from the Greek “Ergon” means work and “nomos” means rules. So the rules needed in doing work so that the workforce remains healthy and productive. Ergonomics is also called human factor engineering, given various definitions by several experts.<sup>2</sup> Manuaba (2005)

gives the definition of ergonomics as a “multi / inter / transdisciplinary approach to harmonize work tools, methods and environments for human capabilities, abilities and limitations so as to create healthy, safe, comfortable, effective and efficient working conditions for improvement work productivity and well-being “. Humans as workers have abilities that are brought from birth are often called talents. Skill is the development of talent through the learning process at school or from experience so that they have knowledge and skills. But don't forget that any efforts to increase human knowledge and skills have limits. Overcoming these limitations is very risky to cause health problems. This is where the ergonomics approach seeks to reduce the risks that may arise including on eye health.<sup>4</sup>

## APPLICATION OF ERGONOMIC PRINCIPLE

The application of the principle of ergonomics can be seen from 3 aspects namely task, organization and environment. In doing work usually required work equipment, work methods, organization and work environment where the work will be done. From one aspect or combination of the three that do not meet ergonomic requirements can interfere with eye function or health.<sup>2,3</sup>

Task is a type of task or work that is done where the eyes will always work during the task. During the work the eyes always follow the changes and movements of objects that are seen, so always do accommodation. To accommodate means to put strain on the iris and ciliary muscles. The smaller the object seen or the higher the accuracy required and the faster the rhythm of the task the heavier the burden on the eyes. The load received by the iris and the ciliary muscle to a certain extent causes fatigue, which is followed by complaints in the eye.<sup>2,3</sup>

With the advancement of science and technology and the increasing number of work tools created that are able to see objects that are even smaller in micro sizes such as workers in laboratories, watchmakers, computer builders, silver masses, border builders, etc. accompanied by high accuracy are clearly very risky to health eye. How many decades has been affected by the rapid development of computer and cellphone technology, and the children in the computer or cell phone are cool too. He did not realize that they had been dealing with his computer or cellphone for several hours, so he had not realized that he had put a strain on his eyes. If it is from a young age it has been so, then the vision will also be more quickly disrupted. This is where the application of ergonomics is needed, it

does not mean not using a computer or cell phone but how many hours may and how many hours must rest, that is to see far or far view or a blue painting or green.

If work requires accuracy at least every 2 hours of work followed by a 5 minute break. And if you work with a computer you need to adjust the height of the monitor with eye height when sitting, the distance of the monitor from the eye and the setting of the computer desk.<sup>3</sup>

Work organization involves setting work hours, shift work: such as morning, evening or night assignments. If the organization of work is not compatible with the conditions of the workers, it will quickly cause eye health problems. Through work organizations will be able to provide optimal burden or excessive burden on the eyes. This is where organizational work arrangements are needed so that they do not put a heavy burden on the eyes.<sup>4</sup>

Through setting working hours and rest hours will be able to minimize the risks that may occur including on eye health. Short breaks in accordance with the severity of the work are very to reduce the risk to health. The incidence of work accidents reported at PT. Jamsostek (now BPJS Employment) in Bali is very high before the break time for companies that apply the rest time only at 12.00-13.00 AM (Figure 2).<sup>5</sup> A similar incident also occurred in the IPTN aircraft industry, only workplace accidents occurred earlier because the break at 11.00-12.00 AM.

With the application of breaks for example every 2 hours of work (for light to moderate work) or every 1 hour of work for heavy work or that requires high accuracy can reduce the risk of work accidents even able to increase work productivity and company profits. In other words it can reduce high production costs (Figure 3).<sup>6</sup>

The work environment greatly affects the ability of the eye to be able to see clearly, let alone have to do work related to color and requires high accuracy. To be able to see clearly requires appropriate lighting intensity. The smaller the object that must be seen, the higher the intensity of lighting needed. If the intensity of application is less than the eye's provisions will make additional efforts that cause the eyes to get tired quickly.

This condition has been started since elementary school, because almost 80% of the intensity of lighting (light) in elementary schools in Denpasar is less than 150 lux.<sup>8</sup> Whereas the intensity of lighting needed to read and write is at least 250-300 lux.<sup>3</sup>

Doing work outside in the sun or exposed to ultraviolet (UV) rays such as surfing, fishermen, field workers cause eye disorders such as pterygium and cataracts.<sup>9,10</sup>

However, doing work also risks the occurrence of work accidents, which can affect the eyes. Accidents often occur in welders, construction, use of chainsaws, lawn mowers, etc. A work accident can affect one or both eyes, so:

1. eyeballs come out or come off.
2. Regarding the eyelids
3. Regarding the cornea
4. Eye nerves
5. The center of vision

Occupational accidents that reach the eye often also occur due to the three aspects of ergonomics, namely aspects of the task, organization and environment, because of these three aspects quickly arise fatigue, which causes less alertness, become careless, less focused when doing work.

In addition, the lack of commitment of workers and employers in the implementation of occupational health and safety triggers workplace

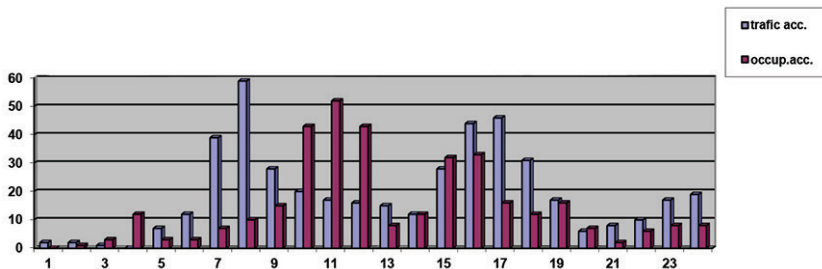


Figure 2. Occupational accidents reported at PT. JAMSOSTEK 1995-1998.<sup>5</sup>

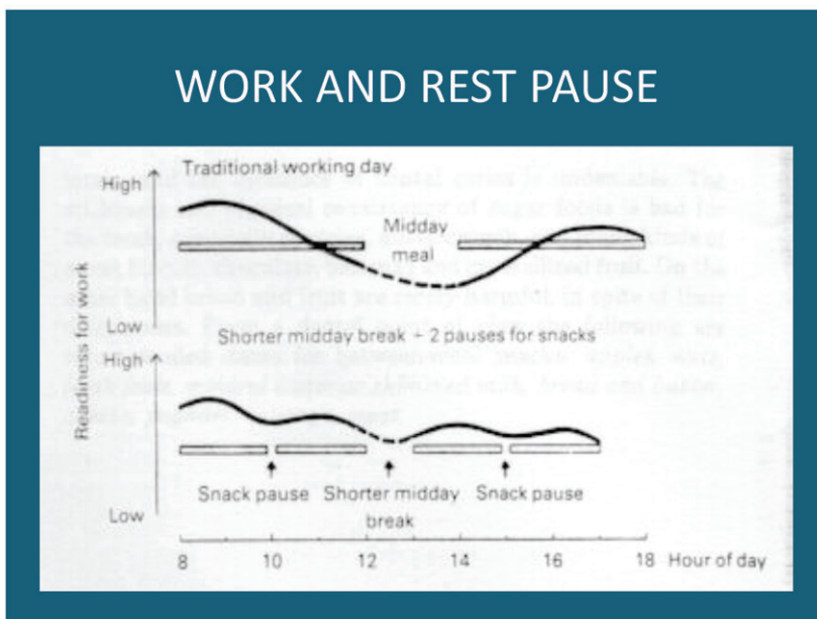


Figure 3. Working and resting hours<sup>7</sup>

accidents. Also in the application of SOPs in every work implementation including the use of personal protective equipment (PPE) is good and right as a cause of severe risk to eye health.<sup>7,11</sup> With the use of PPE the severity of the risk to eye health can be minimized. Also not less important is the supervision of employers for the application of work safety and to reduce high production costs.

## CONCLUSION

Good health and eye function is needed to carry out daily activities. Nearly 90% of daily activities are controlled by eye function, let alone to do work. The development of science and technology is found and developed a variety of technologies and work tools so that they are able to work longer hours, the results are more good quality work, more work productivity. On the other hand, the burden on the eye is getting heavier so it risks affecting the health of the eyes, such as getting tired quickly, various complaints arise and can even irritate the eyes.

From the aspect of ergonomics there are three aspects that can affect eye health, namely aspects of Task, organization and work environment. From one or a combination of the three aspects are very risky to eye health. Of the three aspects, it is also very risky for work accidents concerning the eyes.

To reduce the bad influence of work on eye health, the application of ergonomic principles since planning is a must. In addition to the commitment of employers and workers it is very important to minimize risks to eye health, as well as reduce production costs.

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