

The Relationship of Lighting Intensity with Eye Fatigue in Workers at Mekar Armada Jaya Inc. in 2021

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Abstract. Based on the report on the intensity of lighting in company in 2016-2018, the intensity of lighting in the company exceeds the lighting standard ($\pm 100-300$ lux), the high intensity of lighting that can cause fatigue in the organs of vision. To determine the relationship between lighting intensity and eye fatigue of workers in the manufacturing industry, this study was conducted by involving 88 research subjects who were selected through random sampling with a different sample calculation of two variables. The research design was cross-sectional with Chi-Square statistical analysis about the relationship between lighting intensity, age, working period, driving a vehicle and history of illness with eye fatigue among workers in manufacturing industry. Researchers obtained the results of statistical tests as follows, lighting intensity with (P-value = 0,000), age (P-value = 0,496), working period (P-value = 0,049), disease history (Eyes Refractive Disorder) (P-value = 0,011) and driving a vehicle (P-value) = 1,000). It can be concluded that, lighting intensity, working period and history of illness (Eye Refractive Disorder) have a relationship with eye fatigue in workers in the company, while age and driving a vehicle do not have a significant relationship with eye fatigue in workers in the company.

Keywords: Eye Fatigue, Lighting Intensity, Worker

1. Introduction

The cases of eye fatigue in Indonesia are categorized as severe low vision with a prevalence of 0.9%, while the prevalence in West Java is 0.8% (1). Eye fatigue can result from overexertion of vision, since excess dilation is taking place in the eye (2). Light problems can arise in almost any workplace, for in principle doing the work requires almost entirely sufficient light to see objects properly, clearly and without overexertion (2). A workplace with bad lighting can cause a clear deterioration of the vision capacity of the eye, if occurring continually would result in tension in the optic nerve and eye fatigue (3). Inadequate lighting can cause problems, such as; Acute vision decreases, blurred vision, around the headaches, burning corneas, irritation of the eyes and watery eyes (2).

The tired eye is an impairment of the eye that results from long, sustained periods of rest (4). Eye fatigue can also be classified into muscle fatigue, muscle fatigue is the physical inability while muscles for maximum work (5). Eye fatigue often causes discomfort and can interfere with everyday activities, especially when these conditions occur during learning, working, or riding (6)

According to experts, the age runs counter to physical endurance, in which the human physical condition is most optimal at 25 years of age, while at 50-60 are down to 60% of sensory capacity and muscles are down by 25% (5). Sharpness depends on the ability of the eye to accommodate accommodation which is arranged by the lens in order to regulate the 'rays' rays on the retina (2). Long hours spent focusing on a fast-moving object can make it difficult to see the object (2). Vehicle driving is one of the factors that can cause eyestrain (7).

The cause of eye fatigue is divided into 3 (8), which is caused by eye refraction and tension in the ciliary muscle, inappropriate and excessive exposure or because of extra-muscular imbalance. Hypertension can also be related to eye fatigue, for when increased blood pressure produces a set of microvascular changes called hypertensive retinas, consisting of general retinal arterioles and phocals, nicking arteriovenous, retinal hemorrhage, microaneurysm and in severe cases of operates and macular edema (9). Diabetes mellitus can also be related to eye fatigue, for when a diabetic has a high sugar content for a long time, fluids build up in the lenses that regulate focus. It altered the curvature of the lens, causing a vision change (10). In Armstrong (1992) Suggests that insufficient lighting can cause vision impairment and eyestrain. In addition to this excess intensity of lighting can also lead to glare, reflection, shadow and eyestrain (2). By measuring the intensity of regular lighting every two times a year, corporate lighting exceeds the standard. As for the data of the lighting measurement from 2016-2021 depicted at table 1.

Table 1. Lighting Data Company 2016-2021

Date	Measurement Location				
	DM ^a	PLA ^b	MF ^c	IRM ^d	W ^e
	Lighting Standards				
	200	200	200	100	200
6/2016	978	1105	820	1116	1837
7/2017	331	191.6	933.4	408.9	335.1
10/2017	223.2	550.3	1230.2	479.8	225.9
6/2018	242	295	1648	283	442
12/2018	281	292	876	436	786
6/2019	251.03	484.67	816.74	284.5	763.38
10/ 2019	252	298	2100	400	507
4/2020	196	212	511	212	297
10/2020	212	499	383	499	719
5/2021	1205	711	1002	549	613

^a DM: Dies maintenance.

^b PLA: Press Line A

^c MF: Metal Finish

^d IRM: Inventory Raw Material

^e W: Welding.

According to this data, the intensity of lighting is very high, so researchers are interested in research to see if there is a connection between the intensity of lighting and eye fatigue in the workers

2. Methodology

This research is an analytic descriptive research that uses cross-sectional design. The research was carried out in the manufacturing industry in May-August 2021. Research in the manufacturing industry as production capacity companies are high enough, the high production processes require workers to do

optimum work. The eye is an organ of one of the body organs important enough for workers to do work, so it is vital to take care of eye health.

The sample's enlargement uses a comparing two proportions formula and proposes an enlarged sample of 88 samples, a sample determined in a simple random sampling way. Fatigue eyes were measured in questionnaires and for measuring intensity lighting done by lux meter.

The analysis of the study USES statistic software by way of two stages, a univariate analysis with frequency distribution tables with independent variables (lighting intensity, age, working age, work time, disease history and driving) and a dependent variable (tired eye complaint) and then a bivariate analysis using a chi-square test. The chi-square test was made to establish a link between statistical data in category with category.

3. Result

The results of the univariate analysis shown in table 2, as follows:

Table 2. Frequency Distribution Table

Variable	Description	N	%
<i>Eye Fatigue</i>	<i>Yes</i>	62	70.5
	<i>No</i>	26	29.5
	<i>Total</i>	88	100
<i>Lighting Intensity</i>	<i>< Standard</i>	53	60.2
	<i>≥ Standard</i>	35	39.8
	<i>Total</i>	88	100
<i>Age</i>	<i>> 40 Years</i>	11	12.5
	<i>≤ 40 Years</i>	77	87.5
	<i>Total</i>	88	100
<i>Working Period</i>	<i>> 3 Years</i>	52	59.1
	<i>≤ 3 Years</i>	36	40.9
	<i>Total</i>	88	100
<i>Illness History</i>	<i>Yes</i>	33	37.5
	<i>No</i>	55	62.5
	<i>Total</i>	88	100
<i>Driving Vehicles</i>	<i>Yes</i>	67	76.1
	<i>No</i>	21	23.9
	<i>Total</i>	88	100

(Source: Researchers, 2021)

According to the table 2 workers who report complaints of eye fatigue by 70.5%, while 29.5% have no complaints of eye fatigue. The intensity of lighting in a company that was less than average by 60.2%, while another 39.8% exceeded the lighting standard. Workers aged ≤ 40 years by 87.5%, while another 12.5, under the age of > 40 . Workers who have a working term of ≤ 3 years by 40.9%, while the other 59.1 have tenure > 3 years. Workers with no history of disease by 62.5%, while another 37.5% had a history of disease (eye refraction disorders). Workers drive to work by 76.1 percent, while 23.9, another % go to work by not driving. Based on the kind of eye fatigue complaints univariate analysis is presented in the following picture 1:

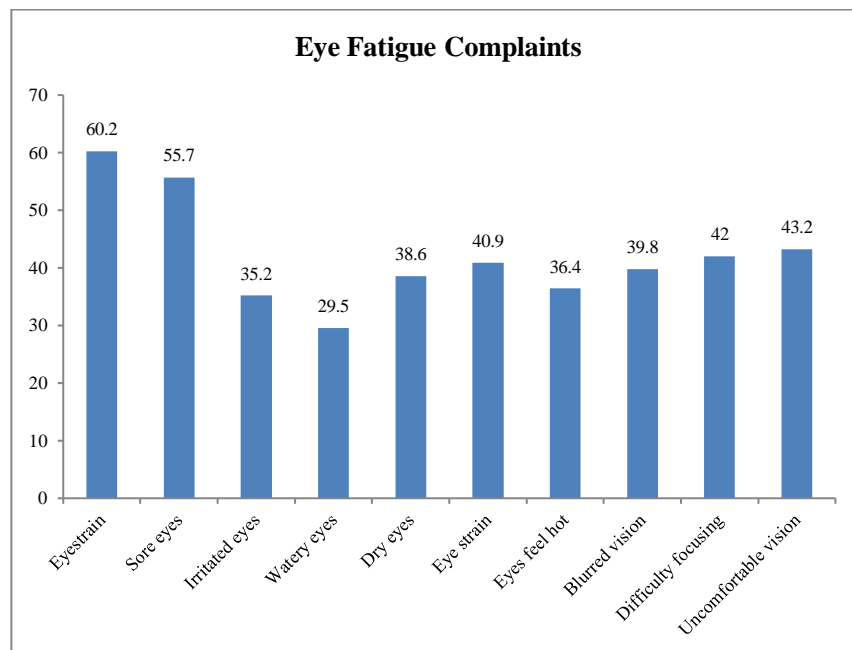


Figure 1. Eye Fatigue Complaints Univariate Analysis
 (Source: Researchers, 2021)

Based on figure 1 it is known that the most tired eye complaints are 60,2%, while the watering eye is the least complaint by labor of 29.5%. In addition to the three types of eye fatigue complaints in the company's most frequent workers are eyestrain (60.2%), sore eyes (55.7%) and impaired vision (40.9%). The following are the results of bivariate analysis with Chi-Square test in table 3, as follows:

Table 3. Chi-Square Test Results

Variable	P _{value}	POR	95% CI
<i>Intensity Lighting</i>	0,000	10,444	3,541-30,809
<i>Age</i>	0,496	2,038	0,409-10,156
<i>Working Period</i>	0,049	0,320	0,113-0,905
<i>Illness History</i>	0,011	4,883	1,491-15,672
<i>Driving Vehicles</i>	1,000	0,940	0,319-2,773

(Source: Researchers, 2021)

The chi-square test between the intensity of the lighting and the eye fatigue with a 5%, acquired P= 0,000 so it may mean that there is a significant connection (P 0.05) between the intensity of exposure and the fatigue complaints in the company workers. The risk distribution is gained by POR= 10.4 (CI 3,541-30.9), meaning standard lighting intensity has odds 10.444 times more to be considered eye fatigue.

Based on the exact results of fisher's tests between ages and eye fatigue with a 5%, gained P= 0.496, so that it can be taken that there is no relation (P > 0.05) between ages with tired eyes on workers in the company (testing is executed with exact results because of E (value of hope) less than 5, there is 25%). The results of the chi-square test between the working period and the eye fatigue with a 5%, gained 0.049 so that it can mean that there is a significant relationship (P <0.05) between the working period and the complaining of eye fatigue in the company. Risk estimate are obtained by POR = 0.320 (CI 95%

= 0.113-0.905), which means the prevalence ratio is not meaningful. Workers who have a working period of < 3 years have odds 0.320 times to be without eye fatigue.

The result of questionnaires is that all workers in the company have working hours > 8 hours per day. Therefore, it could not be done with a statistical test of Chi-Square.

Test results were a chi-square between history and tired eyes with a 5%, obtained $P = 0.011$ and therefore can be suggested that there is a significant relationship ($p < 0.05$) between the history of disease and the weariness of an eye in the company. Risk estimate calculations obtained $POR = 4.833$ (CI 1.491-15.672), which means that workers with no history of disease (eye refraction disorder) have odds 4.833 times to avoid eye fatigue.

The results of the chi-square test between driving a vehicle and eyes fatigue with a 5%, earned $P = 1,000$ so it can mean that there is no relation ($P > 0.05$) between driving a vehicle with complaints of eye fatigue in the company workers.

4. Discussion

According to a study carried out with 88 workers at the company by 2021, it shows that most of the workers were suffering from eye fatigue. Research results from complaints of eye fatigue most frequently found in employees of lean ≤ 40 years, who have worked under the company > 3 years, workers who drive to work, workers with no history of illness and work in areas where light > standard. The most frequent complaints of eye fatigue to a worker are eyestrain. Less than standard intensity of exposure causes eye fatigue complaints in 27 workers, while more than standard lighting causes complaints of eye fatigue in 35 workers. Researchers found there was a significant relation between the intensity of exposure with the eye fatigue on the workers at the company with the results of the test chi-square with a 5% $P = 0,000$. Risk estimate gets $POR = 10.444$, which means the standard exposure intensity has an increase of 10,444 times to avoid eye fatigue.

Previous studies also found that the intensity of lighting is associated with eyewear in Dr. Soediran Mangun Wonogiri (11). Others suggest an intensity of lighting by burnout in the "x" shoe-making industry in the town of Semarang (12). Other studies have concluded that there is a connection between the intensity of room lighting and eyewear in workers (13).

Less and more intensity of exposure also affected eyewear in company workers. The size of the object of work also needs to be noticed by the company in an effort to adjust the intensity of the lighting to a standard level (Minister of Manpower Regulation No. 5 Year 2018). It is hoped that companies will be able to meet the intensity of the lighting in the workplace as is the standard lighting. Fulfilling the standard of lighting intensity in the room could be done by a company with control of the lighting source as well as the treatment of the lighting source.

Other research experts believe that the growth of age will be accompanied by a drop in eyesight, VO2, a speed of differentiation, hearing, decision making and short-term memory (5). But this is incompatible with data obtained by researchers, since workers under the age of > 40 years of age have complaints of eye fatigue of only 8 people, while those with eyelid complaints of eye fatigue of 49. Fisher's Exact test with a 5% getting a result of $p = 0.496$ means there is no link between age and eyelid complaints in the company's workers (testing carried out with fisher's exact test because e (value of hope) is less than 5, there is 25%).

The results of this study agree with the findings that suggest there is no correlation between age and reduced visual function in the toupee worker (14). As with other studies, there is no link between age and eye fatigue in the informal business seamstress of the country's Lhokseumawe in 2018 (15). As already established studies suggest that there is no correlation between eye fatigue and age (16).

Eye fatigue can result from individual physical conditions, which patterns in life and environment can also affect the maintenance of a person's physical condition. As researchers come up with a high rate of eye fatigue occurring at approximately 40 years of age, as the data obtained indicates more respondents by 40 years of age (77). Therefore, the maintenance of physical function should be done by each individual, both individuals aged approximately 40 years who are still productive and more advanced at age >40 years who are at risk of degeneration physical function, and it is expected that the researchers who are samples will have an age that is not dominated by one group only.

Workers in the manufacturing industry with a roughly three-year working period with eye fatigue complaints amounted to 30 people, while those with eyelid complaints > 3 years of work > 3 years. From result of *Chi-Square* with α 5%, getting $P_{\text{value}} = 0,049$ so it's indicative that there's a significant working relationship between tenure and eye fatigue complaints in corporate workers. From count of risk estimate getting result $POR = 0,320$ (CI 0,113-0,905), Meaning the workers who have a 3 - year lifespan have an odds 0.320 times to be without eye fatigue.

It is in line with that said (EU-OSHA, 2007) Work-related cases of disease are less likely to occur in young workers as a result of work-related illnesses only after the cumulative and latent tax takes place (17). Furthermore, accurate data on work-related illnesses is scarce, and particularly data on occupational disease caused by occupational hazards during youth. Similarly, from other research that reveals eye work fatigue >3 years (18). Furthermore, accurate data on work-related illnesses is scarce, and particularly data on occupational disease caused by occupational hazards during youth. Similarly, from other research that reveals eye work fatigue >3 years (16).

The relationship between workers and eye fatigue in the manufacturing industry can be due to the characteristics of the work done by workers within a particular period of work. The characteristics of a variety of work provide an equally diverse workload. To be able to do optimal work over long working periods causes workers to expend effort on the focus of work, forced vision can cause excess of the eye to eventually wear out (2).

Studies resulted from workers with no history of diseases with eyelid complaints amounted to 33, while those with a history of eye fatigue amounted to 29. From the test results of chi-square with α 5%, getting $P_{\text{value}} = 0.011$ it is therefore suggested that there is a relation between the history of illness and the eye fatigue complaints of workers in the company. From the count of risk estimate getting result $POR = 4,833$ (CI 1,491-15,672), Meaning workers who have no history of disease (eye refractive disorders) have an odds 4,833 times to be without eye fatigue.

Previous researchers claim there is a connection between an eye refraction of an eye fatigue occurring in paramedics at Dr. Soediran Mangun Sumarso (19). Other studies have found that eye fatigue is more common in the users of eyeglasses than workers who do not use glasses. Asthenophianism accommodating is eye refraction abnormalities and tension in the onboard cylinder muscle (8).

Eye refraction abnormalities in the manufacturing industry have to do with eyestrain, which can be attributed to poor vision functions that would encourage a person to overwork the viewing of objects. Increased efforts in the eye make the eye muscles work harder, causing the eye to tire more quickly. Eye health care, therefore, is vital for preventing eye refractive disorders. Companies and workers must understand how to care for eye health functions, so that the decline in visual function in particular that results from work can be prevented. Environmental control, employment, increased knowledge for workers in the care of the eye health efforts, the maintenance of the eye and the treatment of nutrients to care for eye health have a major impact on the maintenance of visual function in the workplace.

Workers who did not go to work by car and had complaints of eye fatigue totaled 15 people, while those who went to work by vehicle and had complaints of eye fatigue number 47. From test results chi-square with a 5%, acquired $P_{\text{value}} = 1,000$ so it can mean that there is no relationship ($P_{\text{value}} > 0,05$) Between driving a vehicle and complaining of eye-to-eye exhaustion on workers in the manufacturing industry.

This in contrast with what suggests that long distances can cause eyes fatigue (7). Another study claimed that the driver of Po's long-distance bus night. Mulya's blessing is physical exhaustion (20). As for the fatigue associated with driving is also supported by the facility from the vehicle (21).

No relation between driving a vehicle and eye fatigue on the worker in PT Mekar Armada Jaya it can result from workers who do not travel as far as a bus driver in p-Order to arrive at the manufacturing industry. Once workers arrive in the manufacturing industry, workers engage in a different activities. This causes the difference in the working business to focus on looking at objects, thus keeping the eye from overexertion as it drives.

5. Conclusion

Studies have shown that the factors relating to the eye fatigue of a company worker are intensity exposure, working period and a history of disease, while age and driving vehicles have nothing to do with eye fatigue.

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