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Relationship Between Individual Factors And Environmental Factors Towards Eye Strain In Laptop Workers In Office Environments

[1]Divanadya Pandu Pranata Putri, [2]Dhian Novianthy, [3]Khuliyah Candraning Diyanah, [4]Aditya Sukma Pawitra
Universitas Airlangga

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ABSTRACT
This study aims to analyze the influence of individual and environmental factors on eye fatigue among laptop users in office environments. The research was conducted using a descriptive observational design involving 33 workers at LMA Consortium Office, Kediri, East Java, with data collected through questionnaires, observations, and lighting intensity measurements. The findings reveal that most workers experienced eye fatigue, primarily due to laptop usage exceeding 4 hours per day, low lighting intensity (averaging 95.7 lux), and inadequate rest habits. Common complaints included blurred vision, eye discomfort, and headaches. Individual factors such as age, gender, and eyewear usage showed no significant relationship with eye fatigue, whereas environmental factors, particularly lighting, had a significant impact. Recommendations include improving lighting conditions, implementing ergonomic workplace practices, and raising worker awareness about the importance of eye rest. These findings emphasize the importance of ergonomic workplace management to reduce the risk of eye fatigue among laptop users.

Corresponding Author:
Aditya Sukma Pawitra
Universitas Airlangga
aditya.pawitra@fkm.unair.ac.id

INTRODUCTION

In the modern era, technology advanced has become need fundamental in life human. One of the devices that have role significant is computer. As tool electronics that are not inseparable from activity everyday, computer give convenience and improve efficiency in finish various work. However, according to OSHA in (Dotulong et al., 2021), besides make it easier various activity humans, computers also have impact negative for its users, especially related problem health.

According to *American Optometric Association* in (Pertiwi et al., 2022), *Computer Vision Syndrome* (CVS) is a disturbance eyes and vision caused by use device like computers, tablets, *e-readers,* and mobile phones in a way continuously. Symptoms CVS clinical includes eye tense, eyes dry, vision blurry, sick head, and shoulder pain. Prevalence *Computer Vision Syndrome* (CVS) ranges between 64-90% of users *Visual Display Terminal* (VDT), with amount sufferer globally estimated reaching 60 million people, and every the year there is addition around 1 million case new (Astri et al., 2023). The use of VDT in continously has proven cause decline ability accommodation eyes and imbalance position eye (Ciputra &

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Dwipayani, 2022). In the United States, about 60% of men and 65% of women confess feel symptom *Computer Vision Syndrome* (CVS) (Yudia et al., 2023). For reach optimal performance is important For own environment safe, healthy and comfortable work, including arrangement intensity proper lighting.

In the environment work, lighting play role important in create optimal conditions for worker. Adequate lighting support health, safety and comfort work, and create refreshing environment, while poor lighting can cause eye fast tired Because must Work more hard For see. Poor lighting can cause disturbance vision and tension eyes, while excessive lighting can cause glare, reflections, shadows, and fatigue eyes. Research also shows that people who are more often work in front computer own risk more big experience Computer Vision Syndrome (CVS) vs. with those who are rare using a computer (Alma et al., 2023).

According to (Hasbi et al., 2018), fatigue eye can influenced by four factors, namely characteristics individual (such as age and type gender), design work (including type documents and duration work), condition environment work (such as monitor lighting, lighting room, and temperature room), and device work (such as size and shape object). In addition, according to Pheasant and Haslegrave in (Savitri et al., 2024), mention that various factors, such as use of document holder and monitor display can influence fatigue eyes. A research conducted in 2022 on worker user computers in Jambi Express found that 18 of 35 respondents (85.75%) indicated connection between fatigue eyes and distance view (Nikmah et al., 2023). In addition, the results research at PT Indonesia Power Up Semarang also indicates existence connection between duration use computer more of 4 hours found in 32 respondents (71.1%) of a total of 62 people (Savitri et al., 2024)

Improvement use computer in various activity office has cause increasing disturbance health among workers who use it. Therefore that, the office that uses computer need more notice implementation principle ergonomics in the environment work. Implementation principle proper ergonomics is essential For reduce error work, such as fatigue, and For create environment safe, comfortable and healthy work (Sustri et al., 2022).

Based on background the back that has been explained, research This aiming For to study connection factor individual and factors environment to fatigue eyes on laptop workers in the environment office. Use computer overload can cause eye disorders, such as Computer Vision Syndrome (CVS), which are influenced by factors individual like age, type gender, and duration use digital devices. In addition, the factor environment like lighting, temperature room, and arrangement position and distance monitor view also involved influence level fatigue eyes on the workers. With understand connection this, it is expected can found solution For reduce impact negative to health eye office workers. Research purposes This is For analyze influence factor individual and factors environment to fatigue eyes on laptop workers in the environment office.

RESEARCH METHODS

Study This conducted at the LMA Consortium Office located at Jl. Jawa Bedrek Selatan,

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Grogol, Kediri, East Java. The research process in progress for two months, namely from May to June 2021. The election location based on relevance place with subject research, namely worker laptop users as tool Work main, which allows observation direct to factor individual and environment work. Research This started from stage observation field, division questionnaires, data collection, to data analysis conducted For to obtain results comprehensive ending.

Types of research used is observational descriptive, which aims to For describe in a way objective related factors with complaint fatigue eyes on the worker laptop users without give intervention or treatment certain. Research done through approach directly on site Work For observe condition environment work, activity workers, as well as habits that can influence level fatigue eye.

Subject study chosen through purposive sampling method, with amount Respondent as many as 33 people. Criteria election subject covers use of laptop as tool Work main, and willingness worker For participate in study this. Variable study consists of from variable free and bound. Variables free covering factor individuals, such as age, type gender, use glasses, duration laptop usage, long rest time eyes, position eye to laptop screen, as well as distance vision, and factors environment work, such as intensity lighting general, lighting local, and value reflection in the work area. Variables bound in study This is complaint fatigue eyes felt by workers during or after Work.

For collect data, research This use various methods and instruments. Primary data were collected through distribution questionnaire containing questions structured For explore factor individual and environment related work with fatigue eyes. Interview also done directly to Respondent For delve deeper information about complaint fatigue the eye feels during work. Observation done with observe in a way direct condition place work and activities workers, such as position body, intensity laptop usage, as well as arrangement environment work. In addition, the measurement done use tools special, such as lux meters for measure intensity lighting and value reflection, as well as roll meter or meter For measure distance vision between eyes and laptop screen.

Secondary data obtained from document companies, including profile company, related data risk danger work (HIRADC), as well as documentation others. Literature study from various sources, such as books, journals scientific, and research previously, also used For complete data analysis.

Data collected from results questionnaires, interviews, observations and measurements Then processed use method tabulation crosstabs for identify pattern connection between variable free and variable bound. Analysis done in a way descriptive For explain the data obtained in form tables, graphs, and narratives. Results of the analysis served in a way Details For give clear picture about factors that influence complaint fatigue eyes on the worker laptop users at the LMA Consortium Office.

RESULTS AND DISCUSSION

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Based on results study this, \ can concluded that factor individual, habit laptop usage, and conditions environment Work own significant role in influence complaint fatigue eyes on workers at the LMA Consortium. Here is explanation more Details about results research obtained.

Individual Factors

1. Age
   Most workers are under 40 years old, with a percentage reaching 78.8%. Regarding complaints of eye fatigue, respondents under 40 years old reported more complaints than those over 40 years old. As many as 88.5% of young workers experienced eye fatigue, while among older workers (≥ 40 years old), this figure was slightly lower, at 85.7%. This shows that although younger ages tend to experience complaints more often, other factors such as the duration of laptop use also affect this result.
2. Gender
   The results showed that male workers experienced more complaints of eye fatigue, with 85% of male respondents reporting complaints compared to 92.3% of female respondents. Although the percentage of complaints was higher in women, the number of men who experienced complaints was still greater, considering the greater proportion of men in this study.
3. Use Glasses
   The use of glasses is also associated with complaints of eye fatigue. As many as 90.5% of respondents who do not wear glasses experience complaints, while 83.3% of respondents who wear glasses report complaints. This indicates that although wearing glasses can help reduce eye strain, other factors, such as long duration of laptop use, still contribute significantly to complaints.
4. Duration Laptop Usage
   Duration of laptop use is a factor that greatly influences complaints of eye fatigue. Respondents who use laptops for more than 4 hours per day reported the most complaints of eye fatigue, with 91.7% experiencing complaints. This is in line with the finding that the longer the duration of laptop use, the higher the likelihood of eye strain and related complaints.
5. Long Time Resting Eyes
   Regularly resting the eyes is a very important habit in reducing eye fatigue. However, almost half of the respondents only rested their eyes for less than 15 minutes. Respondents who rested their eyes for less than 15 minutes (93.3%) reported more frequent complaints than those who rested ≥ 15 minutes (83.3%). This underlines the importance of taking adequate eye rests to prevent fatigue.
6. Eye Position in Relation to Screen
   Eyes positioned higher than the screen appeared to reduce complaints of eye fatigue, with only 81.3% of respondents reporting complaints. In contrast, respondents who had their eyes positioned at the same level as the laptop screen (100%) and lower

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(66.7%) reported more complaints, underscoring the importance of ergonomics in the workplace.

7. Visibility
   Most respondents maintained a viewing distance of more than 50 cm from the laptop screen (90.9%), which is a correct practice in maintaining eye health. Closer viewing distances can increase the risk of eye fatigue, but in this study, most respondents had maintained the correct viewing distance.

Environmental Factors

1. General and Local Lighting Intensity
   Based on lighting measurements at the LMA Consortium, the intensity of general and local lighting was found to be far below the recommended minimum standards. The average general lighting in the workspace was only 95.7 lux, while local lighting was 84.7 lux. This can cause eye strain, as inadequate lighting can force the eyes to work harder in reading and viewing computer screens. According to the standard, the minimum lighting intensity for office work is 300 lux, which has clearly not been achieved at the LMA Consortium.
2. Reflection Value
   Reflectance values on walls (29.9%), tables (21.38%), and floors (28.9%) are within the recommended limits for creating a comfortable working environment for the eyes. However, less than optimal lighting can offset other good conditions in terms of room lighting.

Complaint Eye Fatigue

Frequent complaints reported by workers is vision blurred (57.6%), pain or a throbbing feeling all around eyes (39.4%), and difficulty focus vision (39.4%). Some another complaint that is also numerous reported including pain head (33.3%) and eyes sore (24.2%). Complaints Dizzy accompanied by nauseous is the least common complaint happened, just reported by 9.1% of respondents.

Relationship between Individual and Environmental Factors with Complaint Eye Fatigue

More workers young, who works longer ahead screen, and those who don't rest eye with Good more tend experience complaint fatigue eyes. Position eyes that are not ideal for laptop screen and lighting understaffed office adequate participate to worsen condition the. In conclusion, good factor individual and also environment Work play a role big in the occurrence complaint fatigue eyes on workers at the LMA Consortium.

Study This give description important about influence various factor to health eye workers using laptops in long time, and emphasize importance improvements in aspects environment work and habits Work For reduce risk fatigue eye.

Discussion

Individual Factors

a. Age is factor important that influences fatigue eyes and also play a role in the decline ability vision. According to study Previously, as we age, the elasticity of the eye lens decreases, causing difficulty focusing on close objects. This process is known as

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presbyopia and is generally felt by individuals over the age of 40. (Ulya et al., 2024)The decrease elasticity lens eye cause eye become not enough flexible in adapt focus on close objects. This is leading to trouble in see with clear objects that are in distance close, like read book or see screen. Individuals over the age of 40 are more susceptible to eye fatigue, with a decrease in the eye's accommodation ability usually occurring in the age range of 45 to 50 years. (Tianto et al., 2023)

a. In this study, it was found that young people (<40 years old) tend to complain more about eye fatigue compared to those aged ≥40 years old. As many as 23 out of 26 respondents aged under 40 years old (88.5%) experienced eye fatigue, while only 3 people (11.5%) did not experience it. This shows that although older people are more susceptible to vision problems due to the aging process, heavier work and more work distribution that is burdened on young workers (aged 20-30 years old) can contribute to these complaints. Therefore that, although the aging process play a role in problem vision, factor environment work and habits use digital devices greatly influence complaint fatigue eyes on the worker young
b. A study by (Kartini et al., 2021),recommended duration of monitor use (*screen) time*) varies by age, namely children aged 0-4 years should not use monitors, 5 years old is limited to 1 hour per day, 6-10 years old is recommended 1-1.5 hours per day, 11-13 years old a maximum of 2 hours per day, and adults should be less than 4 hours per day. Efforts to minimize eye fatigue disorders are needed.
c. Recommendations for companies include providing information on good work patterns, as well as providing guidance on proper posture to reduce the risk of eye fatigue, especially for younger workers. In addition, older workers should have adequate lighting and a comfortable temperature in the office area. Optimal lighting, both natural and artificial, can help reduce eye fatigue, improve focus and concentration, and reduce the risk of errors.(Yusuf, 2023).
b. Distribution type sex Respondent in study This show domination Respondent men, with 60.6% men and 39.4% women. From the results analysis, obtained that 85% of respondents male and 92.3% of respondents Woman experience complaint fatigue eyes. Although more Lots the man who became Respondent in study this, no found difference significant between type sex related with complaint fatigue Eyes. Research previously by (Septiyanti et al., 2022)also shows that duration use computer related with a long time work that can influence eye in a way directly, so that complaints that arise often overlooked and ultimately endure although after finished work. Complaints that arise consequence use computer in long time is often considered trivial by some individual, so that No quick handled with right. As a result, complaints the can continued and even endure after time Work finished. This is show that fatigue eyes caused by use computer overload No only related with problem physique that happened moment work, but also can influential term long to comfort and health eyes. Therefore that 's important For do appropriate interventions, such as implementation principle good

ergonomics and pauses enough rest during work in front computer, use prevent impact bad to vision

c. In this study, it was found that 36.4% of respondents used glasses, and 63.6% did not use them. Among those who used glasses, 83.3% experienced complaints of eye fatigue, while 16.7% did not experience it. Meanwhile, 90.5% of respondents who did not use glasses complained of eye fatigue. This finding is not entirely in line with research (Bonita & Widowati, 2022)showing that working continuously for four hours in front of a computer without sufficient rest has a significant relationship with the occurrence of asthenopia.
d. Longer duration of laptop use significantly increases complaints of eye fatigue. The study showed that 88% of workers who use laptops for more than 4 hours a day experience complaints of eye fatigue. The study by (Bonita & Widowati, 2022),confirmed that respondents who work in front of a computer for 4 hours or more have a 4.5 times greater chance of experiencing *Computer Vision Syndrome* compared to those who work in front of a computer for less than 4 hours. Intense visual activity in term long time can cause muscles eye Work more hard For maintain focus, which ultimately cause eye strain. In addition, prolonged use of laptops often accompanied by posture underwork ergonomic, lighting that is not adequate, and distance suboptimal view, all of which contribute to improvement risk fatigue eyes. Therefore that 's important for worker For implementing prevention strategies, such as use The 20-20-20 method is one of the step prevention and treatment *Computer Vision Syndrome* (CVS) for user computer, where every 20 minutes work in front computer, eyes rested with see object Far for 20 seconds (Khamid, 2020).
e. Workers who work more than 4 hours a day should be given information about the importance of regular breaks and doing eye exercises to reduce eye fatigue. Research conducted by Sulistiyani et al. (2012) in (Maisal et al., 2020)**,** showed that eye exercises have a significant effect in reducing eye fatigue in batik workers. It is also recommended that workers take a break from activities involving computer screens by doing other activities, such as chatting with coworkers or enjoying the scenery outside the office.
f. Enough rest can reduce fatigue eyes. However in study this, no found difference significant between workers taking a break eye during not enough from 15 minutes with those who rest during more from 15 minutes. Although Thus, research show that more workers often rest eye tend experience complaint fatigue eye more a little. Therefore That, according to Tribley et al (2011) in (Darmawan & Wahyuningsih, 2021)**,** step prevention For reduce risk caught *Computer Vision Syndrome* (CVS) can done with take Rest for 10-15 minutes after Work in a way constantly in front computer for 1-2 hours.
g. Position eye to the screen also has an effect to complaint fatigue eyes. Workers who place eyes in position more tall from laptop screen tends to experience more A little complaint compared to with those who position eye parallel or below screen. Research This show that 81.3% of workers who position themselves eye more tall from screen

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experience complaint fatigue eyes, while 100% of workers positioned eye parallel with screen experience complaints. According to theory, height, slope, and distance view monitor from eye user own influence significant to emergence symptom *Computer Vision Syndrome* (CVS) (Darmawan & Wahyuningsih, 2021).

h. Recommendation For company is for the company give training to employee about position Work correct ergonomics moment using a laptop. One of the for example is ensure screen computer placed A little more low from the horizontal line of sight of the eye, so that can push frequency more blinking often and prevent eye become dry. (Yandi, 2017).

i. According to *Occupational Safety and Health Association* (OSHA) (1997) in (Putri & Mulyono, 2018), recommended distance between eyes and computer monitor screen is 18–24 inches (46–61 cm), with distance ideally about 20 inches or about 50.80 cm. Research This show that workers who see screen with distance more near from 50 cm more often complain about fatigue eyes. As many as 100% of workers who position distance eye not enough from 50 cm complaining fatigue eyes, while only 86.7% of workers saw it with distance more from 50 cm which experienced complaint similar.

This shows the importance of maintaining sufficient distance between the eyes and the computer screen. Therefore, it is recommended that employees who work in front of a computer with a distance of less than 50 cm be more aware of the risk of experiencing blurred vision and complaints related to *Computer Vision Syndrome* (CVS)

1. Work Environment Factors:
   Lighting that is not Enough can to worsen symptom fatigue Eyes. Research This show that level lighting in the work area averages 84.7 lux far more low from recommended standards. According to Regulation of the Minister of Health Number 70 of 2016, about Environmental Health Standards and Requirements Industrial Work, level recommended minimum lighting is 300 lux. Working workers with poor lighting from 84.7 lux tends to experience complaint fatigue eye more often. Therefore, it is recommended that companies increase lighting in the work area, good with add light or utilise light experience with open curtain window.
2. Main Complaint
   Majority worker in study this, namely 88%, experienced complaint fatigue eyes, which are related close with factor individual and environment work that has been done explained previously. Workers with duration more laptop usage from 4 hours, distance vision not enough from 50 cm, and poor lighting adequate more tend experience symptom fatigue significant eyes. With Thus, the company need give attention main on repair lighting, duration work, position body, as well as time adequate rest use increase comfort and productivity workers. With notice factors said, the company can create environment more work ergonomic and supportive health worker. Sufficient lighting can prevent tension eyes, duration controlled work can reduce fatigue, position the right body avoid disturbance physical, as well as time enough rest give chance for body For recover and reduce stress. All effort This will impact on increasing performance,

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https://ejournal.seaninstitute.or.id/index.php/healt

comfort, and satisfaction Work workers, and ultimately contribute to productivity company.

CONCLUSION

Based on results processing and analysis of related data connection factor individual and factors environment with complaint fatigue eyes on the worker laptop users in the LMA Consortium, obtained findings as following: The majority of workers using laptops at the LMA Consortium were under 40 years old, male, did not wear glasses, worked more than 4 hours per day, rested their eyes for ≥15 minutes, positioned their eyes higher than the laptop screen, and maintained a viewing distance of ≥50 cm from the screen. The average general lighting level in the office was recorded at 95.7 lux, while local lighting was still below the established standard (300 lux). The reflectance value around the work area was in accordance with the recommendations. The most frequently reported complaint of eye fatigue is blurred vision, while the least common complaint is dizziness accompanied by nausea. Individual factors, such as age, gender, use of glasses, duration of eye rest, eye position to the screen, and viewing distance, did not show a significant relationship with complaints of eye fatigue. However, the duration of laptop use showed a significant relationship. Lighting levels have been shown to be associated with complaints of eye fatigue.

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