

Analysis of Cognitive Ergonomic and Digital Environment Risks Regarding Visual Fatigue and Burnout Among Remote Workers

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ABSTRACT

Background: Technological advancements have accelerated workflows by enabling remote work; however, this shift can lead to increased worker burnout due to technostress and visual fatigue. The purpose of this research is to analyze the risks of cognitive ergonomics and the digital environment on burnout and visual fatigue among remote workers.

Subjects and Methods: This study employed an analytic observational design using a cross sectional approach. A total of 200 remote workers were selected by purposive sampling. This dependent variable was burnout. The independent variables were ergonomic design, lighting and micro-break. The mediator variables were visual fatigue, work load mental and technostress. This study employs an instrument that has undergone validity and reliability testing. Data were analyzed using simple linear regression and path analysis to examine direct and indirect relationships among variables.

Results: Based on the direct effect analysis, visual fatigue emerged as the strongest direct predictor of burnout ($b=0.69$; 95% CI= 0.47 to 0.91; $p<0.001$), followed by the variable of technostress ($b=0.36$; 95% CI 0.18 to 0.54; $p<0.001$). Furthermore, visual fatigue was significantly influenced by mental workload ($b=0.29$; 95% CI 0.20 to 0.38; $p<0.001$) and technostress ($b=0.41$; 95% CI= 0.32 to 0.50; $p<0.001$). Meanwhile, lighting did not show a significant direct effect on visual fatigue ($b=0.00$; 95% CI= -0.00 to 0.01; $p=0.292$). Regarding ergonomic design and the implementation of microbreaks, both were found to significantly influence technostress ($b=3.48$; 95% CI= 2.32 to 4.66; $p<0.001$ and $b=2.87$; 95% CI= 2.16 to 3.59; $p<0.001$) as well as mental workload ($b=2.86$; 95% CI= 1.73 to 4.00; $p<0.001$ and $b=2.96$; 95% CI= 2.27 to 3.65; $p<0.001$).

Conclusion: Visual fatigue is a primary trigger for burnout, strongly influenced by high mental workload and technostress. Conversely, ergonomic designs and microbreaks have proven effective in mitigating the impact of both technostress and mental workload.

Keywords: burnout, cognitive ergonomics, visual fatigue, digital environment, remote workers

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BACKGROUND

The rapid transition to remote and hybrid work models post-COVID-19 pandemic has transformed employment practices globally. This change gives workers more freedom, but it also has psychosocial risks that could make burnout much more common ([Khalid & Naz, 2025](#)). In general, burnout is also associated with feelings of extreme fatigue, heaviness, and a sense of detachment from work ([Maslach & Leiter, 2016](#)).

Another consequence of the remote work environment is visual fatigue caused by excessive screen time and suboptimal visual conditions at home ([Moore et al., 2024](#); [Sheppard & Wolffsohn, 2018](#)). This visual fatigue not only reduces focus and productivity but also has the potential to trigger stress and worsen burnout ([Deniz et al., 2022](#); [Turgut et al., 2025](#)). Additionally, the lack of direct supervision and reduced opportunities for informal communication can increase stress and decrease job satisfaction, as employees feel unsupported or uncertain about their career progression ([Urrejola-contreras, 2023](#)).

Existing research tends to examine burnout or visual fatigue partially ([Montag et al., 2020](#)), focusing exclusively on physical ergonomics issues ([Gumasing et al., 2025](#)) or workload and work stress. Although there is strong evidence that visual fatigue and burnout are interconnected, the interaction mechanisms between the two in the context of remote work have not yet been comprehensively mapped ([Kaptanoğlu, 2025](#)). In fact, the high frequency of virtual interactions and digital workloads in remote work models create simultaneous exposure to cognitive and visual stressors for workers ([Supriyadi et al., 2025](#)).

Previous studies on remote work have extensively analyzed ergonomic risks ([Narainsamy et al., 2025](#); [Wells et al., 2023](#)) and social isolation ([Figueiredo & Margaçá,](#)

[2025](#); [He et al., 2026](#)) but the existing literature tends to examine visual fatigue and burnout separately. The phenomenon of visual fatigue due to computer use or Computer Vision Syndrome is often limited to the field of ophthalmology ([Kahal et al., 2025](#); [Nuzuliawati et al., 2022](#)), while burnout is dominated by organizational psychology factors ([Kong et al., 2025](#)). This gap leads to limitations in understanding how sensory overload from excessive screen exposure can escalate into chronic emotional fatigue (burnout).

To bridge this empirical gap, a clear conceptual pathway can be established through the lens of the Conservation of Resources (COR) theory and Cognitive Load Theory. Temporally, exposure to a technocentric work environment triggers technostress (e.g., techno overload and constant connectivity) and high mental workload as remote workers continuously digest complex digital information without adequate intervals. This high cognitive and digital demand causes acute sensory strain, specifically visual fatigue (Computer Vision Syndrome), driven by prolonged accommodation, glare, and uninterrupted screen glare ([Consiglio et al., 2023](#)).

Visual fatigue acts as a crucial mediating mechanism rather than just a parallel symptom: workers must use more compensatory cognitive effort to maintain focus due to ongoing physical/sensory discomfort and poor visual function. Acute sensory strain eventually turns into chronic psychological tiredness and burnout as a result of this ongoing resource depletion without adequate recuperation. Therefore, the physiological and sensory link that allows digital and cognitive demands to increase into long-term emotional exhaustion is visual fatigue ([Behrens et al., 2023](#)).

Remote and hybrid work environments trigger technostress and excessive

mental workload. This cognitive load leads to physical and sensory strain on the eyes, manifesting as visual fatigue. Faced with eye fatigue yet compelled to continue working, the brain exerts compensatory effort to maintain focus. This sustained cognitive strain exacerbated by the lack of micro-breaks completely depletes psychological energy, ultimately leading to burnout ([Kim et al., 2022](#)).

The absence of a predictive model that integrates cognitive ergonomics with specific digital environment variables such as room lighting, daily screen duration, work design settings, and microbreak frequency poses a barrier to the preventive mitigation of workers' mental health risks. Based on this, it is necessary to construct a predictive model that positions visual fatigue as a crucial mediating variable in the relationship between cognitive ergonomics and burnout. Unlike previous studies that emphasized body posture ([Alfavo-Viquez et al., 2024](#)), this research offers a new proposition through the analysis of dynamic and technocentric digital environment risks. The purpose of this research is to analyze the risks of cognitive ergonomics and the digital environment on burnout and visual fatigue among remote workers.

SUBJECTS AND METHOD

1. Study Design

This was a cross-sectional study carried out Surakarta Residency, Central Java, Indonesia, from July to August 2026.

2. Population and Sample

The study population consists of remote workers in the Surakarta Residency area. A purposive sampling method was employed based on the following inclusion criteria:

- workers aged 18 to 50 years;
- working remotely;
- permanent, contract, or freelance workers; and

- workers using a computer or laptop and online meeting applications.

Meanwhile, the exclusion criteria were:

- workers aged under 18 or over 50 years;
- not working remotely; and
- not working using a computer or laptop and online meeting applications.

The sample size was set at 200 respondents, determined using the maximum likelihood estimation technique for establishing the minimum sample size. This technique typically requires a sample size ranging from 100 to 200; thus, the total of 200 respondents met the requirement.

3. Study Variables

This dependent variable was burnout. The independent variable were cognitive ergonomics (technostress and mental workload); visual fatigue; digital environment (ergonomics design, lighting and microbreak).

4. Operational Definition of Variables

Burnout was a state of physical, emotional, and mental exhaustion among remote workers resulting from chronic work-related stress, characterized by emotional exhaustion, depersonalization (cynicism), and reduced self-efficacy or personal accomplishment. The data was measured by Maslach Burnout Inventory (MBI-HSS) questionnaire.

Cognitive ergonomics was the level of fit and cognitive load experienced by remote workers when interacting with tasks, software interfaces, and information processing (including mental workload, interruptions, multitasking, and technostress). The data was measured by NASA-TLX (Mental Demand) and Technostress Scale questionnaire.

Visual fatigue was symptoms of visual strain and fatigue experienced by remote workers due to the continuous use of digital screen devices. The data was measured by Visual Fatigue Index (VFI) questionnaire.

Ergonomic Design was the arrangement and suitability of physical facilities used by individuals when working from home/outside the office (such as backrests, footrests, eye-to-screen distance, hand angles). The ergonomic design variable consists of five questions requiring "yes" or "no" answers. Validity and reliability testing showed a validity coefficient greater than 0.361 and a Cronbach's alpha of 0.740 (exceeding the 0.60 threshold). Scoring categories are defined as follows: poor (0–1), moderate (2–3), and good (4–5).

Lighting was the amount or intensity of natural and artificial light present in a remote workspace. This light is measured in lux using a light-measuring device called a lux meter.

Microbreak was the habit or frequency of individuals taking short breaks regularly during remote work activities to stretch, change sitting positions, rest their eyes, or take short walks. The ergonomic design variable consisted of three questions regarding the frequency of microbreaks, the application of the 20-20-20 rule, and the activities performed during microbreaks. Responses were categorized into four levels, with total scores classified as poor (<4), moderate (5–8), or good (9–12). Validity and reliability testing were conducted; validity results showed values of >0.629, 0.621, and 0.666, while the Cronbach's alpha value was 0.740 (>0.60).

5. Study Instruments

Burnout was measured by Maslach Burnout Inventory (MBI-HSS) questionnaire.

Cognitive ergonomics was measured by NASA-TLX (Mental Demand) and Technostress Scale questionnaire.

Visual fatigue was measured by Visual Fatigue Index (VFI) questionnaire.

The other variables were collected by questionnaire. Validity and reliability testing for the entire questionnaire was

conducted on 30 respondents separate from the main respondent group. The validity test results exceeded 0.361, and the Cronbach's alpha value was greater than 0.60.

6. Data Analysis

Univariate analysis described the frequency distribution of all variables. Bivariate analysis was conducted using simple linear regression to examine associations between independent and dependent variables. Multivariate analysis employed path analysis. The direct and indirect associations between variables were analyzed by path analysis. The path analysis proceeded in steps including model specification, model identification, model fit, parameter estimate, and model re-specification (if necessary).

7. Research Ethics

Research ethical issues including informed consent, anonymity, and confidentiality, were addressed carefully during the study process. The research ethical clearance approval letter was obtained from the Health Research Ethics Committee of Faculty of Medicine Universitas Muhammadiyah Surakarta, Indonesia, No. 6519/B.2-/KEPK-FKUMS/VII/2026.

RESULTS

1. Sample Characteristics

Table 1 presents the characteristics of the study sample. Based on 200 remote workers, the average age was 29.35 years, with a minimum of 20 years and a maximum of 46 years. The average length of service was 4.55 years, with a minimum of 1 year and a maximum of 19 years. The frequency of online meetings per week averaged 5.39 times, with a minimum of 2 times and a maximum of 15 times. The average daily working time was 12.93 hours, with a minimum of 6 hours and a maximum of 19 hours. Screen time without breaks averaged

7 hours, with a minimum of 2 hours and a maximum of 9 hours.

Workplace ergonomic design had an average assessment score of 3.04 (ranging from a minimum of 1 to a maximum of 5), falling into the moderate category. The average room lighting was 236.91 lux, with values ranging from a minimum of 44.9 lux to a maximum of 427.7 lux. The average microbreak assessment score was 4.69 (ranging from a minimum of 2 to a maximum of 8), falling into the poor microbreak category.

The assessment of technostress yielded an average score of 69.97 (ranging from a minimum of 42 to a maximum of 86), indicating a moderate level of technostress. Mental workload assessments resulted in an average score of 69.18 (ranging from 45 to 92), placing it in the high mental workload category. Visual fatigue recorded an average score of 76.95 (ranging from 58 to 91), signifying a high level of visual fatigue among workers. Meanwhile, the burnout assessment score averaged 76.35 (ranging from 35 to 109), falling into the moderate-to-high category.

Table 1. Sample Characteristics (continuous data)

Variables	Mean	SD	Min.	Max.
1. Age (years)	29.35	5.71	20	46
2. Tenure (years)	4.55	3.14	1	19
3. Frequency of meeting (in a week)	5.39	1.93	2	15
4. Daily working hours (hours)	12.93	3.56	6	19
5. Continuous screen time (hours)	7	1.68	2	9
6. Ergonomic design (scores)	3.04	0.85	1	5
7. Lighting (lux)	236.92	69.81	44.9	427.7
8. Microbreak (scores)	4.69	1.39	2	8
9. Technostress (scores)	69.97	8.73	42	86
10. Work load mental (scores)	69.18	8.43	45	92
11. Visual fatigue (scores)	76.95	7.15	58	91
12. Burnout (scores)	76.35	11.25	35	109

Table 2 presents the characteristics of the remote workers. Regarding gender, 53% of the workers are female and 47% are male. The work locations are distributed as follows: Surakarta City (28%), Karanganyar

(13.5%), Sragen (14%), Boyolali (16.5%), Klaten (11%), Sukoharjo (7%), and Wonogiri (10%). Of the remote workers, 58.5% work for national companies, while 41.5% work for international companies.

Table 2. Sample Characteristics (categorical data)

Characteristics	Category	Frequency	Percentage
Gender	Women	106	53%
	Men	94	47%
Working Area	Surakarta	56	28%
	Karanganyar	27	13.5%
	Sragen	28	14%
	Boyolali	33	16.5%
	Klaten	22	11%
	Sukoharjo	14	7%
	Wonogiri	20	10%
Type of company	National	117	58.5%
	International	83	41.5%

2. Bivariate Analysis

Table 3 presents the bivariate analysis of the independent variables in relation to the dependent variable, burnout. Ergonomic design ($b = 0.01$; 95% CI = 0.00–0.02; $p = 0.017$), microbreaks ($b = 0.04$; 95% CI = 0.02–0.05; $p < 0.001$), technostress ($b = 0.44$; 95% CI = 0.35–0.53; $p < 0.001$),

mental workload ($b = 0.31$; 95% CI = 0.21–0.41; $p < 0.001$), and visual fatigue ($b = 0.39$; 95% CI = 0.32–0.46; $p < 0.001$) were found to influence burnout among remote workers. In contrast, lighting ($b = -0.09$; 95% CI = -0.96–0.78; $p = 0.844$) did not have an effect on burnout among remote workers.

Table 3. The result of linear regression analysis

Independent Variables	b	95% CI		p
		Lower Limit	Upper Limit	
Ergonomic design (scores)	0.01	0.00	0.02	0.017
Lighting (lux)	-0.09	-0.96	0.78	0.844
Microbreak (scores)	0.04	0.02	0.05	<0.001
Technostress (scores)	0.44	0.35	0.53	<0.001
Work load mental (scores)	0.31	0.21	0.41	<0.001
Visual fatigue (scores)	0.39	0.32	0.46	<0.001

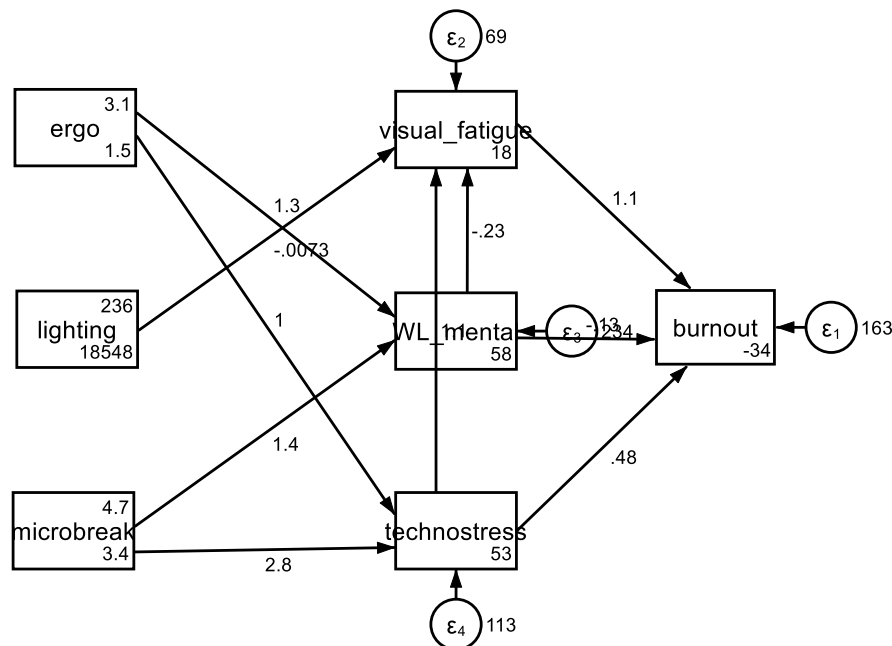


Figure 1. Initial path analysis model based on the conceptual framework

3. Path Analysis

Figure 1 illustrates the path analysis model regarding the determinants of burnout among remote workers, based on the study's initial conceptual framework. Table 4 reveals that the path model exhibits poor goodness-of-fit, as four fit indices failed to meet the recommended criteria. The chi-

square test indicated an unacceptable fit ($p < 0.001$), whereas the p-value should exceed 0.05. The RMSEA value of 0.146 exceeded the recommended threshold of < 0.05 . The Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values were 0.942 and 0.869, respectively; the TLI value was unsatisfactory as it fell below 0.90. Further-

more, the Standardized Root Mean Square Residual (SRMR) value of 0.108 indicated a poor model fit, as the value should be <0.08. The coefficient of determination (CD) was 0.264, indicating a significant deviation

from a value of 1. Consequently, we remodeled the path analysis model to satisfy the goodness-of-fit criteria; the final path analysis model resulting from this remodeling is shown in Figure 2.

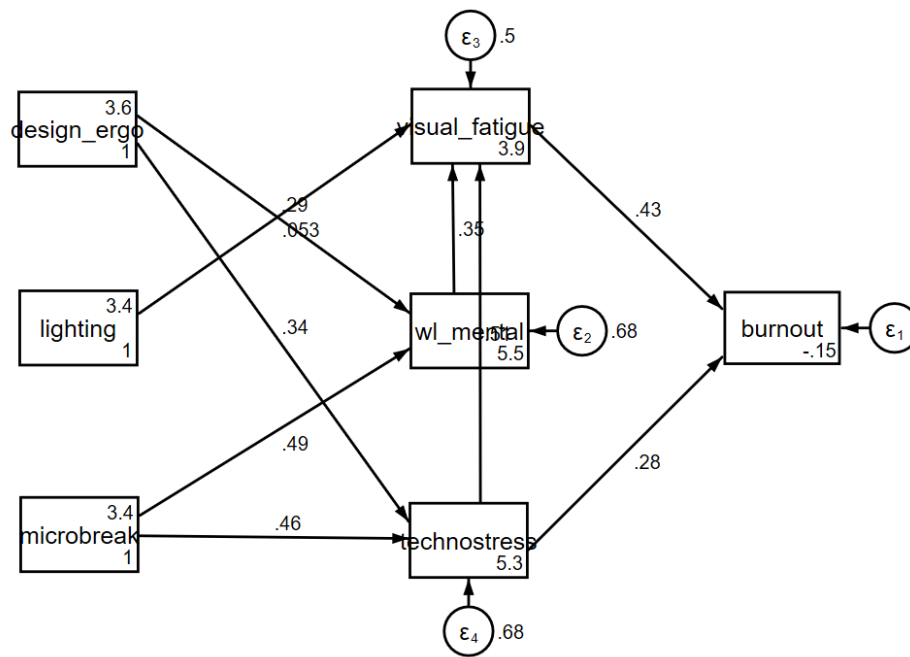


Figure 2. Path analysis model with estimation

Table 4. The results of path analysis model based on conceptual framework

Study Variables		b	95% CI		p
			Lower Limit	Upper Limit	
Direct effect					
Burnout	← Work mental Load	-0.13	-0.26	-0.00	<0.049
	← Visual fatigue	1.11	0.90	1.32	<0.001
	← Technostress	0.48	0.20	0.76	0.001
Visual fatigue	← Work mental Load	-0.22	-0.31	-0.14	<0.001
	← Technostress	1.09	0.99	1.20	<0.001
	← Lighting	-0.01	-0.02	0.00	0.090
Technostress	← Ergonomic design	1.03	-0.23	2.30	0.110
	← Microbreak	2.82	1.98	3.66	<0.001
Work mental Load	← Ergonomic design	1.39	-0.49	3.15	0.153
	← Microbreak	1.35	0.14	2.56	0.028
Indirect effect					
Burnout	← Technostress	1.21	0.96	1.47	<0.001
	← Work mental Load	-0.25	-0.35	-0.15	<0.001
	← Ergonomic design	1.24	-1.03	3.52	0.283
	← Lighting	-0.01	-0.2	0.00	0.095
	← Microbreak	4.28	2.70	5.87	<0.001
Visual fatigue	← Ergonomic design	0.83	-0.62	2.28	0.262
	← Microbreak	2.79	1.79	3.79	<0.001
N observation= 200					
Log likelihood= 41.743					

Study Variables	b	95% CI		p
		Lower Limit	Upper Limit	
Chi Square p< 0.001; RSMEA= 0.146 (>0.08) ; CFI= 0.942(>0.90)				
TLI= 0.869 (<0.90); SRMR= 0.108 (>0.05); CD= 0.264				

Figure 2 illustrates the path analysis model regarding the determinants of burnout among remote workers in the Surakarta Residency. Table 5 shows that the path analysis model demonstrates good goodness-of-fit, as all fit indices meet the recommended criteria. The chi-square test indicates an acceptable level of fit ($p = 0.205$). The RMSEA value is 0.043, which is below the recommended threshold of 0.08. The Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values are 0.992 and 0.985, respectively; both exceed the recommended value of 0.90. Additionally, the Standardized Root Mean Square Residual (SRMR) value is 0.041, indicating good model fit. The coefficient of determination (CD) value is 0.489.

Based on the direct effect analysis, visual fatigue emerged as the strongest direct predictor of burnout ($b=0.69$; 95% CI= 0.47–0.91; $p<0.001$), followed by the variable of technostress ($b=0.36$; 95% CI 0.18–0.54; $p<0.001$). Furthermore, visual fatigue was significantly influenced by mental workload ($b=0.29$; 95% CI 0.20–0.38; $p<0.001$) and technostress ($b=0.41$; 95% CI= 0.32–0.50; $p<0.001$). Meanwhile, lighting did not show a significant direct effect on visual fatigue ($b=0.00$; 95% CI= -

0.00–0.01; $p=0.292$). Regarding ergonomic design and the implementation of microbreaks, both were found to significantly influence technostress ($b=3.38$; 95% CI= 2.32–4.66; $p<0.001$ and $b=2.87$; 95% CI= 2.16–3.59; $p<0.001$) as well as mental workload ($b=2.86$; 95% CI= 1.73–4.00; $p<0.001$ and $b=2.96$; 95% CI= 2.27–3.65; $p<0.001$).

In the analysis of indirect effects, technostress ($b=0.28$; 95% CI = 0.17–0.39; $p<0.001$), work mental load ($b=0.20$; 95% CI = 0.11–0.29; $p<0.001$), ergonomic design ($b=2.81$; 95% CI = 1.86–3.75; $p<0.001$), and microbreaks ($b=2.44$; 95% CI = 1.78–3.09; $p<0.001$) were found to have significant indirect effects on the development of burnout through mediating variables. Additionally, ergonomic design and microbreaks also exerted indirect effects on visual fatigue ($b=2.26$; 95% CI = 1.60–2.91; $p<0.001$ and $b= 2.04$; 95% CI= 1.59–2.49; $p<0.001$, respectively). Conversely, lighting did not show a significant indirect effect on burnout ($b= -0.01$; 95% CI = -0.02–0.01; $p=0.299$). These findings underscore the importance of improving ergonomic design and implementing microbreaks to alleviate mental load and technostress, thereby effectively minimizing visual fatigue and mitigating the risk of burnout among workers.

Table 5. Path analysis of cognitive ergonomic and digital environment risks associated with visual fatigue and burnout among remote workers

Study Variables		b	95% CI		p
			Lower Limit	Upper Limit	
Direct effect					
Burnout	← Visual fatigue	0.69	0.47	0.91	<0.001
	← Technostress	0.36	0.18	0.54	<0.001
Visual fatigue	← Work mental Load	0.29	0.20	0.38	<0.001
	← Technostress	0.41	0.32	0.50	<0.001
	← Lighting	0.00	-0.00	0.01	0.292
Technostress	← Ergonomic design	3.48	2.31	4.66	<0.001

Study Variables		b	95% CI		p
			Lower Limit	Upper Limit	
Work mental Load	← Microbreak	2.87	2.16	3.59	<0.001
	← Ergonomic design	2.86	1.73	4.00	<0.001
	← Microbreak	2.96	2.27	3.65	<0.001
Indirect effect					
Burnout	← Technostress	0.28	0.17	0.39	<0.001
	← Work mental Load	0.20	0.11	0.29	<0.001
	← Ergonomic design	2.81	1.86	3.75	<0.001
	← Lighting	-0.01	-0.02	0.01	0.299
	← Microbreak	2.44	1.78	3.09	<0.001
Visual fatigue	← Ergonomic design	2.26	1.60	2.91	<0.001
	← Microbreak	2.04	1.59	2.49	<0.001

N observation= 200
Log likelihood= 12.15
Chi Square p= 0.205; RSMEA= 0.042 (<0.08) ; CFI= 0.992(>0.90)
TLI= 0.985 (>0.90); SRMR= 0.041 (<0.05); CD= 0.489

DISCUSSION

Information and Communication Technology (ICT) within organizations has seen significant growth, particularly following the COVID-19 outbreak ([Nagel, 2020](#)). In fact, during the pandemic, the government implemented various restrictive policies in the labor sector, requiring organizations to close their offices and adopt new work models that replaced face-to-face interaction with remote work. This shift forced millions of workers worldwide to face a significant transformation in their work systems ([Sostero et al., 2020](#)).

Remote work reduces workplace interactions and social connections ([Chen & Eyoun, 2021](#); [Krug et al., 2021](#)) and negatively impacts employees' mental health and psychological well-being ([Costin et al., 2022](#)). Difficulties in managing remote work or effectively performing professional tasks are associated with burnout and emotional stress. Employees who feel isolated and lack support experience professional alienation, reduced efficacy, a loss of work engagement, increased job demands, burnout, and emotional exhaustion ([Holmes et al., 2021](#); [Singh et al., 2022](#)).

Flexible Working Arrangements (FWAs) or remote work situations that lack clear time boundaries can actually lead to excessive pressure and acute exhaustion among workers. Burnout is a psychological syndrome resulting from a failure to manage prolonged work-related stress, characterized by emotional exhaustion, depersonalization, and a diminished sense of personal accomplishment ([Demerouti, 2024](#)). Triggering factors include excessive workloads, unpredictable demands, role ambiguity, a lack of social support, and organizational injustice. For workers in flexible arrangements, this risk is increasingly difficult to identify without data-driven analytics, as their psychological states tend to fluctuate dynamically ([Masduki et al., 2021](#)).

Stress-related mental health issues, along with perceived levels of physical and cognitive fatigue, impact job satisfaction and work-life balance. Remote workers face challenges such as work-related exhaustion, daily work stressors, emotional work demands, and work-life balance issues ([Costin et al., 2022](#)). In this context, burnout is treated as the chronic consequence of prolonged stress, distinct from short-term

stress reactions or broader mental health indicators ([Karakitsiou et al., 2025](#)).

Based on the direct effect analysis, visual fatigue emerges as the strongest direct predictor of burnout. Consequently, remote workers exposed to higher levels of technostressors tend to experience higher levels of burnout and poorer psychological health. This study extends the findings of [Consiglio et al. \(2023\)](#) by identifying visual fatigue as a crucial mediating variable in the causal chain linking technostress to burnout a pathway that has not previously been explicitly detailed in the literature.

Research by [Frick et al. \(2025\)](#) indicates that when individuals are exposed to higher hourly lighting levels compared to their average personal exposure during work hours, they experience lower levels of momentary fatigue afterward. This relationship between lighting levels and momentary fatigue appears particularly pronounced in individuals with relatively high levels of trait exhaustion. Thus, improving lighting conditions in remote work settings represents a simple intervention that could potentially have a significant impact on reducing the risk of worker burnout.

The results of this study indicate that in the context of remote work which is dominated by visual digital activities a more complex mechanism is at play: mental workload must first be converted into visual fatigue through intensive interaction with screen based devices, and it is only then that this visual fatigue triggers burnout. Conversely, factors such as high mental workload, work stress, and burnout negatively impact organizational outcomes, leading to issues like lost productivity, performance decline, or low organizational commitment ([Rizta et al., 2025](#); [Wang & Prester, 2025](#); [Zhang & Deng, 2025](#)). Many remote workers experience fatigue resulting from back-to-back virtual meetings, which often trigger

excessive cognitive load ([Syakir & Hasna, 2025](#)).

The positive correlation between technostress and burnout found in this study aligns with research by [Shaban et al. \(2025\)](#), which consistently demonstrates that increased exposure to technological demands contributes to higher levels of stress and emotional exhaustion. Furthermore, given the significant relationship between technostress and burnout, efforts to improve ergonomic work design and the frequency of micro-breaks are crucial for mitigating technostress.

Research indicates that technology-induced stress is a dominant predictor of visual fatigue among remote workers. The mechanism linking technostress to visual fatigue can be explained through two pathways. First, technostress compels individuals to constantly monitor screens, check messages, and respond to notifications, thereby directly increasing the duration of visual exposure to digital screens. Second, stress physiologically triggers a sympathetic nervous system response that can affect lacrimal function and ocular accommodation, thereby exacerbating symptoms of visual fatigue even when screen exposure duration remains constant ([Kahal et al., 2025](#)).

Visual fatigue is not merely an ophthalmological issue caused by physical exposure to screens; it is also a manifestation of cognitive fatigue reflecting an overload of information processing capacity ([Mahdavi et al., 2024](#)). The visual and cognitive systems interact dynamically, such that fatigue at the cognitive level is reflected in a decline in visual performance and comfort ([Wang et al., 2025](#)). The fact that lighting did not affect visual fatigue in this study could be attributed to other factors, such as prolonged screen time, age, or an excessively close viewing distance to the monitor.

Occupational health and ergonomics play a vital role in optimizing the work environment and ensuring employee well-being. Workplace design encompassing physical layout, equipment placement, and organizational processes aims to create an efficient, safe, and comfortable workspace that boosts productivity while minimizing risks. Ergonomics takes into account the physical and mental demands that tasks place on individuals. Activities such as heavy lifting, repetitive movements, and prolonged sitting can cause physical strain, whereas complex decision-making and information processing can lead to mental fatigue. Designing tasks and environments that balance these workloads is essential for supporting overall well-being ([Adiga et al., 2023](#); [Ionit et al., 2025](#)).

Poor ergonomic design such as sub-optimal monitor positioning, unsuitable desk height, or non-ergonomic input device configurations gradually increases cognitive workload, as individuals must exert greater effort to maintain proper working posture while performing cognitive tasks. This situation exacerbates technostress because interacting with digital devices becomes more fatiguing ([Kibria et al., 2023](#); [Mottaghi et al., 2024](#); [Trujillo-guerrero et al., 2025](#)). Optimizing visual ergonomics including screen placement, viewing distance, and lighting serves as an effective primary prevention strategy to avert visual fatigue and enhance long-term cognitive performance ([Harmoudi, 2024](#)).

Microbreaks are characterized by their short duration and spontaneous nature, offering mental and physical relief without disrupting the workflow. Originally emerging within the field of ergonomics to address physical issues, the concept of the microbreak subsequently evolved in organizational literature into a concise strategy for replenishing psychological resources

([Grobelny et al., 2024](#); [Albulescu et al., 2022](#)). [Sonnentag et al. \(2022\)](#) It highlights micro-breaks as a vital means of restoring employee energy. These brief pauses allow the mind to disengage from work and shift focus, ultimately enhancing cognitive function, creativity, and performance particularly in high-demand professions.

The findings of this study present the first empirical evidence identifying visual fatigue as a significant mediator and a strong direct predictor of burnout, thereby bridging the gap between the ophthalmology/ ergonomics literature and the occupational health psychology literature; specifically, a coefficient of $b = 0.69$ 95% CI= 0.47–0.91; $p < 0.001$. Indicates the direct effect of visual fatigue on worker burnout. These findings offer an empirical basis for the argument that visual fatigue is not merely an uncomfortable physical condition but a crucial precursor to the chronic emotional exhaustion that lies at the core of burnout ([Khammissa et al., 2022](#); [Lane & Micklewright, 2025](#)).

The study results also indicate that visual fatigue fully mediates the relationship between mental workload and burnout. This means that mental workload does not directly cause burnout; rather, it first induces visual fatigue, which subsequently triggers burnout. This pattern of full mediation carries significant practical implications: interventions that successfully prevent or alleviate visual fatigue among remote workers such as implementing regular screen breaks, optimizing visual ergonomics, and managing light intensity have the potential to break the causal chain leading to burnout, even when mental workload cannot be reduced.

These findings also confirm the relevance of the Socio-Technical Systems approach in understanding occupational health risks among remote workers. This

approach emphasizes that technological and human systems cannot be analyzed in isolation but must be understood as an integrated entity interacting dynamically. In the context of this study, digital technology devices (which generate technostress), physical environmental conditions (ergonomic design and lighting), and work behaviors (micro-break frequency) constitute components of the remote work system that interact simultaneously to shape specific occupational health outcomes. The resulting predictive model quantifies these simultaneous interactions, providing a tool for researchers, occupational health and safety (OHS) practitioners, and policymakers to identify burnout risks among remote workers based on their cognitive ergonomic and digital environment profiles.

Recommendations include optimizing screen layout, viewing distance, and desk height, as well as increasing lighting intensity in remote workspaces to mitigate immediate fatigue and the risk of long-term burnout. It is also advisable to foster a culture of spontaneous, periodic micro-breaks and to establish clear policies regarding work duration and digital communication, ensuring employees do not feel compelled to remain constantly on standby.

A limitation of this study is that many remote workers operate from varying locations (e.g., working from cafés); consequently, ergonomic design, natural lighting levels, and environmental distractions vary significantly among individuals and are difficult to standardize compared to conventional office environments. Furthermore, fluctuations in daily workloads impact workers' conditions in a dynamic manner. The cross-sectional study design may introduce bias, as measurements were taken on a single day and do not reflect burnout levels throughout the year. Additionally, the self-administered data collection method could lead to errors

in questionnaire completion or interpretation. This study did not control for variables that could act as influencing factors—such as age, tenure, and work duration because the research focused on aspects of cognitive ergonomics, the digital environment, visual fatigue, and burnout. The study was also geographically limited to the Surakarta Residency area.

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CONFLICT OF INTEREST

There are no conflicts of interest.

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