

The Impact of Workstation Ergonomics on Digital Fatigue in Information Technology Workers

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ABSTRACT

With increasing digitalization, information technology employees are experiencing digital fatigue from prolonged screen time, static posture, and inadequate ergonomics. This course aims to examine the effects of work environment ergonomics and screen exposure on digital fatigue in IT employees and the regulatory role of organizational conditions in this relationship. In the cross-sectional, quantitative research design, data were collected from 217 public- and private-sector IT professionals in Turkey via an online questionnaire. NIOSH Computer Work Environment Ergonomics Checklist and Digital Fatigue Scale were used; correlation and hierarchical regression analyses were conducted. In addition, an observational ergonomic evaluation using the ROSA method was performed in a subsample ($n = 10$). Ergonomic risk has a strong, positive effect on digital fatigue, while age has a significant negative effect. It was determined that screen exposure did not have a direct effect. Moderation analyses show that workload perception weakens the ergonomic risk-digital fatigue relationship; ergonomic support facilities and break programs significantly differentiated the effect of screen exposure. Digital fatigue cannot be explained by screen usage time alone; It is a multidimensional occupational health risk shaped by the interaction of ergonomic and organizational conditions.

Keywords: Digital fatigue, Ergonomics, Workstation ergonomics, Screen exposure, Information technologies, Ergonomic risk assessment

INTRODUCTION

Information technology (IT) sector workers are heavily exposed to both physiological and psychosocial stressors due to prolonged screen-based tasks, sedentary work habits, and ergonomically inadequate workstations.

Prolonged exposure to digital vision is one of the key determinants of computer-induced visual symptoms (Computer Vision Syndrome, CVS). CVS: It is characterized by symptoms such as dry eyes, burning, blurred vision, headache, and difficulty concentrating (Rosenfield, 2011). The prevalence of CVS among office and IT workers is reported to range from 60% to 95% (Sheppard & Wolffsohn, 2018). The widespread adoption of remote and hybrid work arrangements after COVID-19 has significantly increased screen-based workload and the risk of digital fatigue (Al Ashkar et al., 2024; Alatawi et al., 2022; Almarzouki et al., 2021). Studies conducted in Turkey

also show that digitalization increases visual fatigue and head and neck complaints among workers (Koç, 2022).

Ergonomic work design plays a central role in protecting worker health. The International Ergonomics Association defines ergonomics as “a scientific discipline that studies the interactions between people and system components and aims to improve human well-being and system performance” (IEA, 2000). In IT workstations, physical parameters such as anthropometric fit, monitor height, seating equipment, keyboard-mouse layout, lighting, and break schedule are key components of ergonomic risk. Tools like the Rapid Office Strain Assessment (ROSA) quantitatively classify posture and equipment fit in office workers and provide measurements sensitive to the impact of ergonomic interventions (Sonne et al., 2012). Similarly, the NIOSH Computer Workstation Checklist evaluates basic ergonomic requirements in a workstation from a user-based perspective (NIOSH, 2017). Ergonomic risks in the IT sector are not limited solely to hardware incompatibility. ROSA offers an advantage in evaluating the effectiveness of ergonomic interventions by enabling targeted identification of these risks (de Barros et al., 2022; Matos & Arezes, 2015; Sonne et al., 2012). It has been reported that even small changes, such as monitor alignment, workstation layout, and neck neutrality, significantly affect CSI complaints in IT workers (Alghadir et al., 2022; Prasetya et al., 2024a; Prasetya et al., 2024b).

Digital fatigue manifests as visual discomfort, distractibility, cognitive overload, emotional tension, decreased performance, and sleep disturbances. The Digital Fatigue Scale (DFS), developed in Turkey, is a valid and reliable tool for measuring this construct in a multidimensional manner (Tutar & Mutlu, 2024). In international literature, scales such as the Zoom Exhaustion & Fatigue Scale document cognitive and emotional exhaustion resulting from online interaction (Fauville et al., 2021).

It has been shown that working more than 6-8 hours a day on screens increases physical complaints and cognitive exhaustion and raises the risk of distractibility and sleep disturbances (Meo & Al-Drees, 2005). Remote work, with its reduced breaks and blurred work-life boundaries, has been identified as an additional factor that reinforces digital fatigue (Waizenegger et al., 2020). While the existing literature has addressed the relationships among ergonomic risks, screen time, and digital fatigue separately, studies that examine these variables together within the same model and in the context of organizational conditions (perceived workload, ergonomic support, break schedules) are limited. The pressure to be constantly online, performance monitoring, and camera surveillance creates a social and psychological demand for digital fatigue (Constantin, 2024; Fauville et al., 2021; Park et al., 2025). Therefore, measuring digital fatigue in the work environment is of great importance not only for health protection but also for productivity and sustainable work design. This study aims to quantify ergonomic risk levels in IT workers using the NIOSH Computer Workstation Ergonomics Self-Assessment Checklist and ROSA, to assess digital fatigue in a multidimensional way through the DAF (Digital Fatigue Assessment) method, and to examine the moderating roles of screen exposure, workload perception, ergonomic support, and break schedule in these relationships. Thus, by addressing the ergonomic risk-digital exposure-digital fatigue relationship within a holistic framework, the goal is to provide an evidence-based foundation for preventive and remedial interventions for IT workers.

MATERIAL AND METHOD

This research was conducted within the scope of a cross-sectional, quantitative design to examine the relationships among workstation ergonomics, screen exposure, and digital fatigue among individuals working in the information technology sector.

Research Population and Sample

The research population consists of professionals working in the IT sector in Turkey. The sample includes workers working in various technical and non-technical fields, including software development, system and network administration, data engineering/analytics, technical support, cybersecurity, and product management. Convenience sampling and snowball sampling methods were used together in the sampling process. The data collection process was carried out online; participants were provided with an information text, and their voluntary consent was obtained. The study was conducted with the approval of the Bursa Uludağ University Social and Human Sciences Ethics Committee, dated November 28, 2025, and numbered 2025-10.

Data Collection Tools

The data collection tool consists of four components. In the first component, demographic and occupational information was collected regarding participants' age, gender, occupational role, length of service in the sector, and current position, working style (office, remote, hybrid), break schedule, perceived workload, and ergonomic support status.

In the second component, workstation ergonomics were evaluated. All participants were given the NIOSH Computer Workstation Ergonomics Self-Assessment Checklist, and ergonomic risks related to hardware features, posture, seating arrangements, and environmental factors were assessed via self-report. In addition, a limited number of participants ($n = 10$) selected from the main sample based on their occupational roles and work styles were asked to provide standard photographs of the front and side views of their workspaces. These images were scored using the ROSA (Rapid Office Strain Assessment) method, and supporting findings were obtained for observational ergonomic risk assessment. ROSA scoring was performed on standard photographs showing the workstation in a seated position from the front and side (Figure 1).

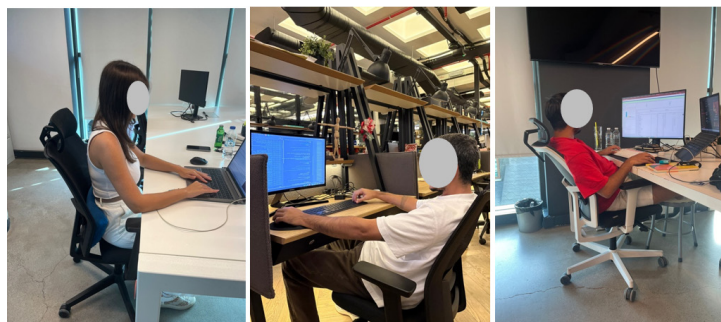


Figure 1: Example of standard workstation photographic perspectives used in ROSA assessment.

In the third component, participants' digital fatigue levels were assessed using the Digital Fatigue Scale (DFS), which measures cognitive, emotional, and physical exhaustion associated with digital device use (Tutar & Mutlu, 2024).

The fourth component relates to screen exposure. Participants' daily screen time, device types used, task screen-based intensity, and behavioral habits related to screen use were measured using structured questions.

Research Model and Hypotheses

This research model is based on a multivariate structure examining the effects of workstation ergonomics and screen exposure on digital fatigue in individuals working in the IT sector.

In this context, the model aims to examine the direct effects of ergonomic risk and screen exposure on digital fatigue, and how these effects differ across working conditions (Figure 2).

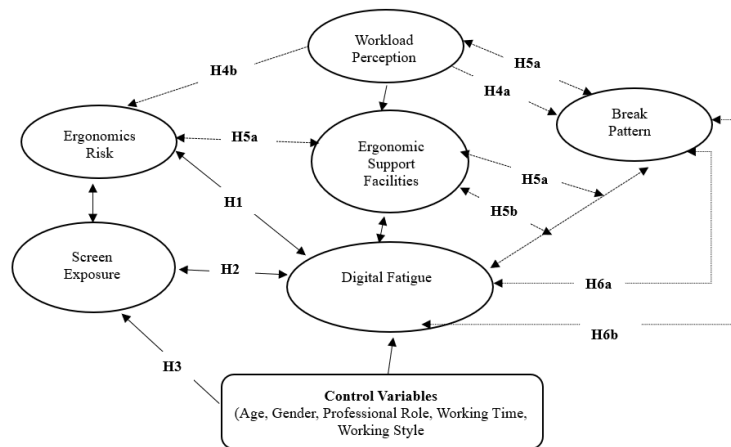


Figure 2: Conceptual model of the research.

Within this framework, the hypotheses regarding the relationships and moderating effects among workstation ergonomics, screen exposure, and digital fatigue, as outlined in the research model, are summarized below.

Research Hypotheses

H1: Ergonomic risk level has a positive and significant effect on digital fatigue.

H2: Screen exposure duration has a positive and significant effect on digital fatigue.

Hypotheses Regarding Control Variables

H3a: Age has a significant effect on the level of digital fatigue.

H3b: Gender has a significant effect on the level of digital fatigue.

H3c: Occupational role has a significant effect on the level of digital fatigue.

H3d: Working time in the sector has a significant effect on the level of digital fatigue.

H3e: Working style (remote, hybrid, face-to-face) has a significant effect on the level of digital fatigue.

Moderating Role of Workload Perception

H4a: Workload perception moderates the relationship between ergonomic risk and digital fatigue.

H4b: Workload perception moderates the relationship between screen exposure and digital fatigue.

Moderating Role of Ergonomic Support Facilities

H5a: Ergonomic support facilities moderate the relationship between ergonomic risk and digital fatigue.

H5b: Ergonomic support facilities moderate the relationship between screen exposure and digital fatigue.

Moderating Role of Break Schedule

H6a: Break schedule moderates the relationship between ergonomic risk and digital fatigue.

H6b: Break schedule moderates the relationship between screen exposure and digital fatigue.

FINDINGS AND INTERPRETATION

This section presents the results of the statistical analysis used to test the hypotheses developed within the research model.

Demographic Characteristics of Participants

The study sample consisted of 217 information technology professionals. 73.3% of the participants were male ($n = 159$), while 26.7% were female ($n = 58$). In terms of educational background, 63.1% held an associate's degree, 26.7% held a bachelor's degree, and 8.8% held a master's degree. In terms of work models, 43.8% of the sample works in a hybrid environment, 38.2% in an office-based environment, and 18% works entirely remotely. In terms of sectoral experience, the majority of participants (69.6%) have 1–2 years of experience. The internal consistency coefficients of all scales used in the study are above the acceptable threshold. The reliability coefficient of the three-item perceived workload dimension, included as a control variable, was calculated as $\alpha = 0.619$. In the literature on scale development and psychometrics, particularly in exploratory studies using scales with a small number of items, Cronbach's Alpha values of 0.60 or higher are considered acceptable (DeVellis, 2017; Hair et al., 2014). Additionally, it is emphasized that the alpha coefficient is sensitive to the number of items and may yield relatively low values in scales with a small number of items (Tavakol & Dennick, 2011). Accordingly, the perceived workload scale was deemed appropriate for the research design and included in the analyses. The results of the reliability analysis for the research variables are presented in Table 1.

Table 1: Reliability coefficients for scales.

Scale and Variables	Number of Articles	Cronbach's Alpha (α)	Evaluation
Digital Fatigue Scale	28	0,963	High Reliability
Ergonomic Risk Scale	22	0,950	High Reliability
Ergonomic Support Scale	2	0,831	High Reliability
Break Schedule Scale	2	0,817	High Reliability
Workload Perception Scale	3	0,619	Acceptable*

Descriptive Statistics and Correlations

The participants' levels of digital fatigue were close to moderate (Mean = 2.99). Screen time exceeding 6 hours per day (Mean = 6.35) indicates that the sample group works under conditions requiring intense screen exposure.

The direction and strength of the relationships between the research variables were assessed using Pearson correlation analysis. Table 2 presents descriptive statistics and correlation analysis results for the variables Digital Fatigue, Ergonomic Risk, Screen Time, Break Schedule, Ergonomic Support, and Workload.

Table 2: Descriptive statistics and correlations.

Variables	Ort.	S.S.	1	2	3	4	5	6
1. Digital Fatigue	2,99	0,95	1					
2. Ergonomics Risk	3,57	0,85	0,01	1				
3. Screen Time	6,35	2,66	0,02	0,09	1			
4. Break Schedule	3,49	1,08	0,14	0,52	-0,06	1		
5. Ergonomic Support	3,39	1,09	0,13	0,56	-0,12	0,57	1	
6. Workload	3,45	1,07	0,09	0,50	-0,18	0,59	0,53	1

** $p < 0,01$; * $p < 0,05$

Hierarchical Regression Analysis and Hypothesis Testing

The three-stage hierarchical regression analysis revealed that the final model explained 27.3% of the total variance in digital fatigue ($R^2 = 0.273$) and that the inclusion of interaction terms increased the explained variance by 0.069 ($\Delta R^2 = 0.069$; $p = 0.006$). This finding confirms that the moderating variables included significantly enhanced the model's explanatory power. The results of the analyses conducted to test the research hypotheses and the obtained regression coefficients are presented in Table 3.

Table 3: Regression analysis results of research hypotheses.

Hypothesis	Structural Relationships	Relationship Direction	β Value	p Value	Conclusion
H1	Ergonomic Risk → Digital Fatigue	+	0,458	< 0,001	Supported
H2	Screen Exposure → Digital Fatigue	+	0,122	0,094	Not supported
H3a	Age → Digital Fatigue	-	- 0,206	0,049	Supported
H3b	Gender → Digital Fatigue			0,392	Not supported
H3c	Professional Role → Digital Fatigue			0,877	Not supported
H3d	Working Time → Digital Fatigue in the Industry			0,124	Not supported
H3e	Work Style → Digital Fatigue			> 0,05	Not supported
H4a	Ergonomic Risk x Workload Perception → Digital Fatigue		- 0,233	0,007	Supported
H4b	Screen Exposure x Workload Perception → Digital Fatigue			0,175	Not supported
H5a	Ergonomic Risk x Ergonomic Support → Digital Fatigue			0,293	Not supported
H5b	Screen Exposure x Ergonomic Support → Digital Fatigue	+	0,184	0,023	Supported
H6a	Ergonomic Risk x Break Schedule → Digital Fatigue			0,647	Not supported
H6b	Screen Exposure x Break Schedule → Digital Fatigue	+	0,270	0,007	Supported

According to the findings of the hierarchical regression analysis, the established model explains the variance in digital fatigue to a significant degree, and ergonomic risks serve as a key predictor within this framework. Indeed, the strong and positive effect of the level of ergonomic risk on digital fatigue ($\beta = 0.458$; $p < 0.001$) confirms Hypothesis H1. On the other hand, the absence of a direct and significant effect of screen exposure on digital fatigue ($\beta = 0.122$; $p = 0.094$) demonstrates that this type of fatigue is not merely a quantitative outcome dependent on screen time alone; rather, it is a multidimensional construct shaped by the work context and ergonomic conditions. Among the control variables, the significant negative effect of age ($\beta = -0.206$; $p = 0.049$) suggests that older workers may have developed more effective strategies for coping with digital demands; however, gender,

occupational role, sectoral experience, and work model were found to have no statistically significant effect.

In the moderation analyses, perceived workload was found to weaken the relationship between ergonomic risk and digital fatigue ($\beta = -0.233$; $p = 0.007$), whereas ergonomic hardware support ($\beta = 0.184$; $p = 0.023$) and break schedules ($\beta = 0.270$; $p = 0.007$) were found to amplify the effect of screen exposure on digital fatigue. These interactions confirm that digital fatigue is not merely a result of individual exposure but rather an integrated process involving organizational dynamics.

Considering the overall findings, it is understood that the primary determinant of digital fatigue is ergonomic risks, and that the effect of screen exposure manifests not directly, but within an organizational and behavioral context. It appears that various organizational practices, such as ergonomic supports and break programs, indirectly contribute to an increase in digital fatigue by making screen-based work more sustainable. Additionally, the results of the ROSA-based observational assessment indicated moderate to high-level risks, particularly regarding monitor alignment, neck angle, and static sitting posture; these data align with the risk scores based on participants' self-reports. The use of ROSA data in this confirmatory manner supports measurement reliability within the study's multi-method approach.

DISCUSSION

This study reveals that participants' levels of digital fatigue are close to moderate and that their average daily screen time exceeds six hours. The findings are consistent with previous studies showing that increased use of digital devices leads to the proliferation of eye strain, cognitive exhaustion, and various physical ailments (Al Ashkar et al., 2024; Coles-Brennan et al., 2019). The research results also indicate that the level of ergonomic risk is the strongest predictor of digital fatigue. This finding aligns with the ergonomics literature, which emphasizes that ergonomically inadequate work environments are not limited to musculoskeletal issues but are also closely related to cognitive and emotional fatigue (Hedge, 2016; Oakman et al., 2017). It is thought that prolonged sitting, improper screen positioning, and unsuitable environmental conditions negatively affect attention and concentration, thereby increasing digital fatigue. In addition, an observational assessment using the ROSA method was conducted on a limited number of participants. A study conducted with young adults reported that, in addition to moderate and high levels of ergonomic risk identified through posture analysis, eye strain, headaches, and neck and shoulder pain were frequently observed (Bagaji & Rao, 2025). Similarly, it is noted that both visual fatigue and musculoskeletal complaints are common among workers with ergonomically unfavorable conditions in computer and digital device use (Zlateva, 2024). It is stated that even relatively short periods of sitting in front of a computer in an office environment can lead to an increase in physical discomfort, deterioration in mental state, and an increase in problem-solving errors; in particular, prolonged sitting and static posture negatively affect cognitive performance (Baker et al., 2018). Studies on digital eye strain also

emphasize that incorrect screen distance and angle, inadequate lighting, and improper posture increase both eye strain and general fatigue (Kaur et al., 2022). Although many studies have found a relationship between screen time and fatigue, the strength and consistency of this relationship vary depending on the context, usage patterns, and individual factors (Kaur et al., 2022; Mubashir Rehman et al., 2024; Naz & Qamar, 2025). Therefore, it is emphasized that interventions focused solely on reducing screen time have limited impact; digital fatigue can be reduced more effectively when ergonomics, cognitive load, job demands, and coping strategies are addressed together (Hilty et al., 2022; Zimmermann & Sobolev, 2023; Supriyadi et al., 2025).

The fact that screen exposure time does not show a direct and significant effect on digital fatigue indicates that screen time alone is not a determining factor. This finding is consistent with studies emphasizing that digital fatigue is shaped not only by the amount of exposure but also by the context of the task, ergonomic conditions, and individual coping strategies (Rosenfield, 2011). Therefore, interventions focused solely on reducing screen time appear to have limited impact. Indeed, Dong and colleagues (2025), using the Fuzzy Cluster Qualitative Comparative Analysis method, showed that digital fatigue arises from different combinations of personal resources and job demands. Similarly, while Supriyadi and colleagues (2025) highlight the negative effects of digital fatigue on worker well-being and performance, Jain and colleagues' (2025) multi-level model addresses digital fatigue as a job demand shaped at the individual, team, and organizational levels. This framework aligns with our findings, which reveal that the impact of ergonomic risks on digital fatigue only becomes meaningful when evaluated alongside organizational conditions such as workload, ergonomic support, and break arrangements. One of the study's notable findings is that the perception of workload weakens the relationship between ergonomic risk and digital fatigue. In the context of the Job Demands–Job Resources model, this suggests that how workers perceive job demands can be a determining factor in burnout processes (Bakker & Demerouti, 2007; Demerouti et al., 2001). Individuals with a high perception of workload may accept ergonomic problems as a natural part of the job, which may make the impact of these risks on digital fatigue less pronounced. The inverse relationship between age and digital fatigue suggests that older workers may have developed coping and self-regulation skills in dealing with digital demands; studies reporting that technology-related stress decreases with age support this interpretation (Chen et al., 2025; Hauk et al., 2019; Reinecke et al., 2017; Scheibe & Moghimi, 2021). In contrast, the limited regulatory role of ergonomic supports and break practices in the ergonomic risk–digital fatigue relationship suggests that ergonomic risks may have more direct and contextually independent effects (Mazmanian et al., 2013; Riedl, 2012). The findings highlight the need for holistic approaches to managing digital fatigue, while supporting the Job Demands–Job Resources model as a robust framework for the digital work context (Bakker & Demerouti, 2017; WHO, 2022). The identification of moderate to high ergonomic risks, particularly regarding monitor alignment and sitting posture, in ROSA-based observational assessments indicates that self-report findings are consistent with objective observations (see Figure 1).

Limitations and Future Research

The causal interpretability of the findings is limited. The fact that the data are predominantly self-reported and that ROSA-based observational measurements were conducted with a limited subsample are methodological limitations that restrict the generalizability of the results. Future research should test these findings using longitudinal research designs, larger sample sizes, and objective ergonomic evaluation methods.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that ergonomic risks are one of the key determinants of digital fatigue among information technology workers, and that this effect is shaped by organizational factors such as perceived workload, ergonomic equipment support, and break schedules. The findings demonstrate that digital fatigue cannot be reduced to merely individual or technical variables; rather, it is a multidimensional occupational health issue encompassing ergonomic, organizational, and psychosocial components. Furthermore, the negative correlation between age and digital fatigue suggests that older workers may be more proficient in self-regulation and setting digital boundaries; this underscores the importance of developing these competencies in digital well-being programs targeting younger workers. In conclusion, this study, which presents a holistic framework consistent with the Job Demands-Job Resources model, demonstrates that ergonomic interventions aimed at reducing digital fatigue must be integrated with work-load balancing and structured break systems.

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